Mathematics

IGCSE O-Level

Classifieds

(Part 1)

British Maths

Eng. Nagy Elraheb

NUMBERS

Decimals

Using calculator

1. June 2017 (3H) Q5

   (a) Use your calculator to work out the value of

   $$\frac{7.3 + 2.1}{6.4} + 2.2^2$$

   Give your answer as a decimal.
   Write down all the figures on your calculator display.
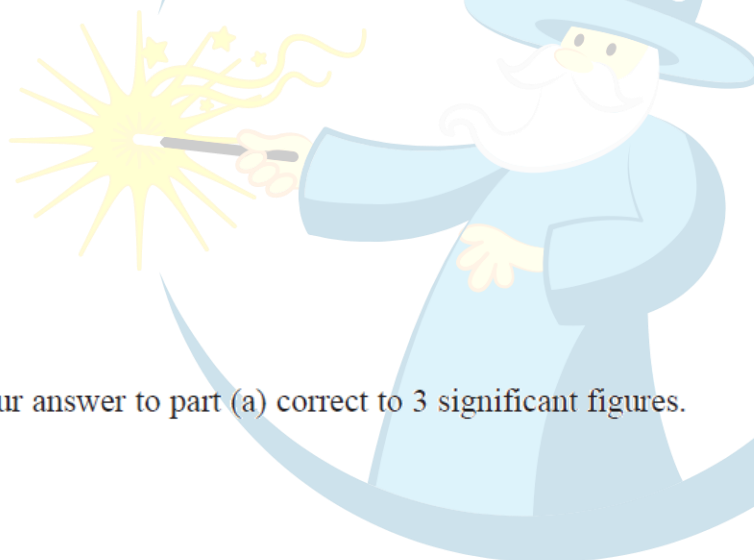
   ....

   (2)

   (b) Give your answer to part (a) correct to 3 significant figures.

   ....

   (1)

   (Total for Question 5 is 3 marks)

2. June 2017 (4HR) Q3

(a) Work out the value of $\dfrac{17.7 \times 5.8}{\sqrt{3.4} + 5.3}$

Write down all the figures on your calculator display.

(2)

(b) Give your answer to part (a) correct to 3 significant figures.

(1)

(Total for Question 3 is 3 marks)

3. Jan 2018 (3H) Q2

(a) Use your calculator to work out the value of

$$\sqrt{\dfrac{8.9 + 2.345}{0.76 \times 2.9}}$$

Write down all the figures on your calculator display.

(2)

(b) Give your answer to part (a) correct to 2 significant figures.
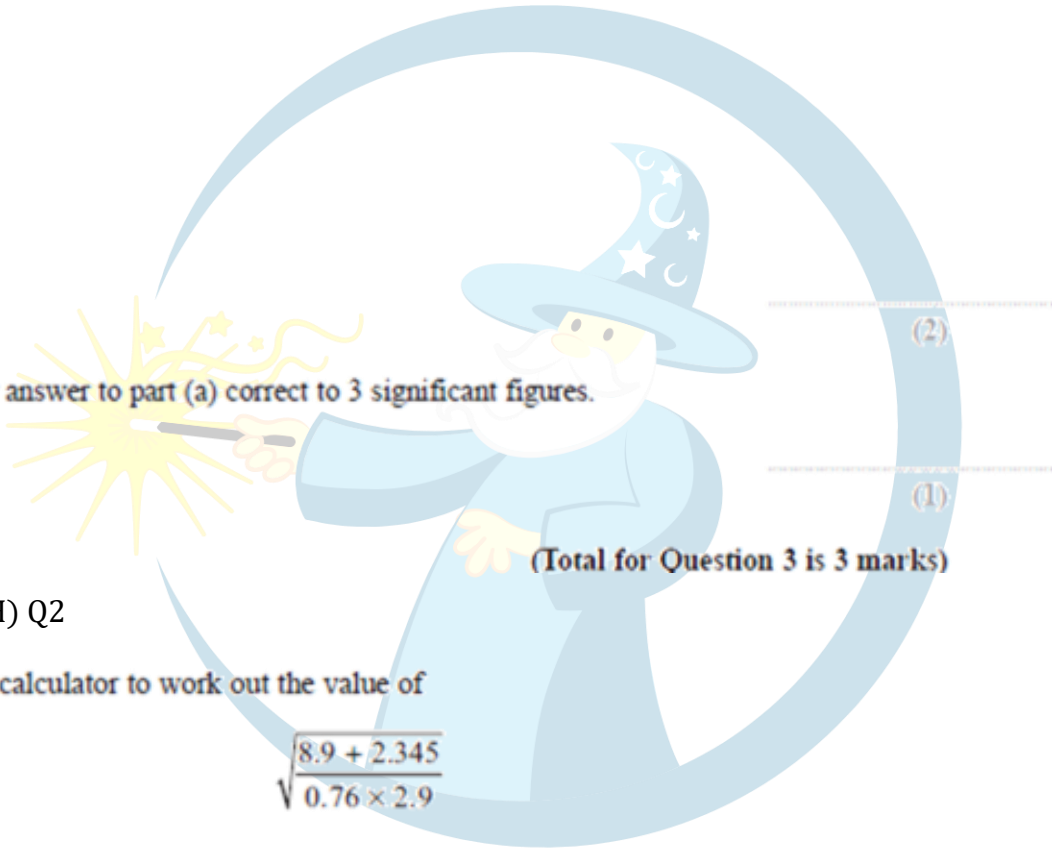
(1)

(Total for Question 2 is 3 marks)

4. June 2018 (3H) Q1

(a) Work out the value of $\dfrac{56^2 + \sqrt{983}}{42.6 - 28.9}$

Write down all the figures on your calculator display.

....

(2)

(b) Give your answer to part (a) correct to 2 significant figures.

....

(1)

(Total for Question 1 is 3 marks)

5. June 2018 (3HR) Q1

(a) Work out the value of $\left(\dfrac{125.6}{4.7}\right)^2$

Write down all the figures on your calculator display.

....

(2)

(b) Write your answer to part (a) correct to 3 significant figures.

....

(1)

(Total for Question 1 is 3 marks)

Recurring

1. May 2019 (1H) Q15

Use algebra to show that the recurring decimal $0.2\dot{5}\dot{4} = \dfrac{14}{55}$

(Total for Question 15 is 2 marks)

2. June 2018 (2HR) Q17

(a) Use algebra to show that $0.4\dot{3}\dot{6} = \dfrac{24}{55}$

(2)

3. Jan 2018 (3H) Q16

Use algebra to show that the recurring decimal $0.3\dot{4}\dot{5} = \dfrac{19}{55}$
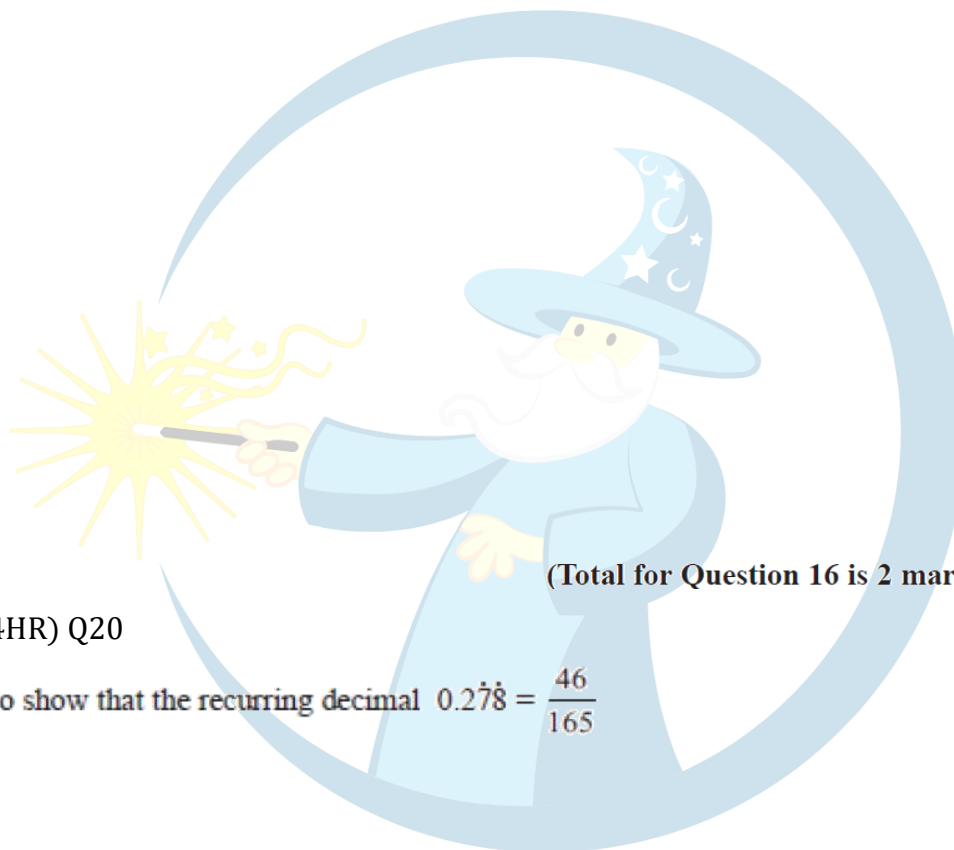
(Total for Question 16 is 2 marks)

4. June 2018 (4HR) Q20

Use algebra to show that the recurring decimal $0.2\dot{7}\dot{8} = \dfrac{46}{165}$

[2 marks]

5. May 2004 (4H) Q17

Convert the recurring decimal $0.3\dot{2}$ to a fraction.

(2 marks)

6. May 2005 (4H) Q19

Convert $0.5\dot{1}$ to a fraction.

(2 marks)

7. Nov 2006 (4H) Q19

Convert the recurring decimal $0.\dot{2}\dot{3}$ to a fraction.

(2 marks)

8. May 2011 (4H) Q18

Show that the recurring decimal

$$0.\dot{3}9\dot{6} = \frac{44}{111}$$

(2 marks)

9. Jan 2012 (3H) Q17

Show that the recurring decimal $0.1\dot{7} = \frac{8}{45}$

(2 marks)

Surds

Expanding brackets

1. June 2016 (3HR) Q20

    (b) Given that a is a positive integer, show that

    $$\sqrt{3a}\left(\sqrt{12a} + a\sqrt{3a}\right)$$

    is always a multiple of 3

2. June 2016 (4H) Q19

    Simplify $(7 + 2\sqrt{50})(5 - 2\sqrt{2})$

    Give your answer in the form $a + b\sqrt{18}$ where a and b are integers.
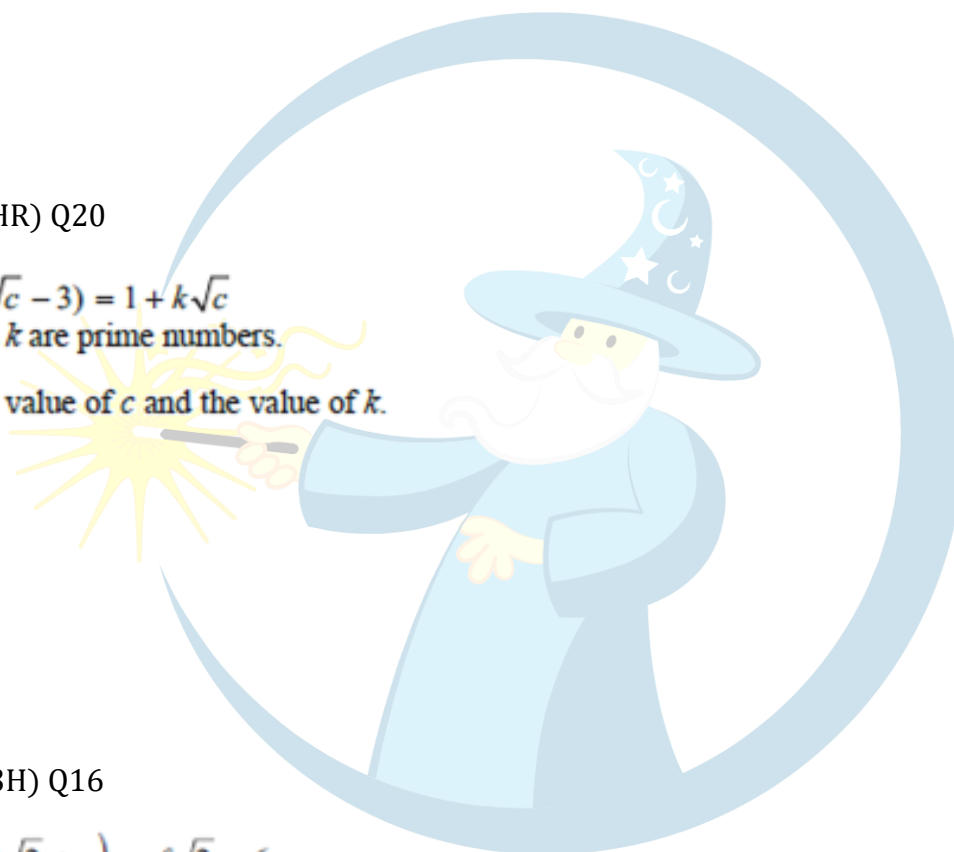   Show your working clearly.

3. Jan 2017 (4H) Q16

   (c) Show that $\left(7 - 2\sqrt{5}\right)\left(7 + 2\sqrt{5}\right) = 29$

   Show your working clearly.

4. Jan 2017 (4HR) Q20

   $(3 + \sqrt{c})(2\sqrt{c} - 3) = 1 + k\sqrt{c}$
   where c and k are prime numbers.

   (a) Find the value of c and the value of k.

5. June 2017 (3H) Q16

   $\left(5\sqrt{2} - e\right)\left(3\sqrt{2} + e\right) = f\sqrt{2} - 6$

   Given that e and f are positive integers,

   find the value of e and the value of f.

Rationalization

1. Jan 2017 (3HR) Q18

    Given that p is a prime number, rationalise the denominator of $\dfrac{7\sqrt{p} - p^2}{\sqrt{p^3}}$

    Simplify your answer.

2. June 2018 (2H) Q21

    (b) Express $\dfrac{2}{\sqrt{3} - 1}$ in the form $p + \sqrt{q}$
    where p and q are integers.
    Show your working clearly.

    (2)

3. June 2018 (2HR) Q17

    (b) Show that $\dfrac{\sqrt{20} + \sqrt{80}}{\sqrt{3}}$ can be expressed in the form $\sqrt{a}$ where a is an integer.
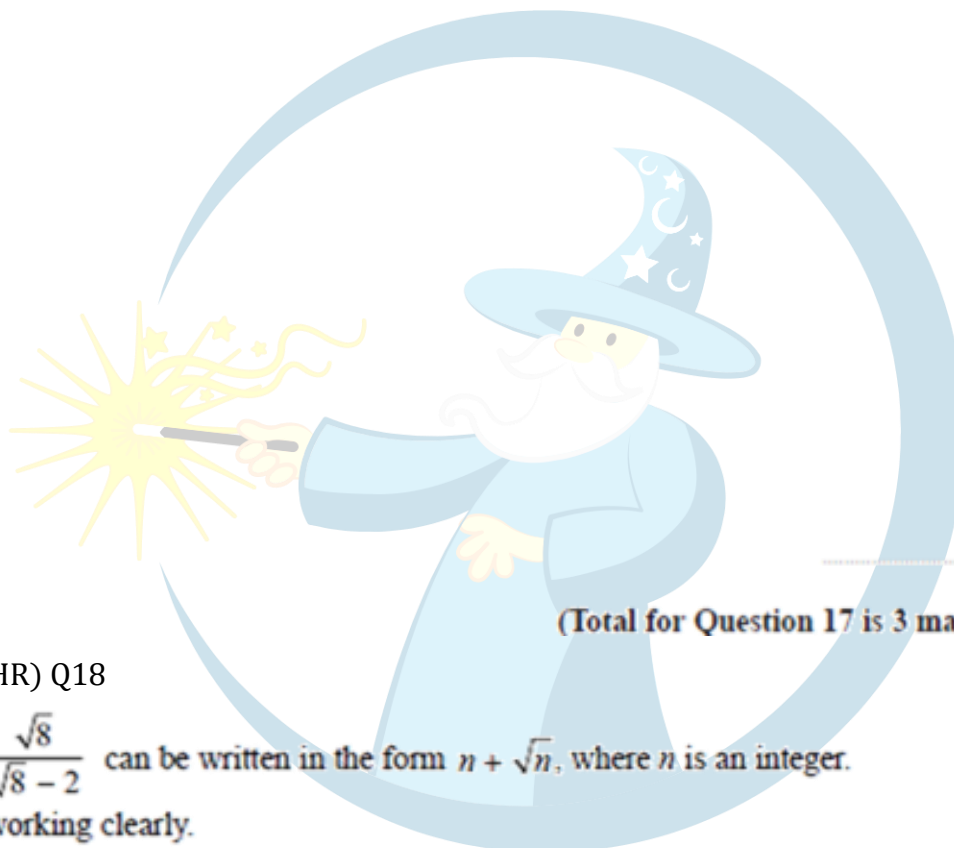
    Show your working clearly.

4. June 2018 (3H) Q17

Rationalise the denominator of $\dfrac{6 + \sqrt{10}}{\sqrt{2}}$

Give your answer in the form $a\sqrt{b} + \sqrt{c}$ where a, b and c are prime numbers.
Show your working clearly.

(Total for Question 17 is 3 marks)

5. Jan 2019 (1HR) Q18

Show that $\dfrac{\sqrt{8}}{\sqrt{8} - 2}$ can be written in the form $n + \sqrt{n}$, where n is an integer.
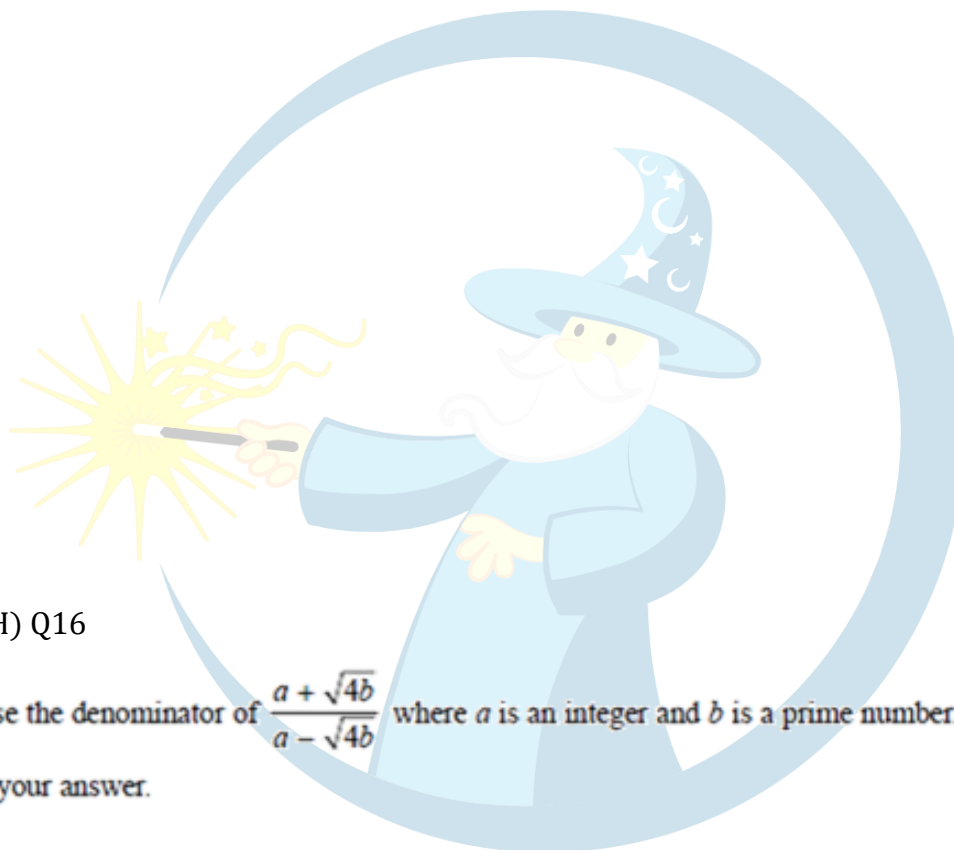Show your working clearly.

(Total for Question 18 is 3 marks)

6. Jan 2018 3H Q20

Given that a is a prime number,

(b) simplify $\dfrac{5\sqrt{a} + a}{10\sqrt{a}}$

Give your answer in the form $x + y\sqrt{a}$, where x and y are fractions.
Show your working clearly.

7. Jan 2019 (1H) Q16

(a) Rationalise the denominator of $\dfrac{a + \sqrt{4b}}{a - \sqrt{4b}}$ where a is an integer and b is a prime number.

Simplify your answer.

Simplifying surds

1. June 2018 (2H) Q21

    (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$
        Show your working clearly.

2. Jan 2018 (3H) Q20

    (a) $\sqrt{50} + \sqrt{128} - \sqrt{200} = n\sqrt{2}$ where n is an integer.

        Find the value of n.
        Show each stage of your working.

3. June 2018 (3HR) Q20

    Show that $\dfrac{\sqrt{50} - \sqrt{18}}{4}$ can be written in the form $\dfrac{1}{\sqrt{k}}$ where k is an integer.
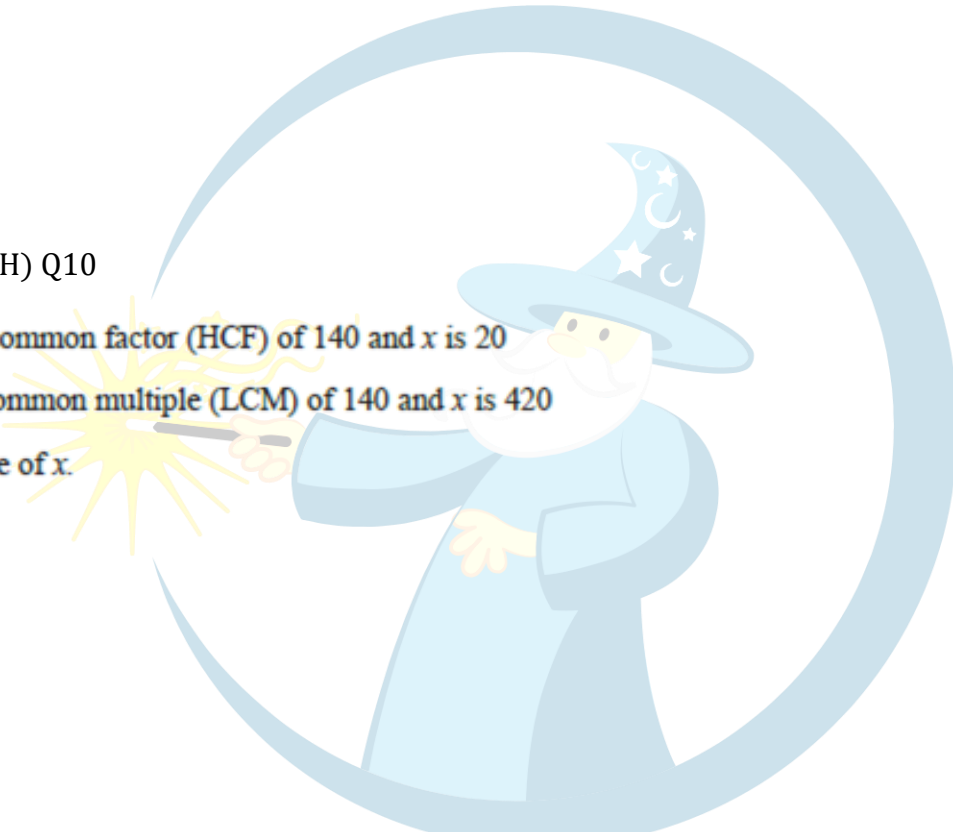   Show your working clearly.

HCF, LCM and Prime Factoring

1. June 2016 (3HR) Q7

    Write 792 as a product of its prime factors.
    Show your working clearly.

2. June 2016 (4H) Q10

    The highest common factor (HCF) of 140 and x is 20

    The lowest common multiple (LCM) of 140 and x is 420

    Find the value of x.

3. June 2017 (3HR) Q7

    Write 336 as a product of its prime factors.
    Show your working clearly.

4. Jan 2017 (4H) Q16

$$g = 2^3 \times 3 \times 7^2 \qquad h = 2 \times 3 \times 7^3$$

(a) Express gh as a product of powers of its prime factors.
Simplify your answer.

....
(2)

$$\frac{g}{h} = 2^a \times 3^b \times 7^c$$

(b) Find the value of a, the value of b and the value of c.

$a =$ ....

$b =$ ....

$c =$ ....
(2)

5. Jan 2017 (4HR) Q10

$m = 3^4 \times 5^3$
$n = 3^3 \times 5^2 \times 11$

(a) Find the Lowest Common Multiple (LCM) of m and n.

.... (2)

(b) Find the Highest Common Factor (HCF) of $5m$ and $3n$.

.... (2)
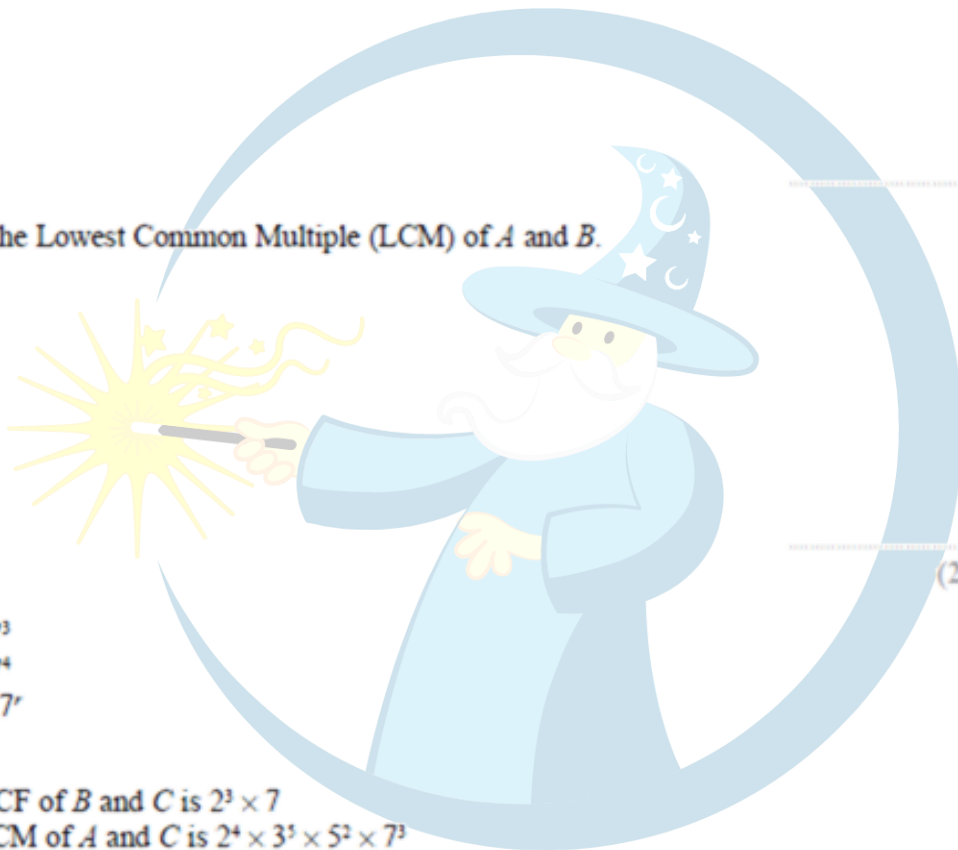
(Total for Question 10 is 4 marks)

6. June 2018 (1H) Q8

$A = 3^5 \times 5 \times 7^3$
$B = 2^3 \times 3 \times 7^4$

(a) (i) Find the Highest Common Factor (HCF) of A and B.

(ii) Find the Lowest Common Multiple (LCM) of A and B.

(2)

$A = 3^5 \times 5 \times 7^3$
$B = 2^3 \times 3 \times 7^4$
$C = 2^p \times 5^q \times 7^r$

Given that
    the HCF of B and C is $2^3 \times 7$
    the LCM of A and C is $2^4 \times 3^5 \times 5^2 \times 7^3$

(b) find the value of p, the value of q and the value of r.

$p = $ ....

$q = $ ....

$r = $ ....

(2)

7. Jan 2018 (4H) Q13

(a) Find the Lowest Common Multiple (LCM) of 24 and 30

.... (2)

$A = 2^5 \times 3^2 \times 5 \times 17$
$B = 2 \times 3^4 \times 7$

(b) Write down the Highest Common Factor (HCF) of A and B.

.... (1)

(Total for Question 13 is 3 marks)

8. Jan 2018 (4HR) Q9

$1426 = 2 \times 23 \times 31$

(i) Find all the factors of 1426

(ii) Write 713 as a product of its prime factors.

(3)

(1)

(Total for Question 9 is 4 marks)

9. June 2018 (4HR) Q10

(a) Write 280 as a product of its prime factors.
Show your working clearly.

....

(3)

(b) Find the Highest Common Factor (HCF) of 280 and 630

....

(2)

(Total for Question 10 is 5 marks)

10. Jan 2019 (2H) Q6

(a) Find the highest common factor (HCF) of 96 and 120

(2)

$A = 2^3 \times 5 \times 7^2 \times 11$
$B = 2^4 \times 7 \times 11$
$C = 3 \times 5^2$

(b) Find the lowest common multiple (LCM) of A, B and C.

(2)

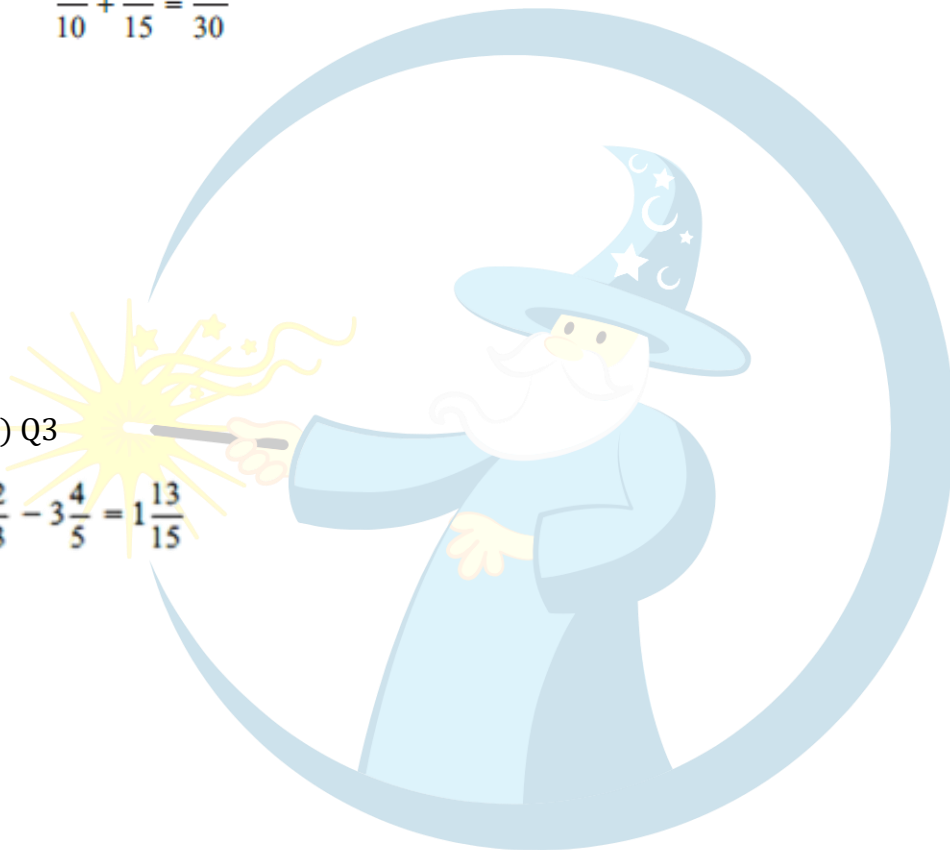(Total for Question 6 is 4 marks)
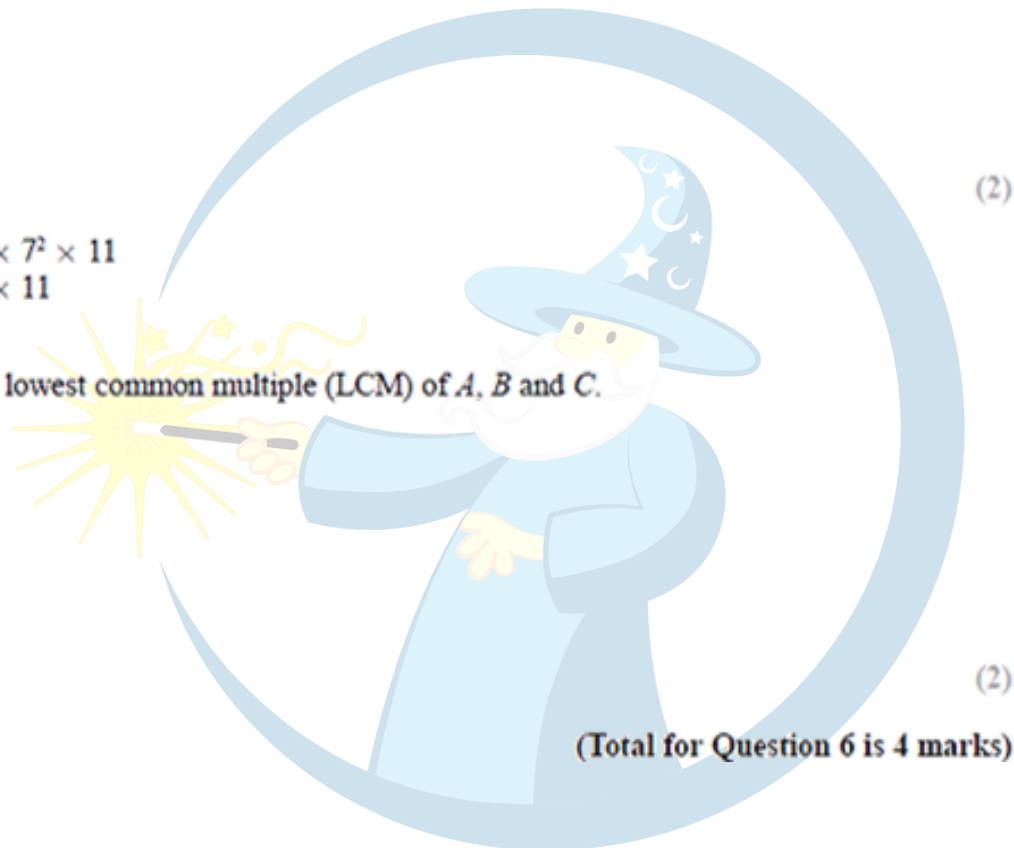
Fractions

Addition and Subtraction

1. June 2016 (3H) Q6

    (a) Show that $\dfrac{3}{10} + \dfrac{2}{15} = \dfrac{13}{30}$

2. Jan 2017 (3H) Q3

    Show that $5\dfrac{2}{3} - 3\dfrac{4}{5} = 1\dfrac{13}{15}$

3. June 2017 (4H) Q7

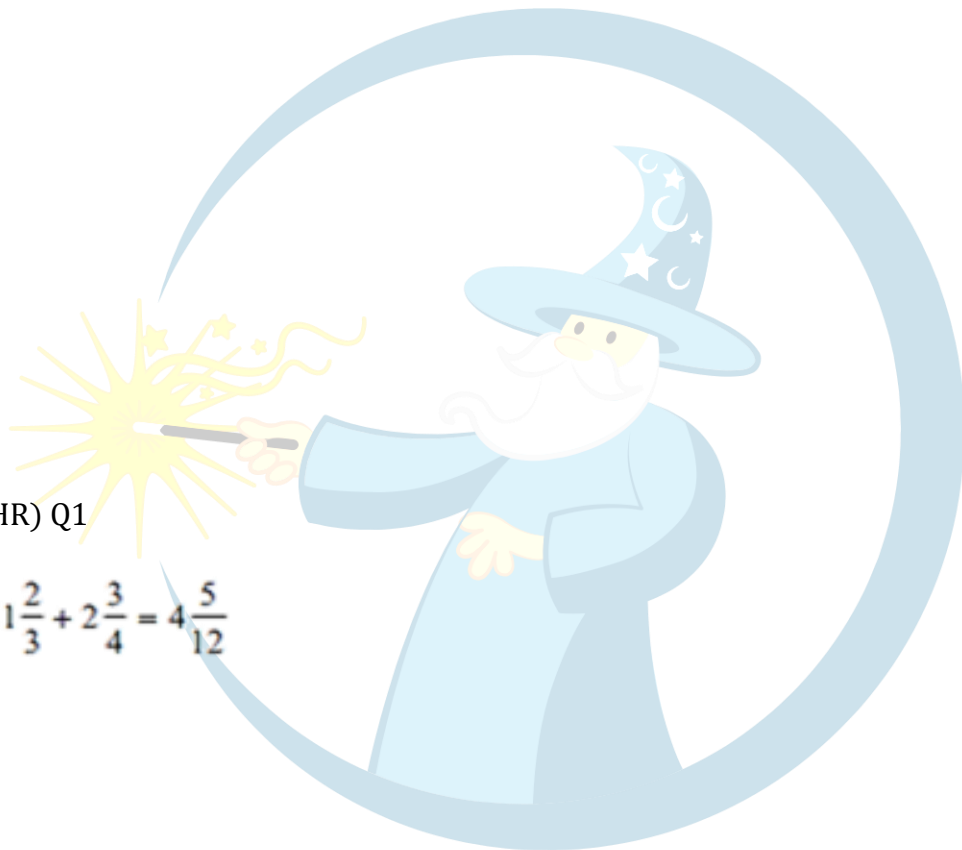   (a) Show that $\dfrac{7}{12} + \dfrac{3}{8} = \dfrac{23}{24}$

4. June 2018 (2H) Q4

Show that $\quad 3\dfrac{4}{7} - 1\dfrac{5}{8} = 1\dfrac{53}{56}$

5. Jan 2019 (1HR) Q1

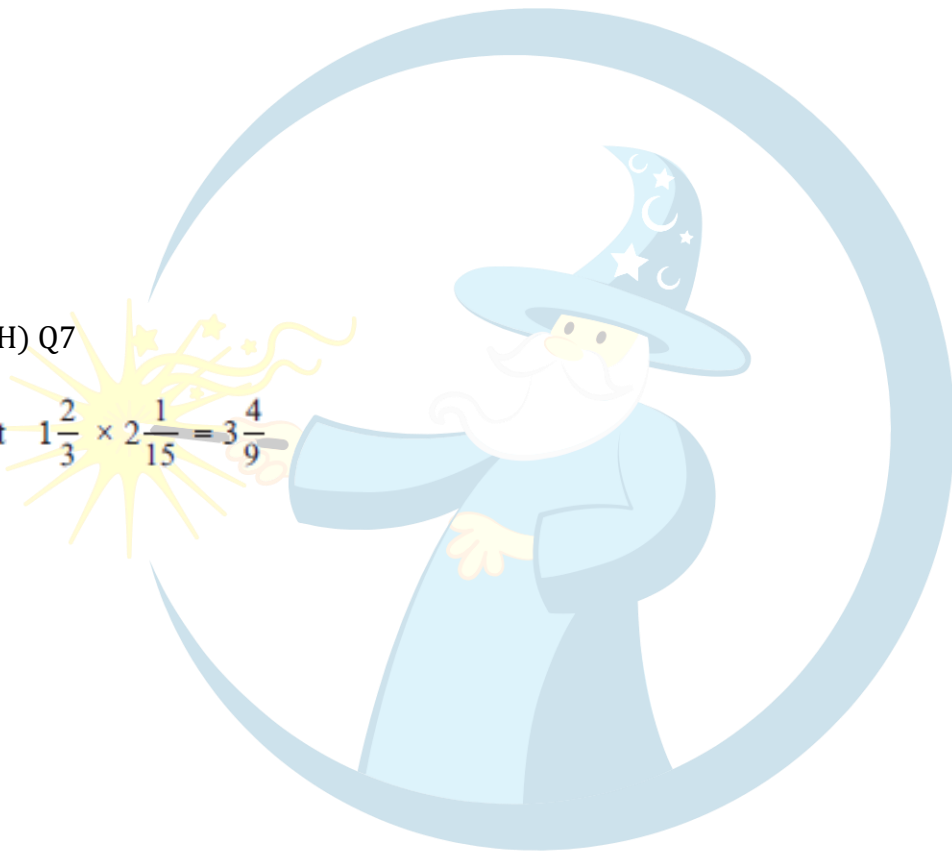Show that $\quad 1\dfrac{2}{3} + 2\dfrac{3}{4} = 4\dfrac{5}{12}$

Multiplication and division

1. June 2016 (3H) Q6

   (b) Show that $\quad 2\dfrac{5}{8} \div 1\dfrac{1}{6} = 2\dfrac{1}{4}$

2. June 2017 (4H) Q7

   (b) Show that $\quad 1\dfrac{2}{3} \times 2\dfrac{1}{15} = 3\dfrac{4}{9}$
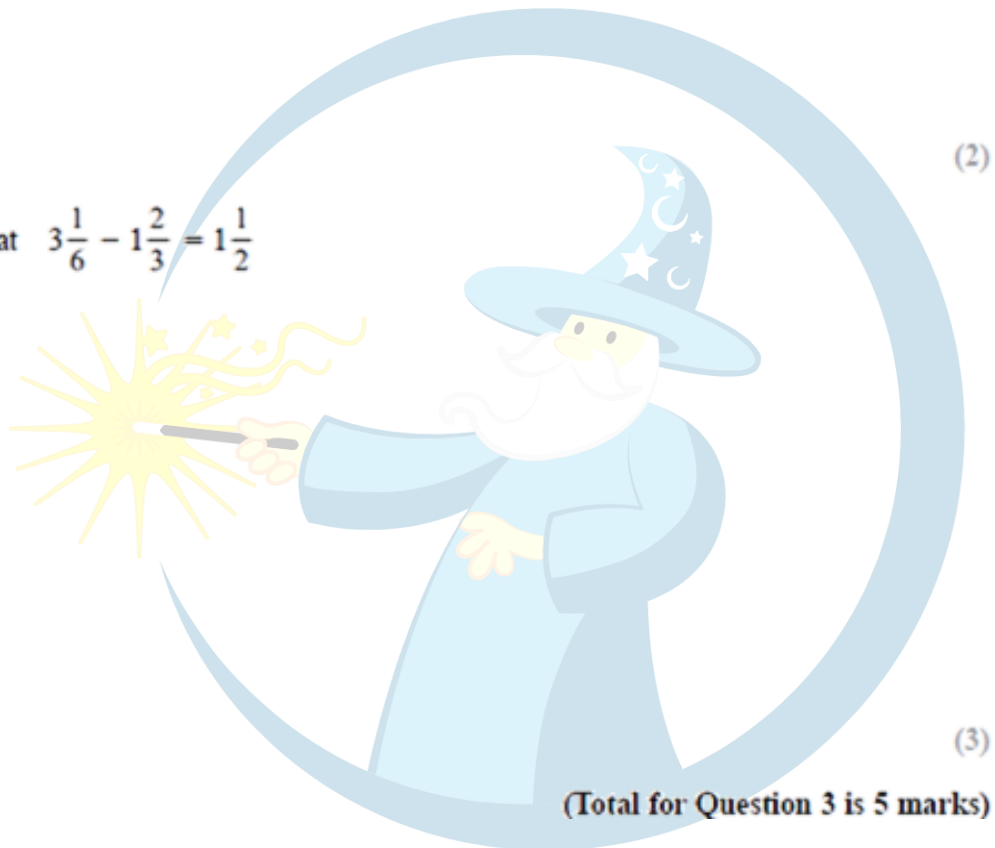
3. June 2018 (3HR) Q9

   Show that $3\dfrac{3}{8} \div 2\dfrac{1}{4} = 1\dfrac{1}{2}$

4. Jan 2018 (4H) Q3

(a) Show that $\dfrac{2}{7} \div \dfrac{4}{5} = \dfrac{5}{14}$

(2)

(b) Show that $3\dfrac{1}{6} - 1\dfrac{2}{3} = 1\dfrac{1}{2}$

(3)

(Total for Question 3 is 5 marks)

Word problems

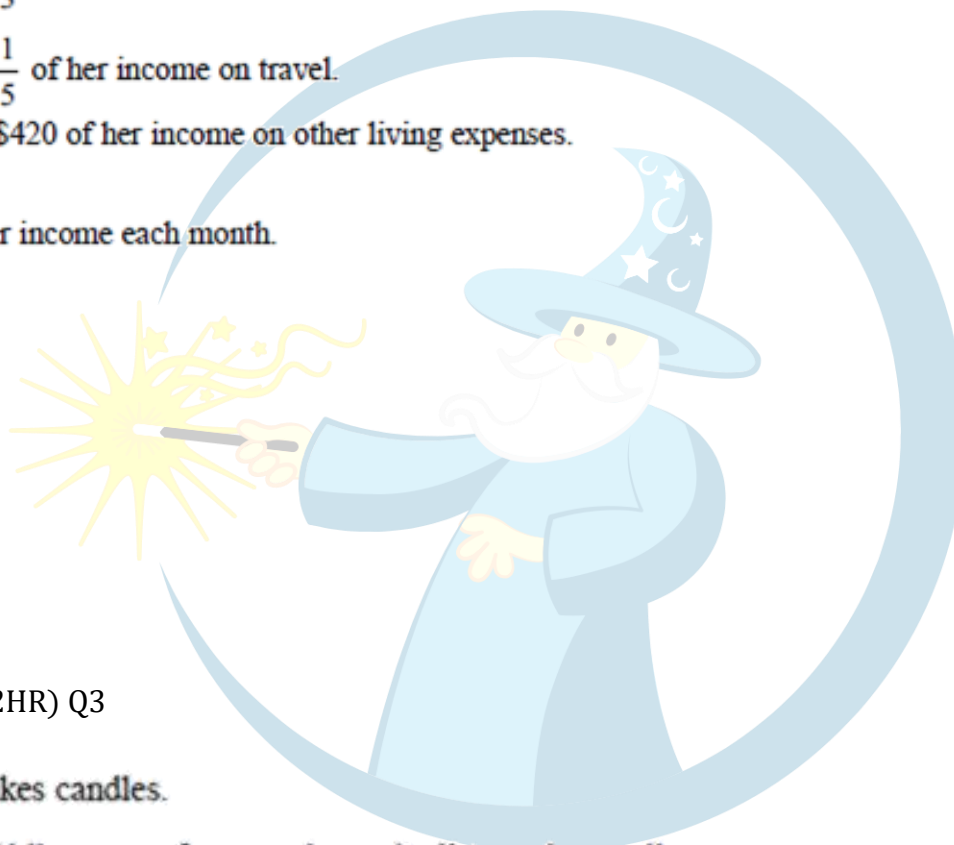1. June 2018 (1HR) Q13

    Each month Edna spends all her income on rent, on travel and on other living expenses.

    She spends $\frac{1}{3}$ of her income on rent.

    She spends $\frac{1}{5}$ of her income on travel.

    She spends $420 of her income on other living expenses.

    Work out her income each month.

2. June 2018 (2HR) Q3

    Behnaz makes candles.

    She has 6.3 kilograms of wax and uses it all to make candles.
    Each candle Behnaz makes uses 210 grams of wax.

    Behnaz sells $\frac{2}{5}$ of the candles for $13 each.

    She then reduces this price by 20% and sells the rest of the candles.

    Work out the total amount of money Behnaz gets by selling all the candles she made.

3. Jan 2018 (3HR) Q9

There are 320 students at a school.

$\frac{5}{8}$ of these students are girls.

$\frac{3}{4}$ of the girls have blue eyes.

$\frac{2}{3}$ of the boys have blue eyes.

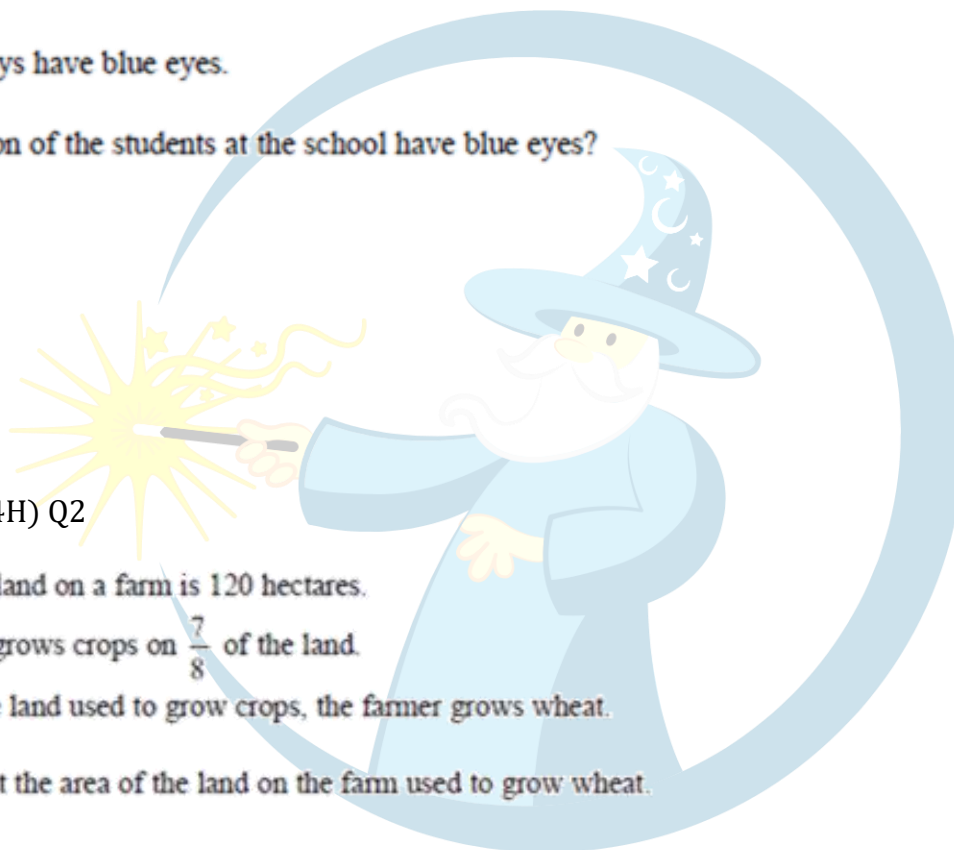What fraction of the students at the school have blue eyes?

4. June 2018 (4H) Q2

The area of land on a farm is 120 hectares.

The farmer grows crops on $\frac{7}{8}$ of the land.

On $\frac{2}{3}$ of the land used to grow crops, the farmer grows wheat.

(a) Work out the area of the land on the farm used to grow wheat.

.... hectares

(3)

5. Jan 2019 (1HR) Q2

There are 60 children in a club.

In the club, the ratio of the number of girls to the number of boys is $3:1$

$\frac{3}{5}$ of the girls play a musical instrument.

$\frac{4}{5}$ of the boys play a musical instrument.

What fraction of the 60 children play a musical instrument?

Percentages

<u>Word problems with increase or decrease</u>

1.   June 2016 (3HR) Q5
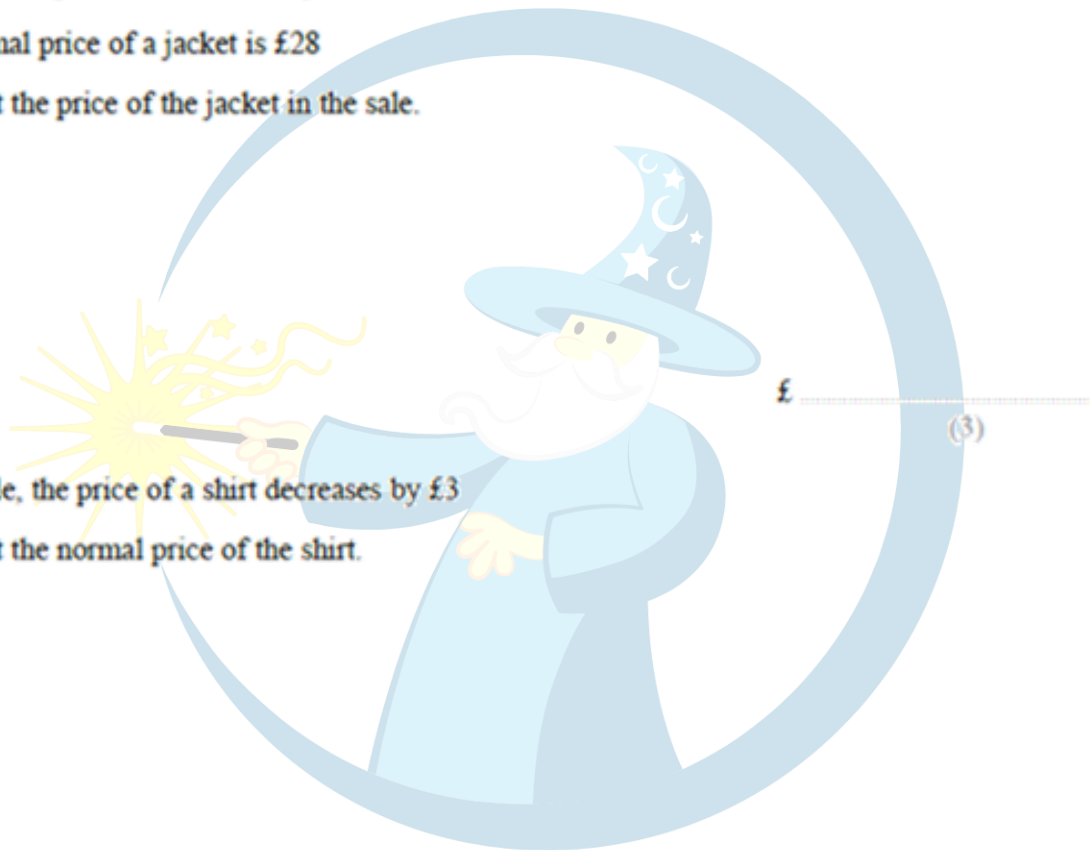
In a sale, normal prices are reduced by 8%

(a) The normal price of a jacket is £28

Work out the price of the jacket in the sale.

£ ....

(3)

(b) In the sale, the price of a shirt decreases by £3

Work out the normal price of the shirt.

£ ....

(3)

(Total for Question 5 is 6 marks)

2. June 2016 (4H) Q3

In a sale, all normal prices are reduced by 20%

(a) The normal price of a television set is 485 euros.
Work out the sale price of the television set.

(b) In the sale, the normal price of a tablet computer is reduced by 79 euros.
Work out the normal price of the tablet computer.

3. June 2016 (4HR) Q3

There were 2.1 million people living in Dubai in 2013
1.75 million of these people were not born in Dubai.

(a) Work out 1.75 as a percentage of 2.1
Give your answer correct to 1 decimal place.

4. Jan 2017 (3H) Q10

In a sale, normal prices are reduced by 18%
The sale price of an umbrella is £25.83

Work out the normal price of the umbrella.

5. Jan 2017 (3HR) Q8

In 2010, there were 411 Asiatic lions in India.
In 2015, there were 523 Asiatic lions in India.

(b) Work out the percentage increase in the number of Asiatic lions in India from 2010 to 2015
Give your answer correct to 1 decimal place.

6. Jan 2017 (4HR) Q3

In a sale, normal prices are reduced by 35%
The normal price of a bed is $1200

Work out the sale price of the bed.

7. June 2017 (3H) Q8

In 2014, Donald's weekly pay was $640
In 2015, Donald's weekly pay was $668.80

(a) Work out the percentage increase in Donald's pay between 2014 and 2015

.... %

(3)

In 2015, Donald's weekly pay was 95% of his weekly pay in 2016

(b) Work out Donald's weekly pay in 2016

$ ....

(3)

(Total for Question 8 is 6 marks)

8. June 2017 (3HR) Q10

The price of 1 kg of silver on 1st January 2010 was $607
By 1st January 2015, the price of 1 kg of silver had decreased by 9.4%

(a) Work out the price of 1 kg of silver on 1st January 2015.
   Give your answer correct to the nearest dollar ($).

$..

(3)
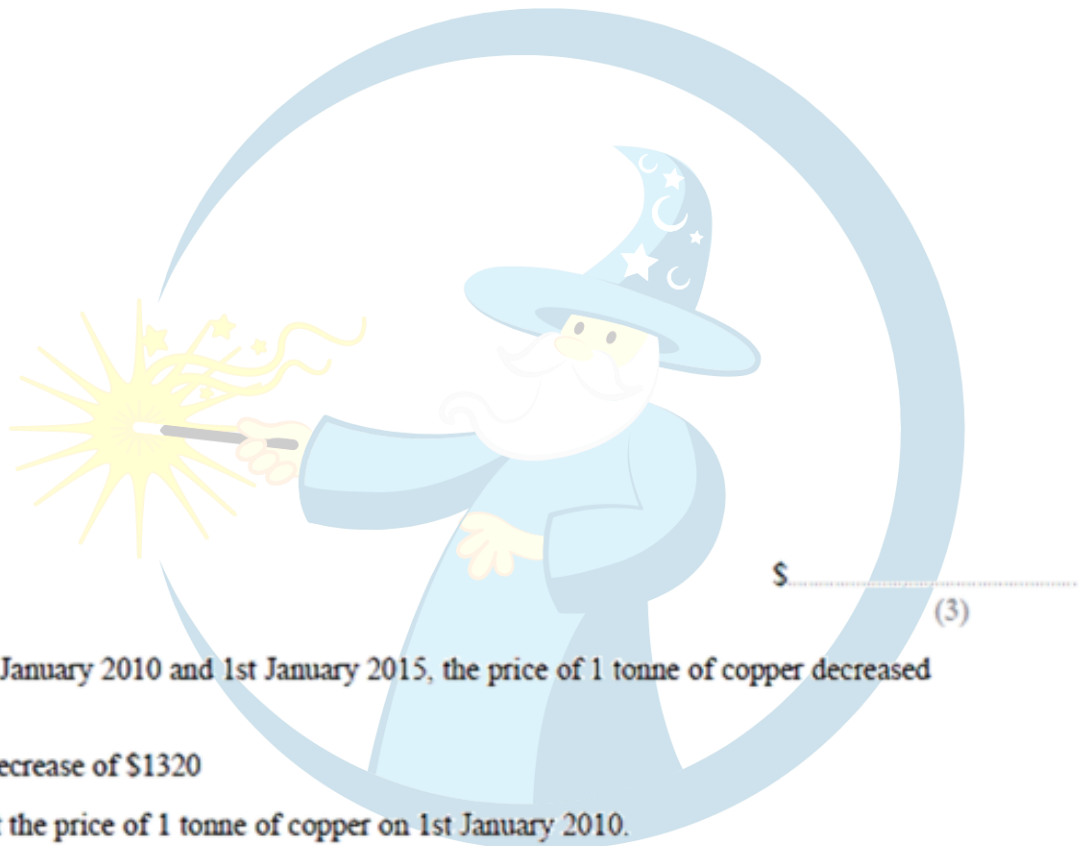
Between 1st January 2010 and 1st January 2015, the price of 1 tonne of copper decreased by 20%

This was a decrease of $1320

(b) Work out the price of 1 tonne of copper on 1st January 2010.

$..

(3)

(Total for Question 10 is 6 marks)

9. June 2018 (1HR) Q12

A company makes cars.

In 2016, the company made 350 cars.

In the first 6 months of 2017, the company made 25 cars each month.
In the last 6 months of 2017, the company made 45 cars each month.

(a) Work out the percentage increase in the number of cars the company made from 2016 to 2017

.... %

(4)

The company's income in 2017 was $500 000 more than the company's income in 2016

The company's income in 2017 was 8% more than the company's income in 2016

(b) Work out the company's income in 2016

$..

(3)

(Total for Question 12 is 7 marks)

10. June 2018 (2H) Q3

Gopal is paid 20 000 rupees each month.
Jamuna is paid 19 200 rupees each month.

Gopal and Jamuna are both given an increase in their monthly pay.
After the increase, they are both paid the same amount each month.

Gopal was given an increase of 8%

Work out the percentage increase that Jamuna was given.

.... %

(Total for Question 3 is 4 marks)

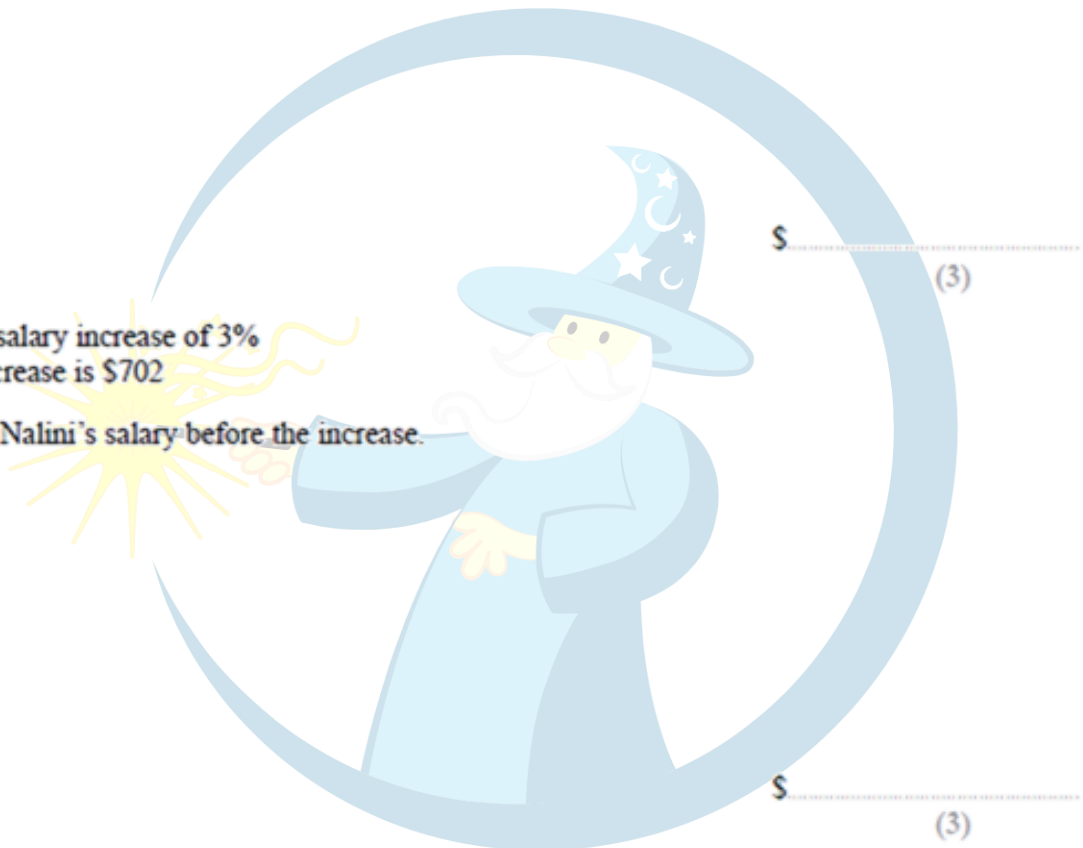**11.** June 2018 (3H) Q3

Steve's salary is $28 500
He gets a salary increase of 2.4%

(b) Work out Steve's salary after the increase.

$..

(3)

Nalini gets a salary increase of 3%
Her salary increase is $702

(c) Work out Nalini's salary before the increase.

$..

(3)

12. June 2018 (4HR) Q4

Charlotte earns £8.50 per hour.
She gets a pay rise of 6%

Work out how much Charlotte earns per hour after her pay rise.

13. Jan 2018 (3HR) Q7

Ahmed bought one box of lemons.
The box of lemons cost $4
There were 24 lemons in the box.

Ahmed sold $\frac{3}{4}$ of all the lemons he bought for 30 cents each.

He then sold the rest of the lemons for 20 cents each.

Calculate the percentage profit that Ahmed made.

Use $1 = 100 cents.

14. June 2018 (4H) Q2

Last year, the farmer made 31 500 euros from selling his wheat.
His total income was 42 000 euros.

(b) Write 31 500 as a percentage of 42 000

.... %

(2)

15. Jan 2018 (4H) Q8

In India,
    62 million mobile phones were sold from 1st October 2014 to 31st December 2014
    14.5% fewer mobile phones were sold from 1st January 2015 to 31st March 2015

(a) Work out the number of mobile phones sold in India from 1st January 2015
    to 31st March 2015

.... million

                 (3)

The table shows information about the mean number of text messages sent by each adult
in the UK in 2013 and in 2014

	Mean number of text messages sent by each adult
2013	1656
2014	1404

(b) Work out the percentage decrease in the mean number of text messages sent by each
    adult in the UK from 2013 to 2014
    Give your answer correct to 1 decimal place.

.... %

                 (3)

16. Jan 2018 (4HR) Q1

In a sale, normal prices are reduced by 12%

The normal price of a shirt is $36

(a) Work out the sale price of the shirt.

$............................
(3)

180 items were sold in the sale.
81 of these items were shirts.

(b) Express the number of shirts sold as a percentage of the number of items sold in the sale.

............................%
(2)

(Total for Question 1 is 5 marks)

17. Jan 2019 (1H) Q4

The table gives information about the price of gold.

	1st February 2016	1st March 2016
Price of one ounce of gold (dollars)	1126.50	1236.50

(a) Work out the percentage increase in the price of gold between 1st February 2016 and 1st March 2016
Give your answer correct to 3 significant figures.

.... %

(3)
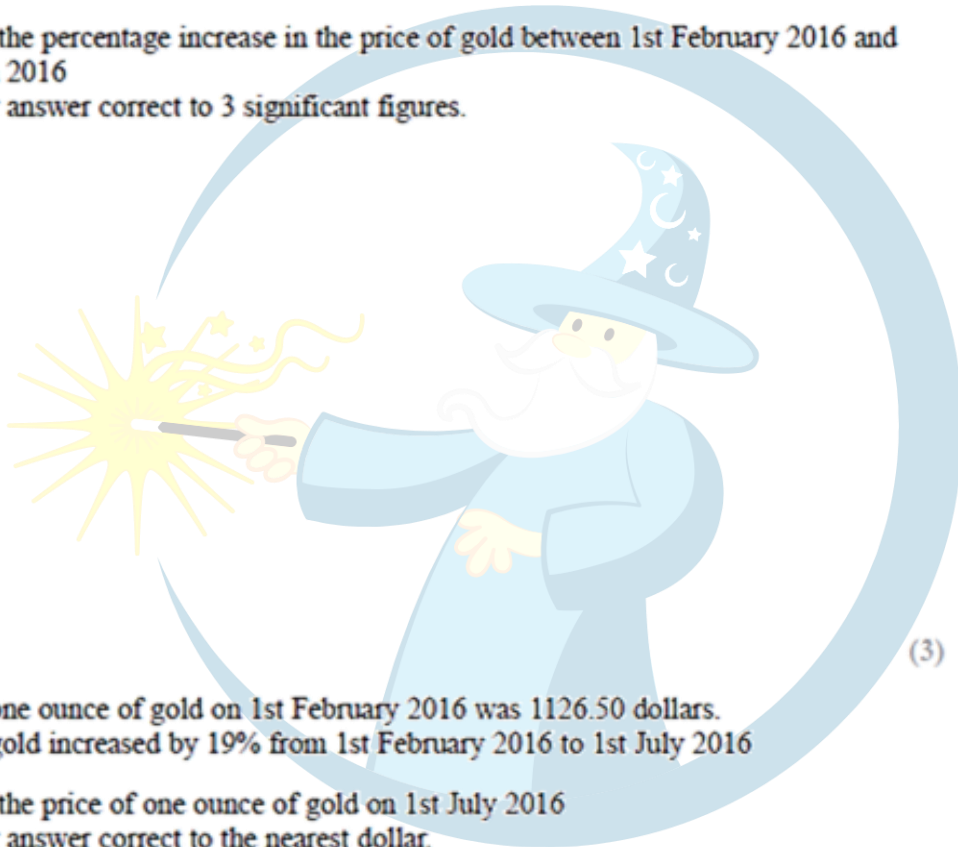
The price of one ounce of gold on 1st February 2016 was 1126.50 dollars.
The price of gold increased by 19% from 1st February 2016 to 1st July 2016

(b) Work out the price of one ounce of gold on 1st July 2016
Give your answer correct to the nearest dollar.

.... dollars

(3)

(Total for Question 4 is 6 marks)

18. Jan 2019 (2HR) Q4

On Saturday, Jacob walked 10 800 steps.
On Sunday, he walked 7% more steps than on Saturday.

Work out how many steps Jacob walked on Sunday.
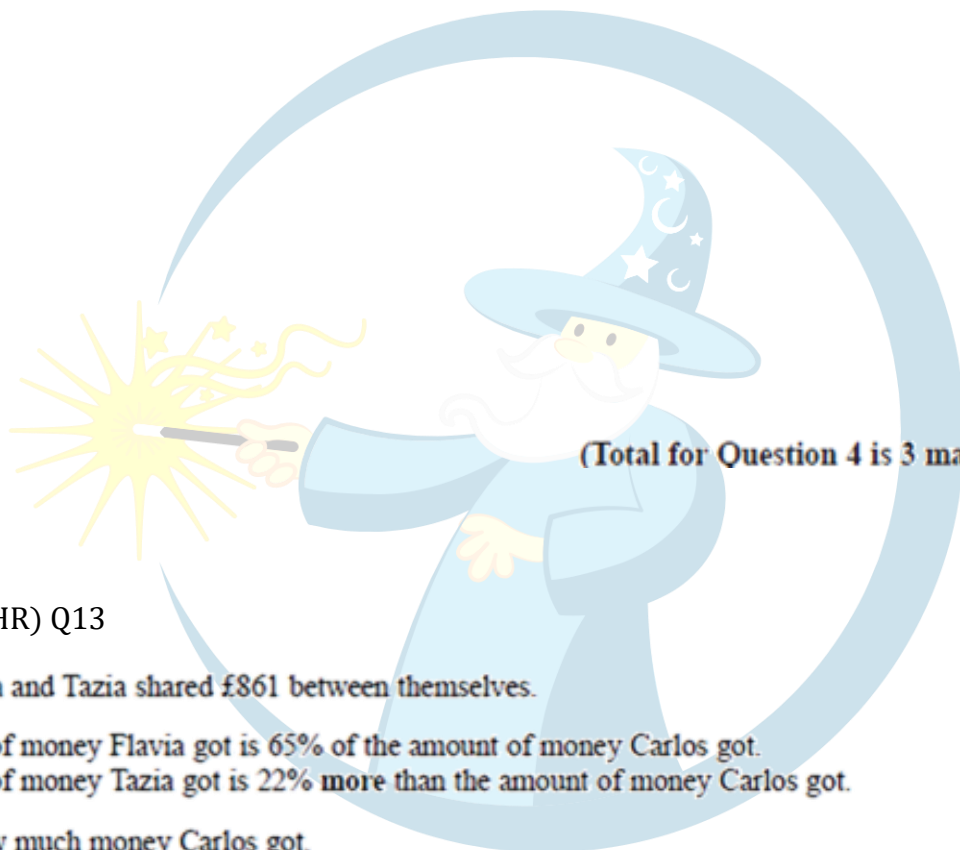
(Total for Question 4 is 3 marks)

19. Jan 2019 (2HR) Q13

Carlos, Flavia and Tazia shared £861 between themselves.

The amount of money Flavia got is 65% of the amount of money Carlos got.
The amount of money Tazia got is 22% **more** than the amount of money Carlos got.

Work out how much money Carlos got.

compound and simple interest

1. Jan 2017 (3H) Q13

   Micah invests $4000 for 3 years at 2.75% per year compound interest.

   Work out the value of the investment at the end of 3 years.

2. Jan 2017 (3HR) Q14

   Amil invests £9000 for 3 years in a savings account.
   He gets 1.8% per year compound interest.

   How much money will Amil have in his savings account at the end of 3 years?

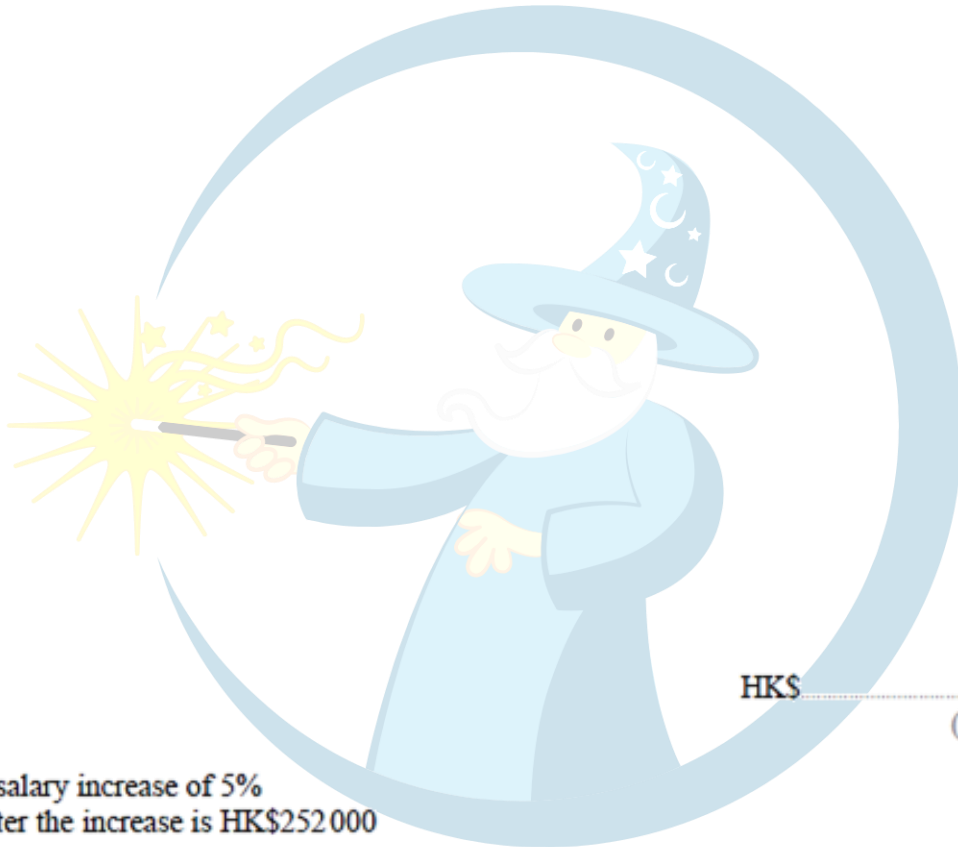3. June 2017 (4HR) Q11

   Mabintou invested $7500 for 3 years at 4% per year compound interest.

   Calculate the value of her investment at the end of 3 years.

4. June 2018 (1H) Q7

Chao bought a boat for HK$160 000
The value of the boat depreciates by 4% each year.

(a) Work out the value of the boat at the end of 3 years.
Give your answer correct to the nearest HK$.

HK$......................................

(3)

Jalina gets a salary increase of 5%
Her salary after the increase is HK$252 000

(b) Work out Jalina's salary before the increase.

HK$......................................

(3)

5. June 2018 (2HR) Q6

Hiran invests 20 000 rupees in an account for 3 years at 1.5% per year compound interest.

Work out the total amount of money in the account at the end of 3 years.
Give your answer to the nearest rupee.

.... rupees

(Total for Question 6 is 3 marks)

6. June 2018 (3H) Q11

On 1st January 2016 Celyn buys a laptop for $330
The value of the laptop decreases by 23% each year.

Work out the value of the laptop on 1st January 2019
Give your answer correct to the nearest dollar.

7. Jan 2018 (3HR) Q14

Andrew invests £3000 in an account for 3 years at 2.4% compound interest per year.
At the end of the 3 years, a deduction of 40% of the **total interest** is made from the account.

Work out the amount in the account at the end of the 3 years, after the deduction has been made.

£...

(Total for Question 14 is 4 marks)

8. Jan 2019 (2HR) Q9

Omar invests 6000 dirham for 4 years in a savings account.
He will get 1.5% per year compound interest.

Work out the total amount of interest Omar will have received by the end of 4 years.
Give your answer correct to the nearest dirham.

9. June 2018 (3HR) Q16

Daniel buys a new car.
In the first year, the value of the car decreases by 24% of its original value.
The value of the car at the end of the first year is $13 300

(a) Work out the original value of the car.

$ ....

(3)

The value of the car at the end of the first year is $13 300
In each of the second year, the third year and the fourth year, the value of the car
decreases by x% of its value at the beginning of each year.

The value of the car at the end of the fourth year is $6500

(b) Work out the value of x.
   Give your answer correct to 3 significant figures.

x = ...

(3)
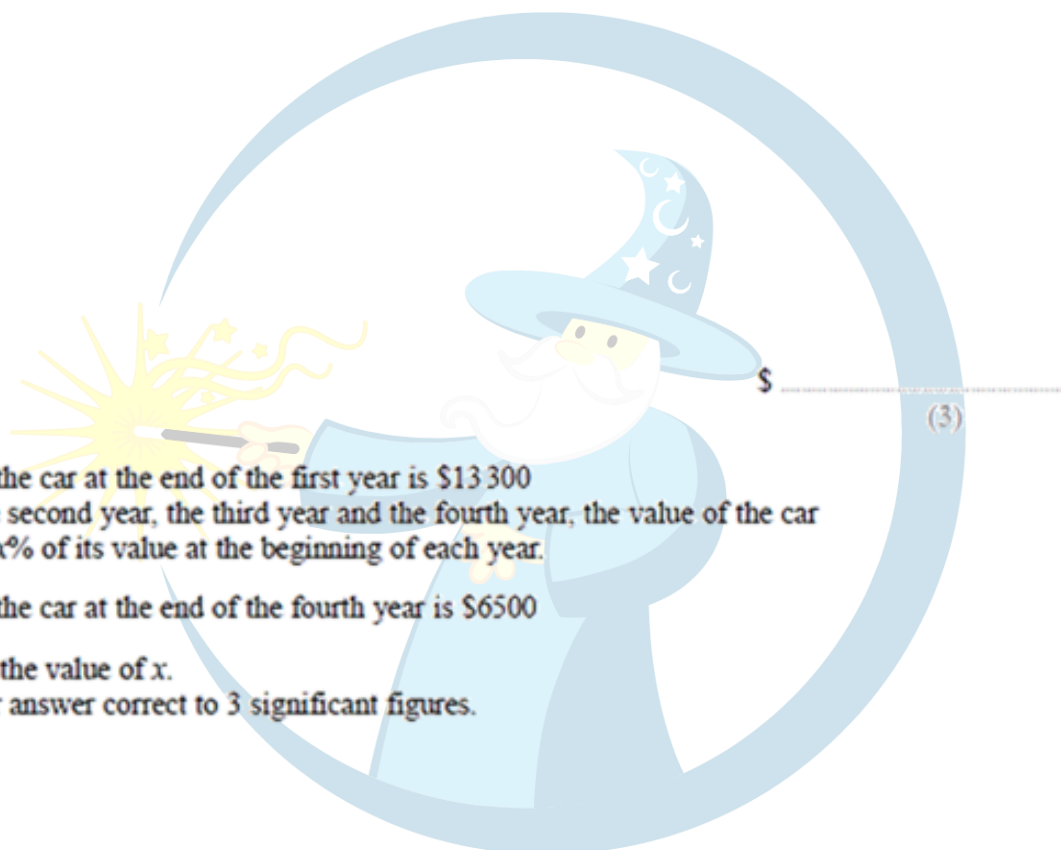
(Total for Question 16 is 6 marks)

10. Jan 2019 (2H) Q7

Jenny invests $8500 for 3 years in a savings account.
She gets 2.3% per year compound interest.

(a) How much money will Jenny have in her savings account at the end of 3 years?
Give your answer correct to the nearest dollar.

$ ....

(3)
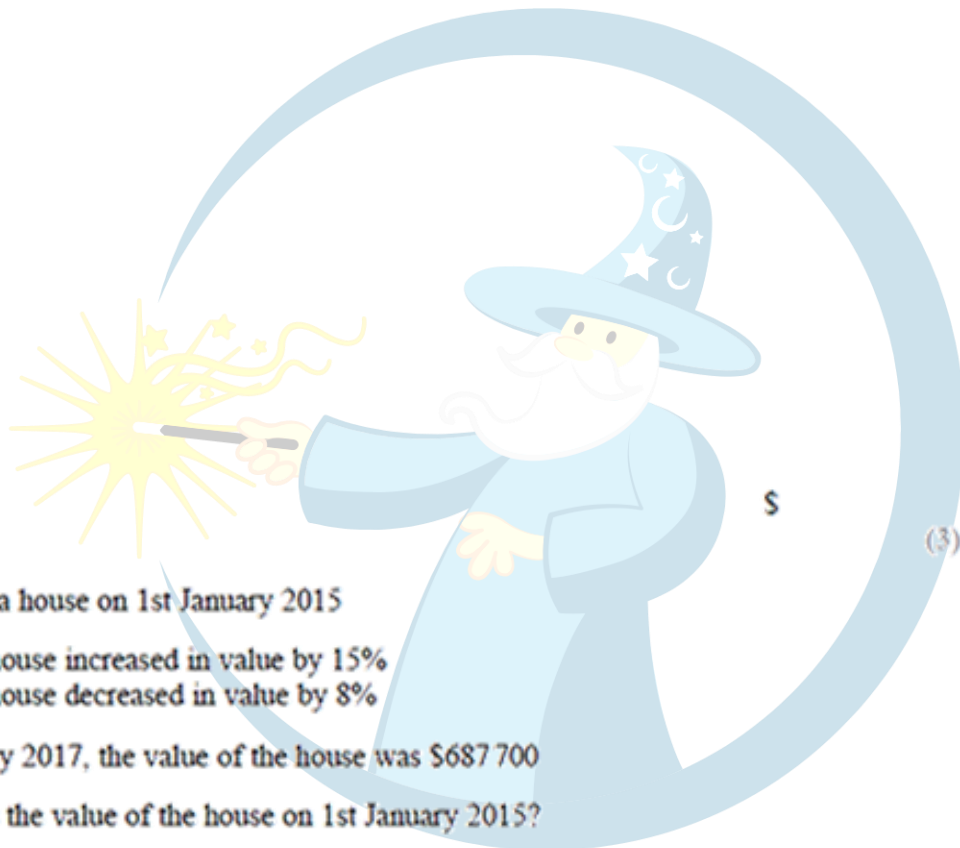
Rami bought a house on 1st January 2015

In 2015, the house increased in value by 15%
In 2016, the house decreased in value by 8%

On 1st January 2017, the value of the house was $687 700

(b) What was the value of the house on 1st January 2015?

$ ....

(3)

(Total for Question 7 is 6 marks)

Ratio, map scale and proportion

Ratio and proportion

1. June 2016 (3H) Q9

   Bhavin, Max and Imran share 6000 rupees in the ratios 2 : 3 : 7

   Imran then gives $\frac{3}{5}$ of his share of the money to Bhavin.

   What percentage of the 6000 rupees does Bhavin now have?
   Give your answer correct to the nearest whole number.
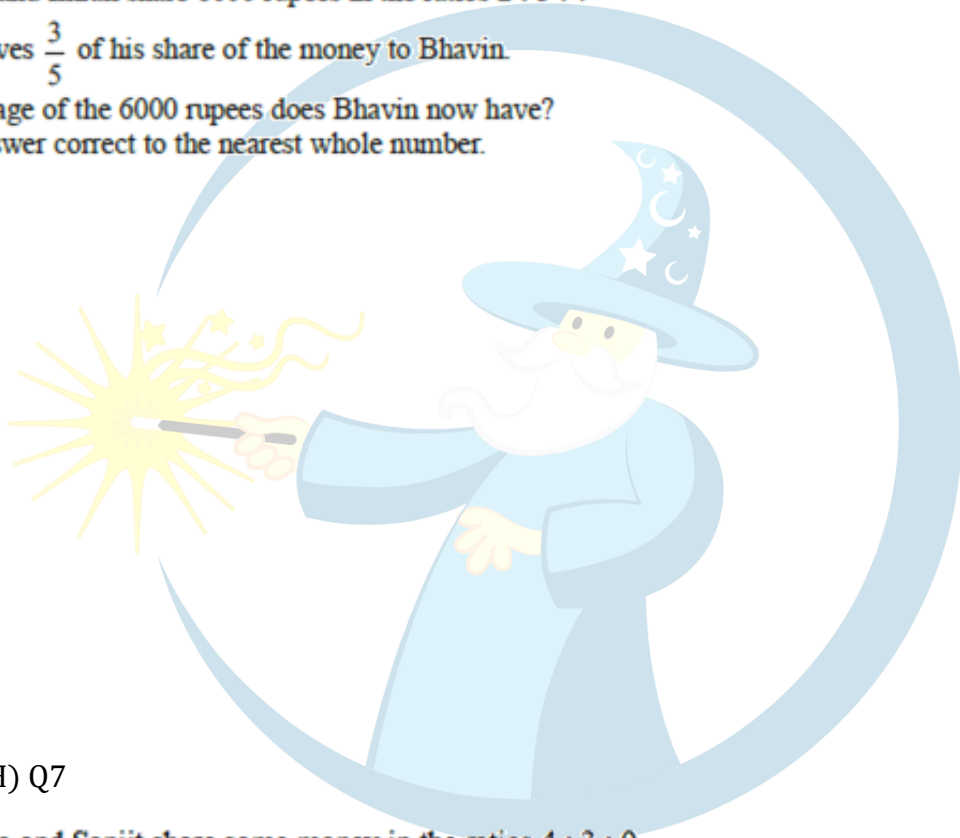
2. Jan 2017 (3H) Q7

   Rachel, Mario and Sanjit share some money in the ratios 4 : 3 : 9
   Mario receives £96
   Work out the difference between the amount received by Rachel and the amount received by Sanjit.

3. June 2016 (3H) Q1

Here are the ingredients needed to make 12 muffins.

Ingredients to make 12 muffins
300 g flour
150 g sugar
250 ml milk
100 g butter
2 eggs

Sarah makes 60 muffins.

(a) Work out how much sugar she uses.

.... g

(2)

James makes some muffins.
He uses 625 ml of milk.

(b) How many muffins did he make?

....

(2)

(Total for Question 1 is 4 marks)

4. June 2016 (3HR) Q1

Rafael and Roger played tennis against each other 30 times.
Each of the times they played, either Rafael won or Roger won.
The ratio of the number of times Rafael won to the number of times Roger won is 7 : 3

(a) Work out the number of times Rafael won.

(2)

In a school, there are 75 girls in the tennis squad.
The ratio of the number of boys in the tennis squad to the number of girls in the tennis squad is 4 : 3

(b) Work out the number of boys in the tennis squad.

(2)

(Total for Question 1 is 4 marks)

5. Jan 2017 (3HR) Q5

There are 80 counters in a bag.
The counters are either red or blue.

The ratio of the number of red counters to the number of blue counters is $3:1$

Michael takes 15% of the red counters out of the bag.

Alison takes $\dfrac{1}{5}$ of the blue counters out of the bag.

How many counters are now in the bag?

6. June 2017 (4H) Q9

Manu, Liam and Ned share £420 in the ratios $4:5:3$
Liam then gives Ned £75

Express the amount of money that Ned now has as a percentage of the £420
Give your answer correct to the nearest whole number.

7. Jan 2017 (4HR) Q1

Here is a list of ingredients for making 24 Rocky Road Crunchy Bars.

Rocky Road Crunchy Bars

Ingredients for 24 bars

125 grams	butter
300 grams	chocolate
3 tablespoons	syrup
200 grams	biscuits
100 grams	marshmallows
2 teaspoons	icing sugar

Silvester wants to make 30 Rocky Road Crunchy Bars.

(a) Work out the amount of marshmallows he needs.

.... grams

(2)

Nigella makes some Rocky Road Crunchy Bars.
She uses 850 grams of chocolate.

(b) Work out the number of Rocky Road Crunchy Bars she makes.

....

(2)

(Total for Question 1 is 4 marks)

8. June 2017 (3H) Q3

Here is a list of ingredients needed to make apple and blackberry crumble for 4 people.

Apple and Blackberry Crumble
Ingredients for 4 people

120 grams	flour
80 grams	sugar
90 grams	butter
300 grams	apples
115 grams	blackberries

Rufus wants to make apple and blackberry crumble for 10 people.

(a) Work out the amount of apples he needs.
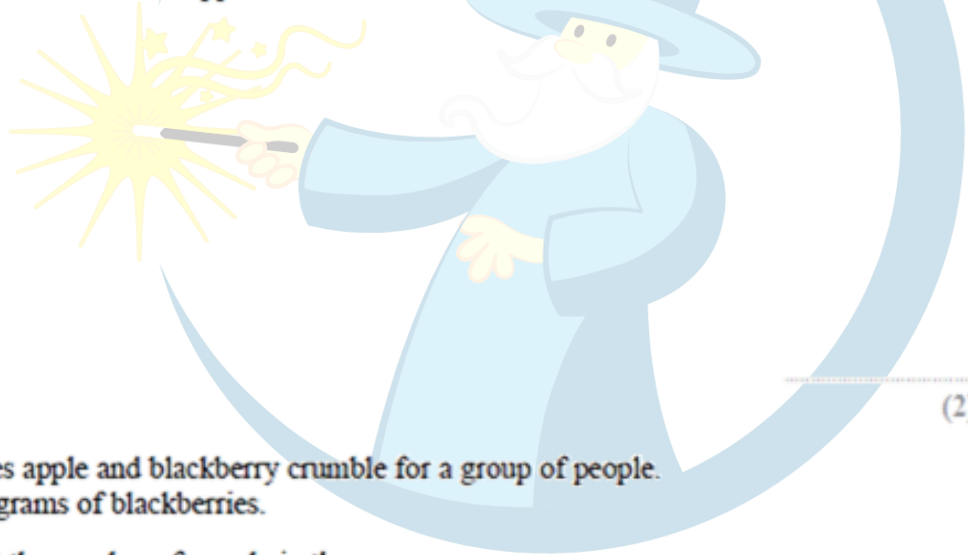
.... grams

(2)

Roland makes apple and blackberry crumble for a group of people.
He uses 920 grams of blackberries.

(b) Work out the number of people in the group.

....

(2)

(Total for Question 3 is 4 marks)

9. June 2017 (4HR) Q1

Here is a list of ingredients to make 12 chocolate cupcakes.

Chocolate cupcakes

Ingredients for **12** cupcakes

110 g butter
100 g sugar
75 g flour
25 g cocoa
2 eggs

James wants to make exactly 30 cupcakes.

(a) How much butter does James need?

.... g
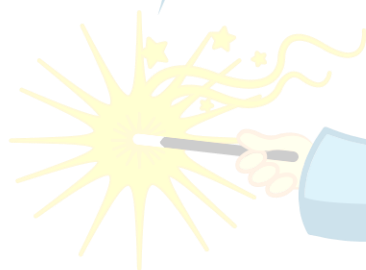
(2)

Sophie made some chocolate cupcakes for a party.
She used 375 g of sugar.

(b) How many cupcakes did Sophie make?

....

(2)

(Total for Question 1 is 4 marks)

10. June 2018 (1H) Q2

There are some people in a cinema.

$\frac{3}{5}$ of the people in the cinema are children.

For the children in the cinema,

number of girls : number of boys = 2 : 7

There are 170 girls in the cinema.

Work out the number of adults in the cinema.

11. Jan 2018 (4HR) Q4

A bag contains only red marbles and green marbles.
The bag contains a total of 400 marbles.
The ratio of the number of red marbles to the number of green marbles is 5 : 3

How many more red marbles are there than green marbles in the bag?

(Total for Question 4 is 3 marks)

12. June 2018 (1HR) Q4

Anna and Lionel share $675 in the ratio 4 : 5

Lionel gives $\frac{3}{5}$ of his share of the money to his mother.

How much money does Lionel give to his mother?

$..
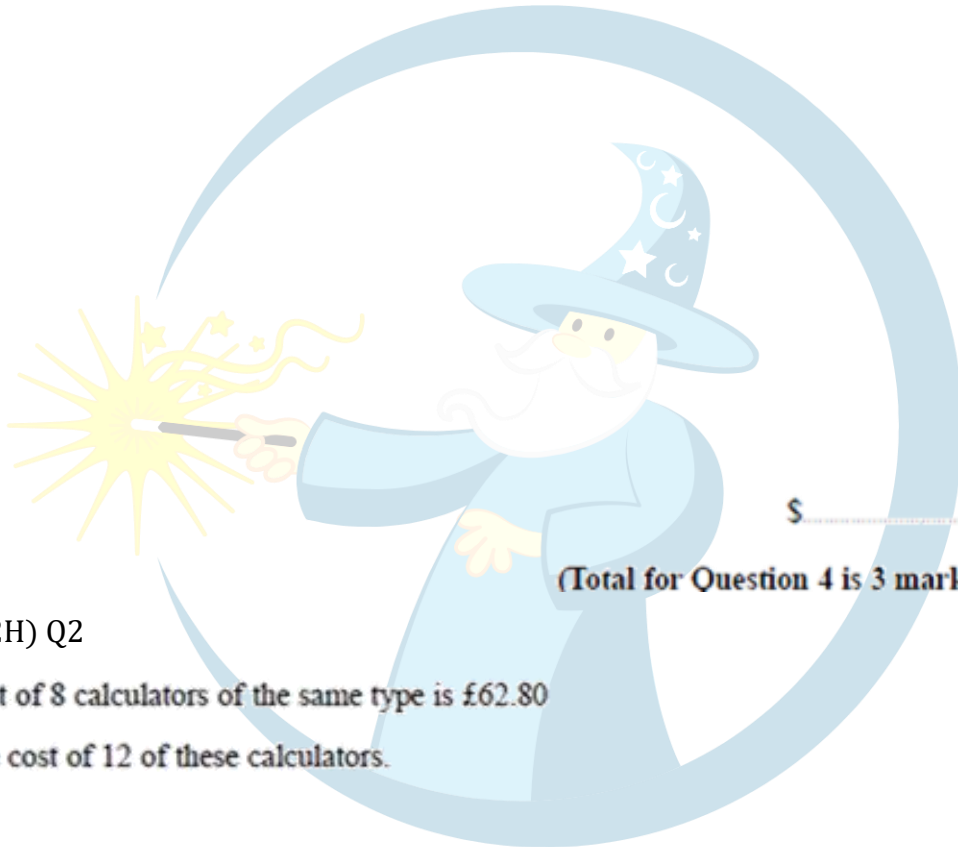
(Total for Question 4 is 3 marks)

13. June 2018 (2H) Q2

The total cost of 8 calculators of the same type is £62.80

Work out the cost of 12 of these calculators.

£..

(Total for Question 2 is 2 marks)

14. June 2018 (3H) Q2

The total cost of 8 calculators of the same type is £62.80

Work out the cost of 12 of these calculators.

£...

(Total for Question 2 is 2 marks)

15. June 2018 (3HR) Q4

The diagram shows two cogs, A and B.
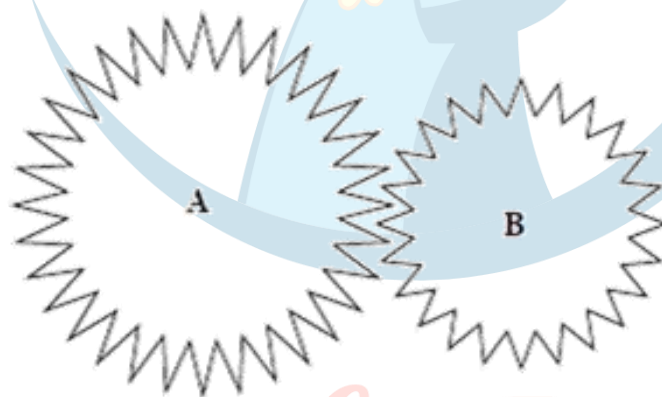
There are 32 teeth on cog A.
There are 24 teeth on cog B.

The two cogs both rotate.
Cog A completes 12 full turns while cog B completes 16 full turns.

Work out the number of full turns that cog A completes while cog B completes 60 full turns.

16. June 2018 (4H) Q5

Jess makes salad dressing by mixing lemon juice and olive oil in the ratio $2:5$ by volume.
She uses 0.5 litres of lemon juice.

(a) Work out how much olive oil she uses to make the salad dressing.

.... litres

(2)

Tiesto wants to make 630 millilitres of the salad dressing.
He mixes lemon juice and olive oil in the ratio $2:5$ by volume.

(b) Work out how much olive oil he uses to make the salad dressing.

.... millilitres

(2)

Salad dressing is made by mixing lemon juice and olive oil in the ratio $2:5$ by volume.
The cost of lemon juice is \$13.50 per litre.
The cost of olive oil is \$18 per litre.

(c) Work out the ratio

cost of lemon juice in the salad dressing : cost of olive oil in the salad dressing

Give your ratio in its simplest form.

....

(3)
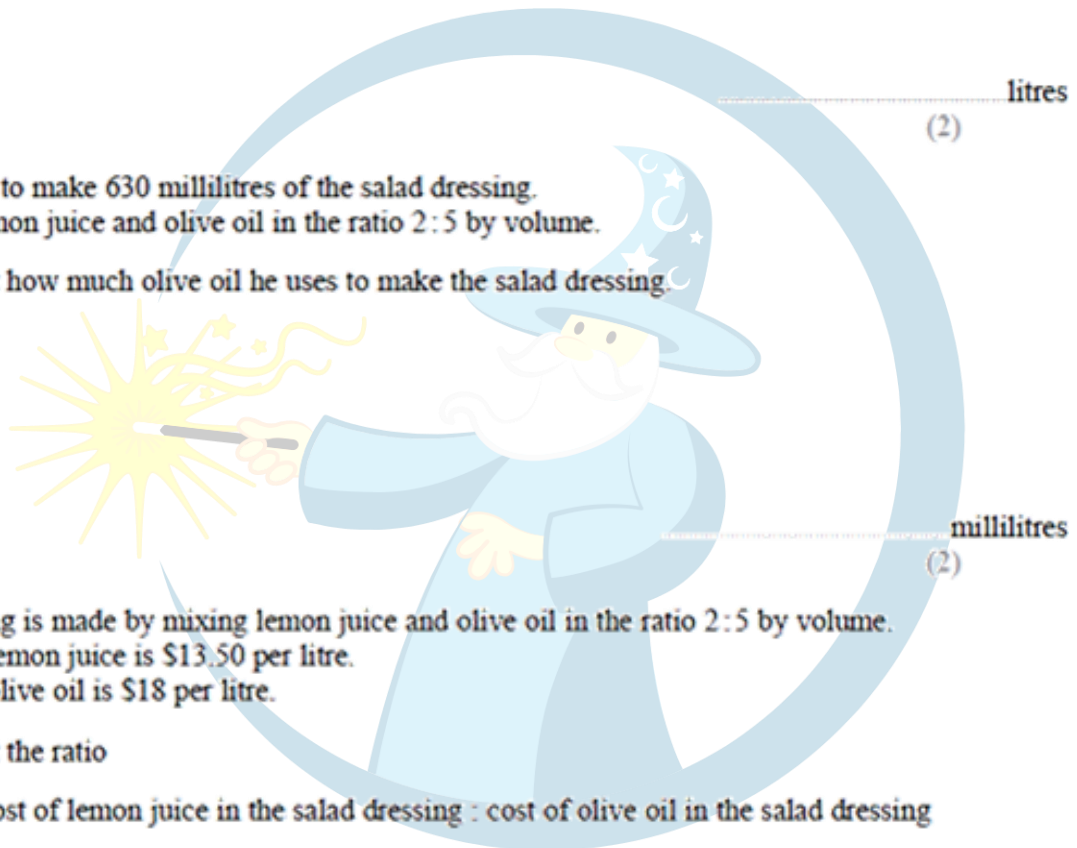
(Total for Question 5 is 7 marks)

Map scale

1. June 2016 (4HR) Q8

    Louis makes a model of a plane.

    The wingspan of the model is 50 centimetres.
    The wingspan of the real plane is 80 metres.

    (a) Work out the scale of the model.
        Give your answer in the form $1: n$

    The length of the real plane is 72 metres.

    (b) Work out the length of the model.
        Give your answer in centimetres.
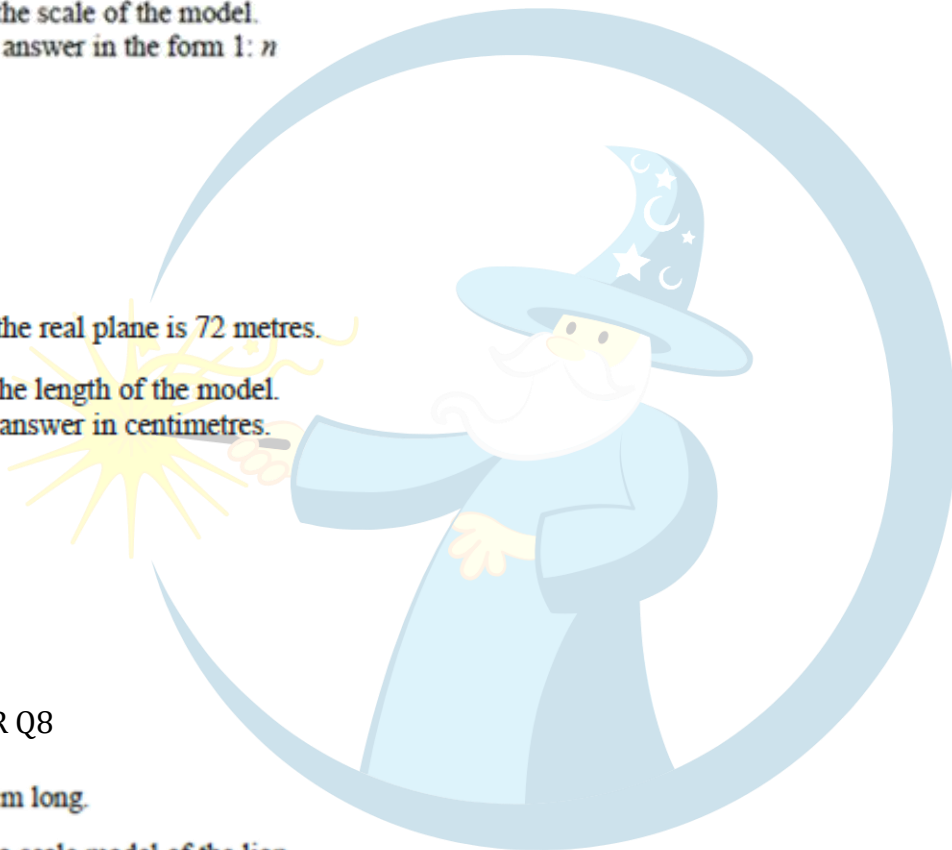
2. Jan 2017 3HR Q8

    A lion is 224 cm long.

    Simon makes a scale model of the lion.
    He uses a scale of $1:8$

    (a) Work out the length of the scale model.

3. June 2017 (3HR) Q5

There is a World Peace Bell in South Korea.

At its widest, the bell has a circular cross section with a diameter of 2.5 m.

(a) Work out the circumference of a circle with diameter 2.5 m.
Give your answer correct to 3 significant figures.

.... m

(2)

The World Peace Bell in South Korea has a height of 4.7 m.
At its widest, the bell has a circular cross section with a diameter of 2.5 m.

A scale model is made of the bell.
At its widest, the scale model has a circular cross section with a diameter 10 cm.

(b) Work out the height of the scale model.
Give your answer in centimetres.

.... cm

(2)

(Total for Question 5 is 4 marks)

4. Jan 2018 (3H) Q1

Pasquale has a map with a scale of 1:125 000
His house is 14 kilometres from an airport.

(a) Work out the distance on Pasquale's map, in centimetres, from his house to the airport.

....cm

(2)
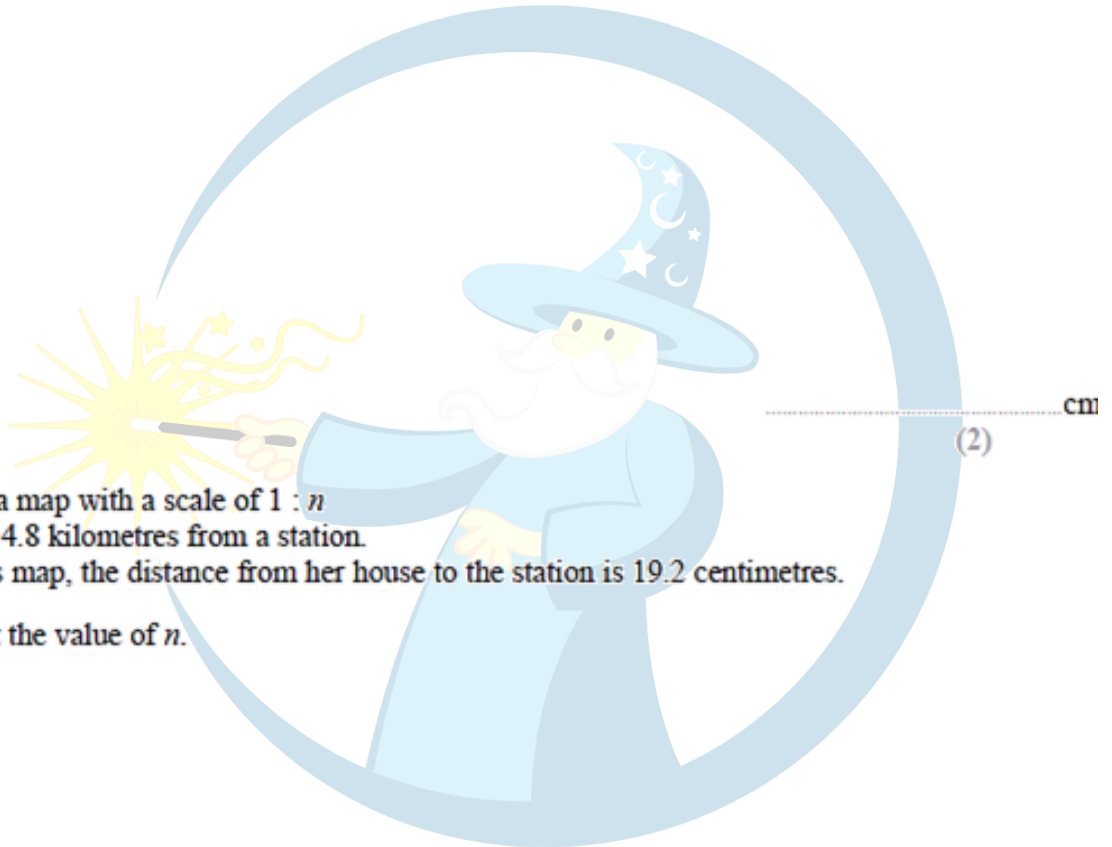
Luciana has a map with a scale of 1 : n
Her house is 4.8 kilometres from a station.
On Luciana's map, the distance from her house to the station is 19.2 centimetres.

(b) Work out the value of n.

$n = $ ....

(2)

(Total for Question 1 is 4 marks)

5. Jan 2018 (3HR) Q8

The scale of a map is 1:50 000

The length of a road on the map is 30 cm.

Work out the length of the real road.
Give your answer in km.

6. Jan 2019 (1HR) Q7

The diagram shows two water towers in Kuwait.

Diagram **NOT**
accurately drawn
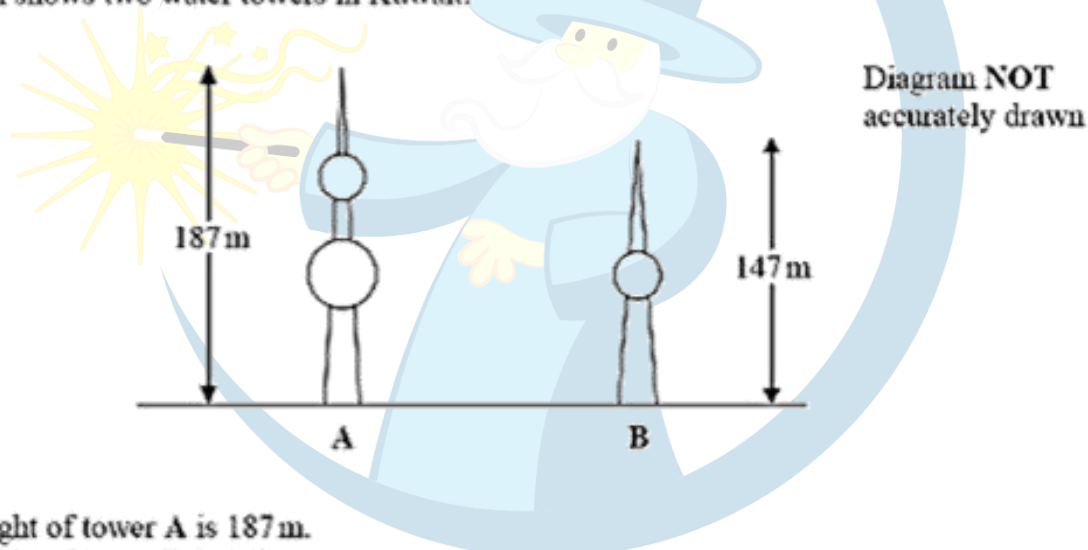
The real height of tower A is 187 m.
The real height of tower B is 147 m.

Ahmed makes a scale model of both towers.

The height of tower A on the scale model is 90 cm.

Work out the height of tower B on the scale model.
Give your answer correct to the nearest centimetre.

7. Jan 2019 (2H) Q1

A plane has a length of 73 metres.

A scale model is made of the plane.
The scale of the model is 1 : 200

Work out the length of the scale model.
Give your answer in centimetres.

Money exchange

1. June 2016 (4HR) Q3

    The unit of currency in Dubai is the dirham.
    The exchange rate is £1 = 5.52 dirham.

    The cost of a pair of running shoes in Dubai is 343 dirham.
    The cost of an identical pair of running shoes in the UK is £54.99

    The pair of running shoes is more expensive in Dubai than in the UK.

    (b) How much more expensive?
        Give your answer to the nearest dirham.
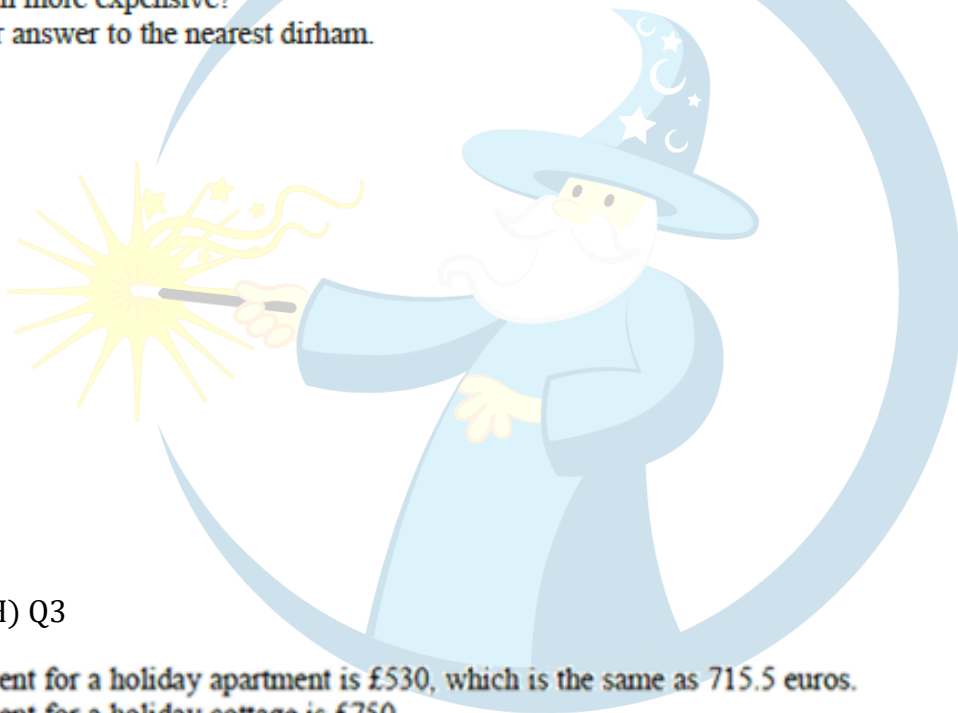
2. Jan 2017 (4H) Q3

    The weekly rent for a holiday apartment is £530, which is the same as 715.5 euros.
    The weekly rent for a holiday cottage is £750

    Using the same rate of currency exchange, work out the weekly rent for the cottage in euros.

3. June 2017 (3HR) Q4

The currency in Bangladesh is the taka.
1 pound (£) = 119 taka

(a) Change 3500 taka to pounds.
   Give your answer correct to 2 decimal places.

£...

(2)

The currency in Thailand is the baht.
1 pound (£) = 52 baht

(b) Change 8500 baht to taka.
   Give your answer correct to the nearest whole number.

.... taka

(3)
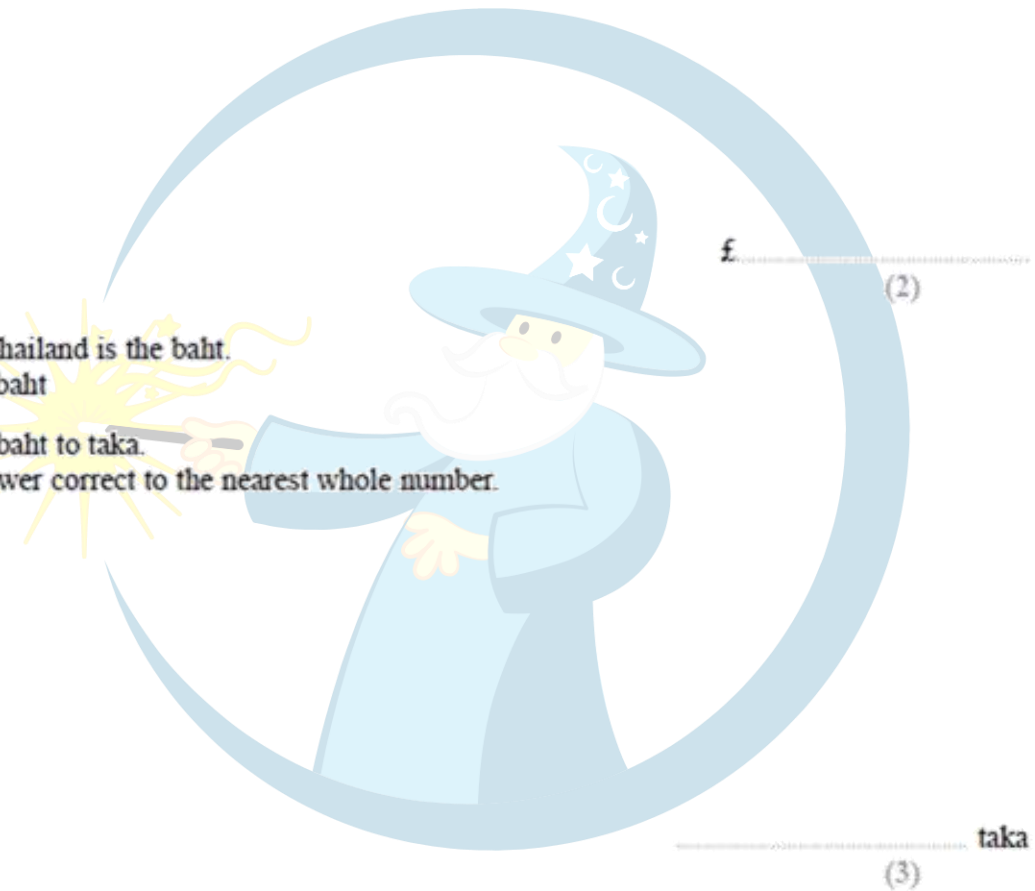
4. June 2017 (4H) Q3

Lyn went on holiday to India.
She changed £250 into rupees.

The exchange rate was £1 = 97 rupees.

(a) How many rupees did Lyn get?

.... rupees

(2)

When she returns from holiday, Lyn has **four** 500 rupee notes.
She changes this money into pounds.

The exchange rate is now £1 = 93.5 rupees.

(b) Work out how many pounds Lyn gets.
Give your answer to the nearest pound.

£ ....

(3)
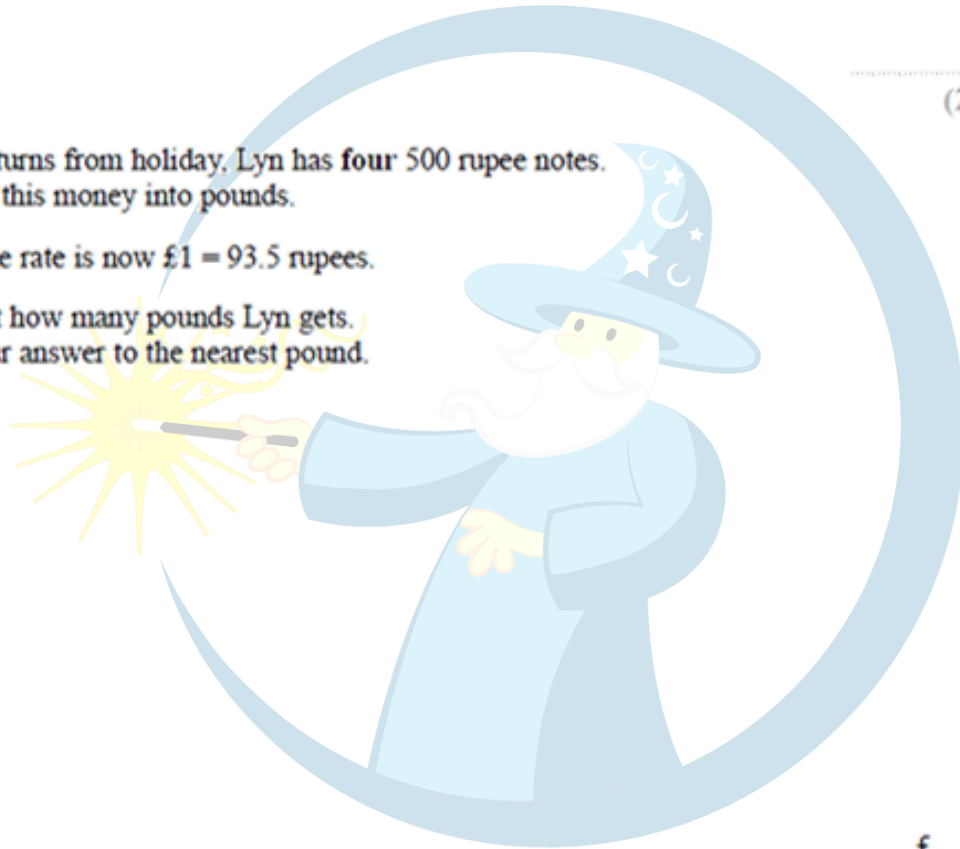
(Total for Question 3 is 5 marks)

5. Jan 2018 (3HR) Q3

Faisal lives in the USA.
He wants to buy one cotton sheet.

In the USA one sheet costs 79 US dollars.

Faisal knows that the same type of sheet costs 210 Egyptian pounds when bought in Egypt.

He also knows these exchange rates.

1 euro = 1.10 US dollars
1 euro = 9.72 Egyptian pounds

How much cheaper is the cost of one sheet when bought in Egypt than when bought in the USA?

Give your answer in US dollars correct to the nearest dollar.
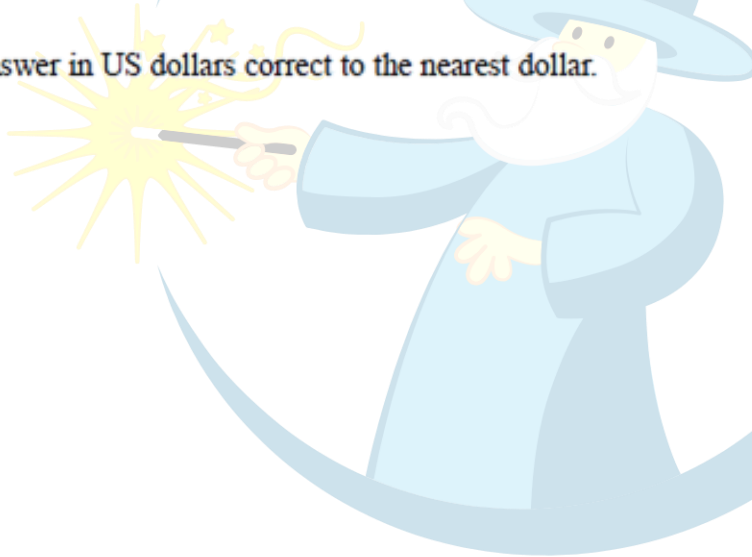
Degree of accuracy (bounds)

1. June 2016 (3H) Q20

A metal cube has sides of length 4.5 cm, correct to the nearest 0.5 cm.

The cube is melted down and the metal is used to make small spheres.
Each sphere has a radius of 3 mm, correct to the nearest millimetre.

Work out the greatest number of spheres that could be made from the metal.
Show your working clearly.
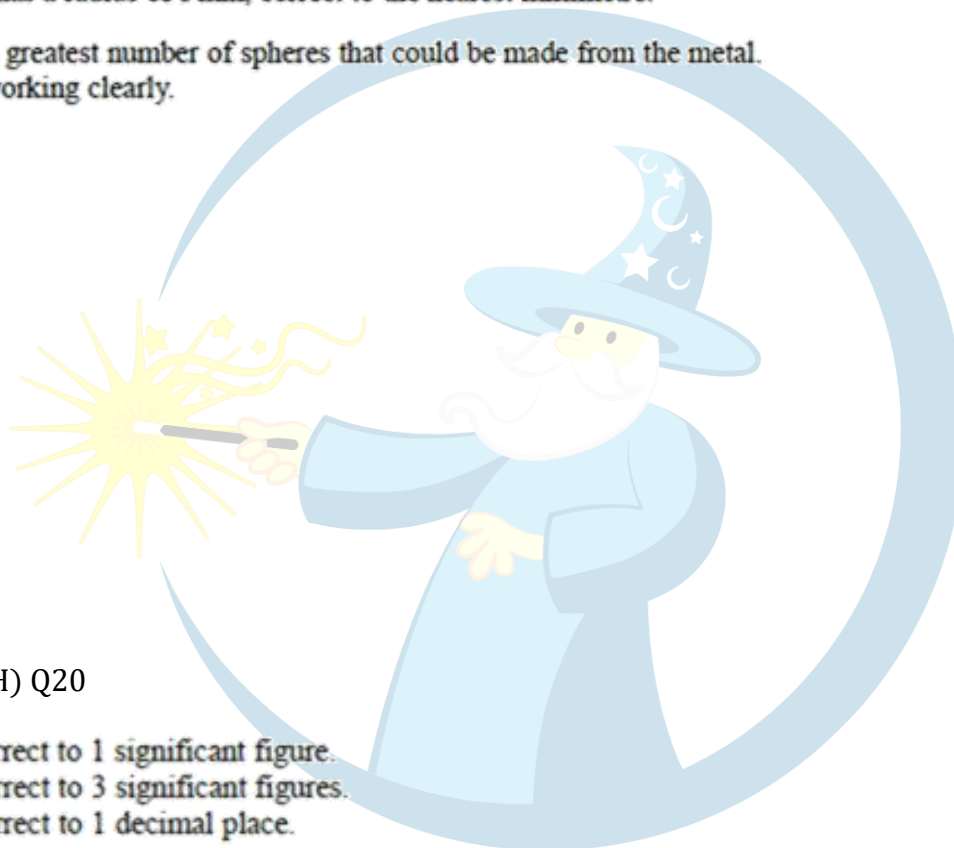
2. Jan 2017 (3H) Q20

$x = 3$ correct to 1 significant figure.
$y = 8.37$ correct to 3 significant figures.
$z = 5.3$ correct to 1 decimal place.

Calculate the upper bound of $x(y - z)$
Show your working clearly.

3. Jan 2017 (4H) Q8

Gordon measures a length on the map as 6.3 cm correct to 1 decimal place.

(c) Write down the lower bound for this length.

4. Jan 2017 (4HR) Q9

The distance from A to B is 110 km correct to 2 significant figures.

(c) (i) Write down the lower bound for the distance from A to B.

.... km

(ii) Write down the upper bound for the distance from A to B.

.... km

(2)
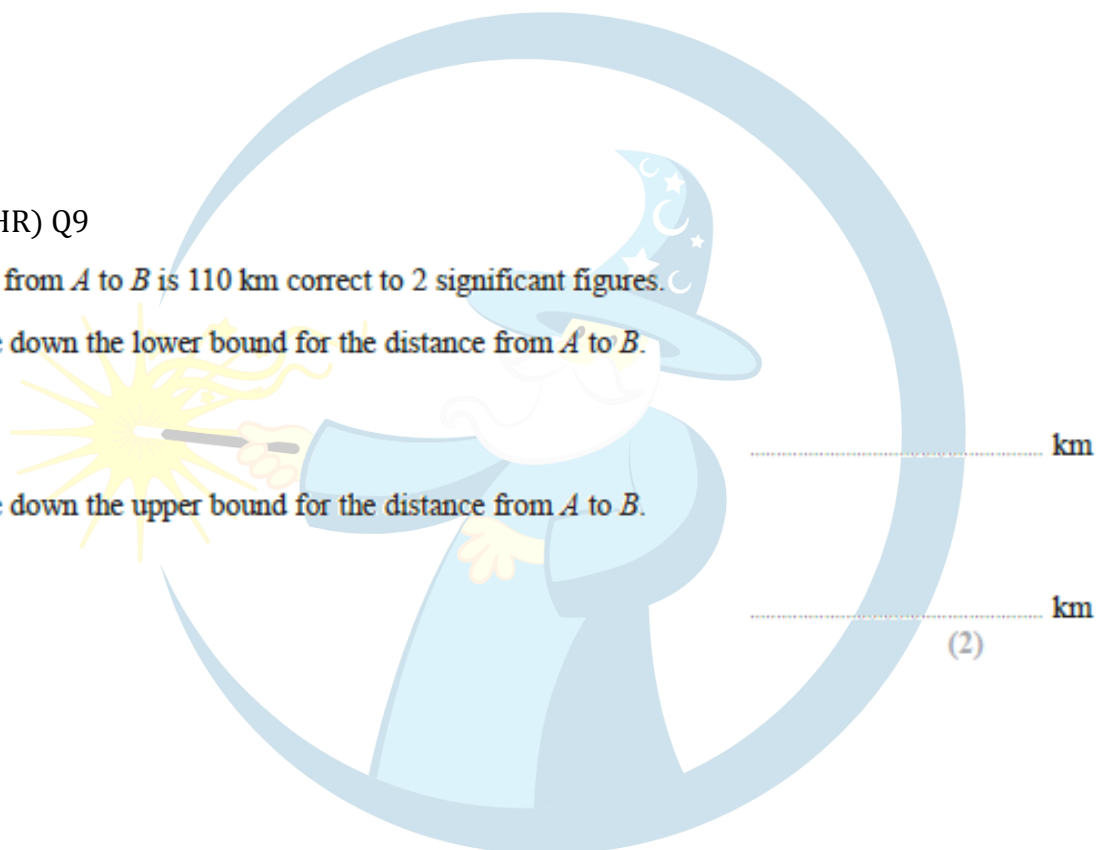
5. June 2017 (4H) Q20

A car travels a distance of 63.5 km, correct to the nearest 0.5 km.
The car takes 45.8 minutes correct to 1 decimal place.

Work out the lower bound for the average speed of the car.
Show your working clearly.
Give your answer in km/h correct to 1 decimal place.

6. June 2017 (4HR) Q23

$$t = \frac{v - u}{a}$$

$v = 27.3$ correct to 3 significant figures.
$u = 18$ correct to 2 significant figures.
$a = 9.81$ correct to 3 significant figures.

Work out the lower bound for the value of t.
Show your working clearly.
Give your answer correct to 3 significant figures.

7. June 2018 (2H) Q15

$e = 8.31$ correct to 2 decimal places
$f = 0.65$ correct to 2 decimal places

Work out the lower bound for the value of $e - f$
Show your working clearly.
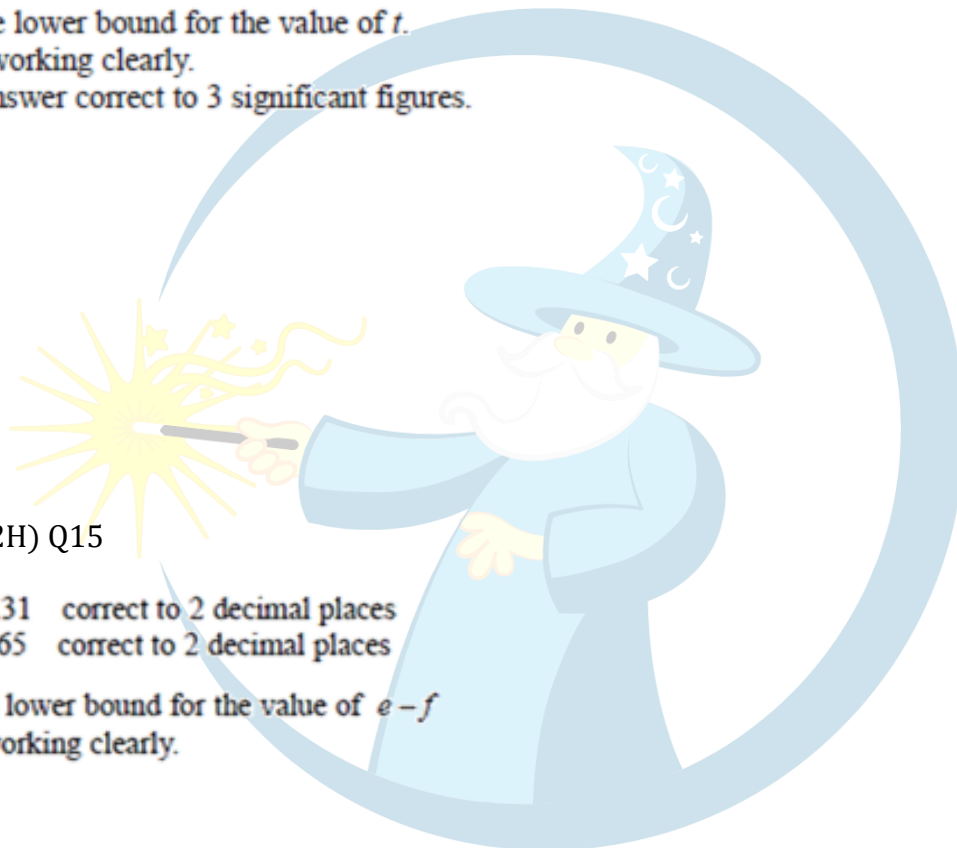
(Total for Question 15 is 2 marks)

8. June 2018 (2HR) Q19

$$a = \frac{p - q}{t}$$

$p = 8.4$ correct to 2 significant figures.
$q = 6.3$ correct to 2 significant figures.
$t = 0.27$ correct to 2 significant figures.

Work out the upper bound for the value of a.
Show your working clearly.
Give your answer correct to 1 decimal place.

9. June 2018 3H Q6

The length of a line is 12.4 cm correct to one decimal place.

(c) Write down the upper bound for the length of the line.

.... cm

(1)

10. Jan 2018 (4H) Q21

The diagram shows a solid cone.
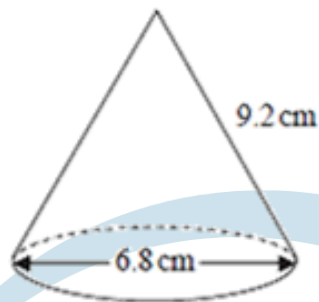
Diagram **NOT** accurately drawn

9.2 cm

6.8 cm

The cone has base diameter 6.8 cm, correct to 1 decimal place.
The cone has slant height 9.2 cm, correct to 1 decimal place.

The **total** surface area of the cone is $k\pi$ cm²

Work out the lower bound for the value of k.
Show your working clearly.
Give your answer correct to 3 significant figures.

...
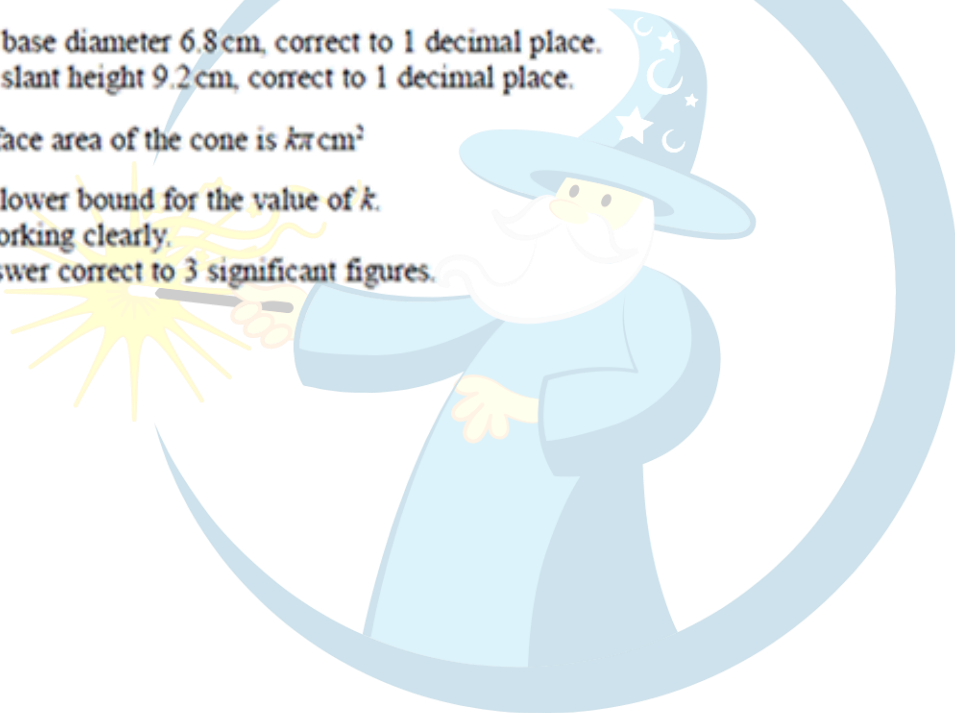
(Total for Question 21 is 3 marks)

11. Jan 2018 (4HR) Q18

ABCD is a rectangle.

The perimeter of ABCD is 64 cm, correct to the nearest centimetre.
AB = 17 cm, correct to the nearest centimetre.

Calculate the lower bound of the length of AD.
Show your working clearly.
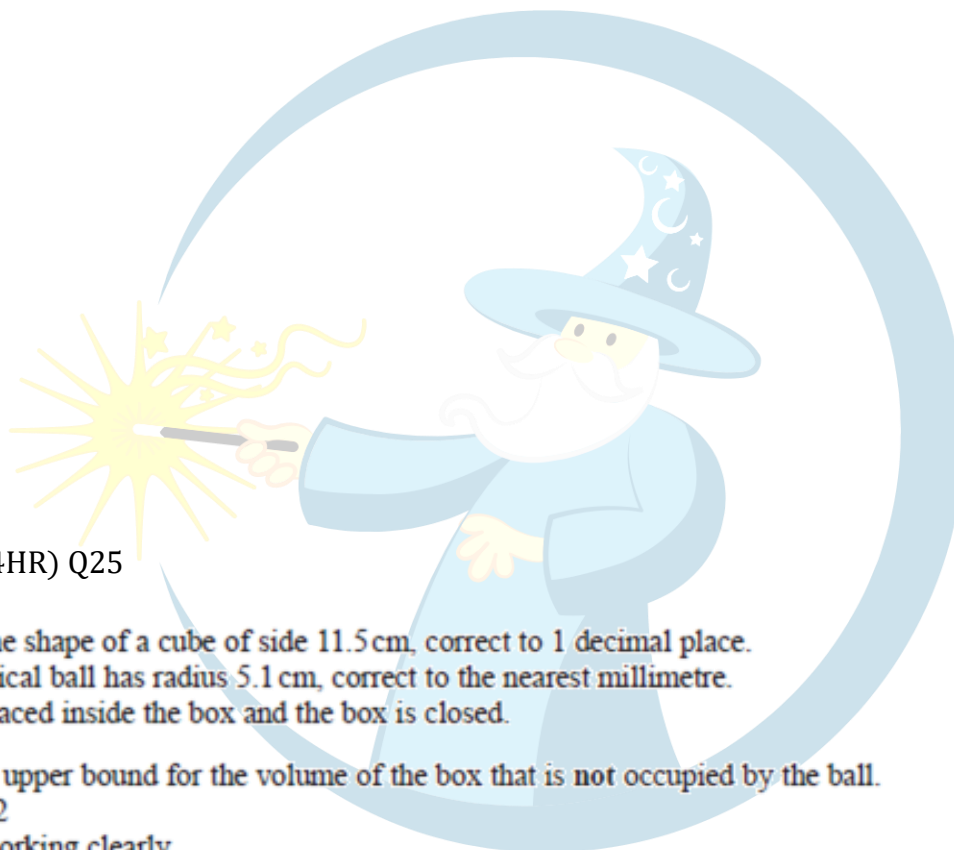
12. June 2018 (4HR) Q25

A box is in the shape of a cube of side 11.5 cm, correct to 1 decimal place.
A solid spherical ball has radius 5.1 cm, correct to the nearest millimetre.
The ball is placed inside the box and the box is closed.

Work out the upper bound for the volume of the box that is not occupied by the ball.
Use $\pi = 3.142$
Show your working clearly.
Give your answer correct to the nearest whole number.

13. Jan 2019 (2H) Q18

$$P = \frac{a}{m - x}$$

$x = 8$ correct to 1 significant figure
$a = 4.6$ correct to 2 significant figures
$m = 20$ correct to the nearest 10

Calculate the lower bound of P.
Show your working clearly.

14. Jan 2019 (2HR) Q17

$P = ef$

e = 4.8 correct to 2 significant figures.
f = 0.26 correct to 2 significant figures.

(a) Work out the lower bound for the value of P.
Show your working clearly.
Give your answer correct to 3 significant figures.

(2)

$Q = \dfrac{t}{w}$

t = 2.73 correct to 3 significant figures.
w = 0.04 correct to 1 significant figure.

(b) Work out the upper bound for the value of Q.
Show your working clearly.
Give your answer correct to 2 significant figures.

(2)

(Total for Question 17 is 4 marks)

Standard form

1. June 2016 (4HR) Q13

    (a) Write 250 000 in standard form.

    (1)

    The radius of the planet Jupiter is 6.99×10^7 metres.
    The radius of the Earth is 6.37×10^6 metres.

    The volume of Jupiter is k times the volume of the Earth.

    (b) Assuming that both planets are spheres, calculate the value of k.
        Give your answer correct to 3 significant figures.
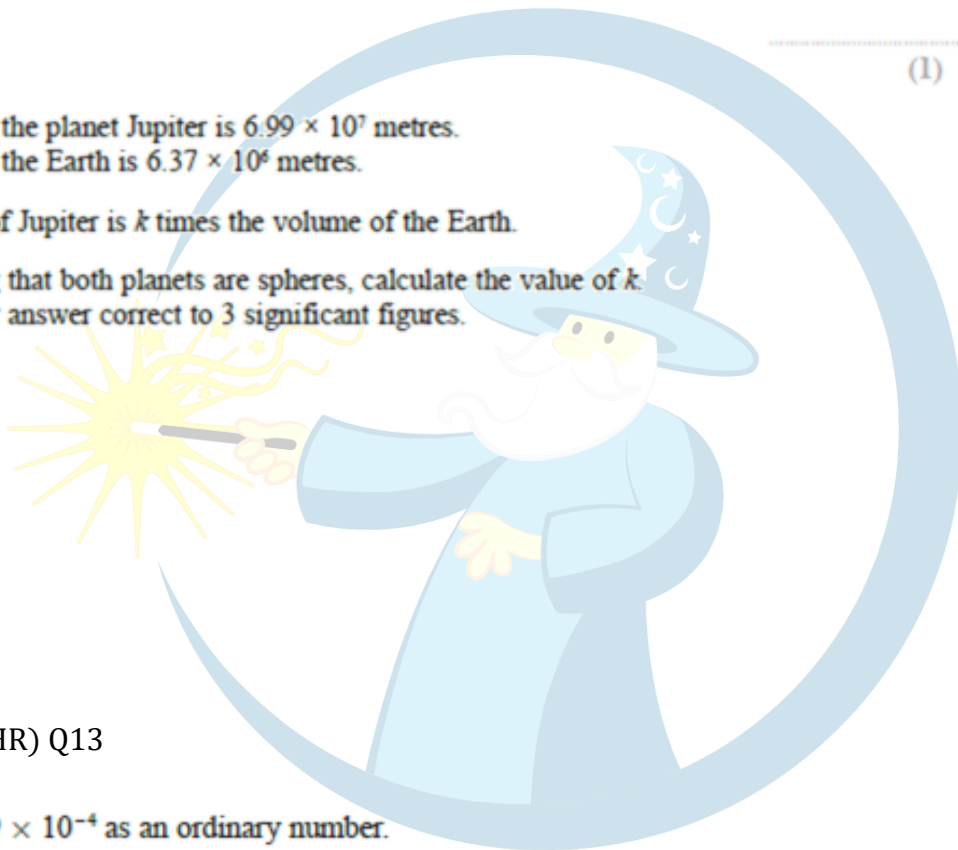
2. Jan 2017 (3HR) Q13

    (a) Write 7.9×10^{-4} as an ordinary number.

    (b) Work out $(6.5 \times 10^3) \times (3.1 \times 10^4)$
        Give your answer in standard form.

3. June 2016 (4H) Q11

The table gives the populations of each of five countries in 2014

Country	Population
China	1.4×10^9
India	1.3×10^9
USA	3.2×10^8
Ethiopia	9.7×10^7
Mexico	1.2×10^8

(a) Write 9.7×10^7 as an ordinary number.

....
(1)

The population of Russia in 2014 was 140 000 000

(b) Write 140 000 000 in standard form.

....
(1)

In 2014, there were more people living in China than were living in the USA.

(c) How many more?
   Give your answer in standard form.

....
(2)

In 2014, the population of India was k times the population of Mexico.

(d) Work out the value of k.
   Give your answer to the nearest whole number.

$k =$ ....
(2)

(Total for Question 11 is 6 marks)

4. Jan 2017 (4H) Q4

(a) (i) Use your calculator to work out the value of

$$\frac{16^2}{3 \times 12 - \pi}$$

Write down all the figures on your calculator display.

(ii) Write your answer to (a)(i) correct to 3 significant figures.

(3)

(b) Work out $\dfrac{4.2 \times 10^4}{700\,000}$

Give your answer in standard form.

(2)

(Total for Question 4 is 5 marks)

5. June 2017 (3H) Q12

(a) Write 0.000451 in standard form.

....
(1)

(b) Work out $\dfrac{7.8 \times 10^5}{2.4 \times 10^{-4}}$

Give your answer in standard form.

....
(2)

(Total for Question 12 is 3 marks)

6. June 2017 (4HR) Q10

2.2×10^7 passengers passed through Beijing Capital International Airport in 2014.

(a) Write 2.2×10^7 as an ordinary number.

....
(1)

950 000 tonnes of cargo traffic passed through Tokyo International Airport in 2014.

(b) Write 950 000 as a number in standard form.

....
(1)

(Total for Question 10 is 2 marks)

7. June 2018 (1H) Q5

(a) Write 8×10^4 as an ordinary number.

.... (1)

(b) Work out $(3.5 \times 10^5) \div (7 \times 10^8)$
Give your answer in standard form.
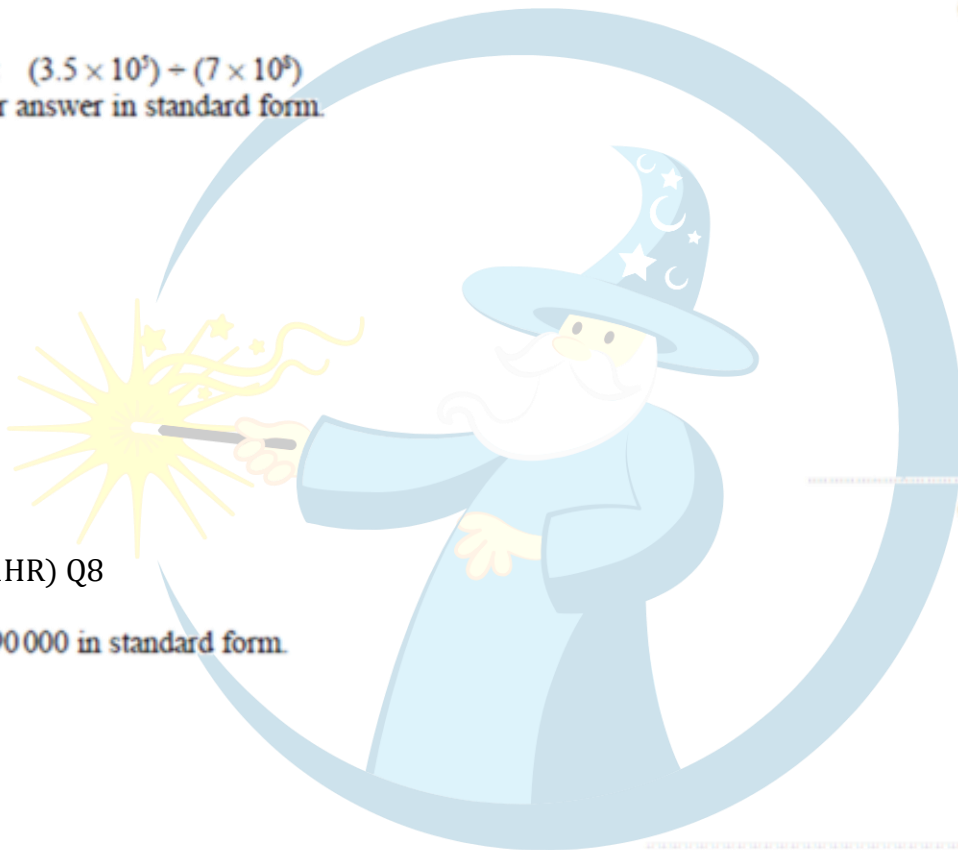
.... (2)

8. June 2018 (1HR) Q8

(a) Write 1 390 000 in standard form.

.... (1)

(b) Write 0.005 in standard form.

.... (1)

(Total for Question 8 is 2 marks)

9. Jan 2018 (3H) Q13

The number of people living in Tokyo is 3.57×10^7

(a) Write 3.57×10^7 as an ordinary number.

....

(1)

The land area of Tokyo is 1.35×10^4 square kilometres.

(b) Work out the mean number of people per square kilometre living in Tokyo.
Give your answer in standard form, correct to 2 significant figures.

....

(2)

(Total for Question 13 is 3 marks)

10. June 2018 (3H) Q9

(a) Write 82 000 000 in standard form.

....

(1)

(b) Write 2.9×10^{-5} as an ordinary number.

....

(1)

Jupiter has a mass of 1.898×10^{27} kg.
Mercury has a mass of 3.285×10^{23} kg.

The mass of Jupiter is k times the mass of Mercury.

(c) Work out the value of k.
Give your answer correct to 2 significant figures.

....

(2)

(Total for Question 9 is 4 marks)

11. Jan 2018 (4HR) Q10

The table gives information about the population of four countries in 2016

Country	Population
China	1.38×10^9
India	1.32×10^9
United Kingdom	6.50×10^7
United States	3.24×10^8

(a) Write 3.24×10^8 as an ordinary number.

....

(1)

(b) Which of the four countries had the least population in 2016?

....

(1)

(c) Work out the total population of all four countries.
   Give your answer in standard form.

....

(2)

The population of Delhi in 2016 was 1.87×10^7
In 2016, the ratio of the population of Delhi to the population of India was $1 : n$

(d) Find the value of n.
   Give your answer correct to 2 significant figures.

....

(2)

(Total for Question 10 is 6 marks)

12. June 2018 (4HR) Q13

(a) Write 0.000 037 in standard form.

....

(1)

(b) Write 234×10^7 in standard form.

....

(1)

The population of China is 1.4×10^9
The population of Morocco is 3.5×10^7

The population of China is k times the population of Morocco.

(c) Work out the value of k.

....

(2)
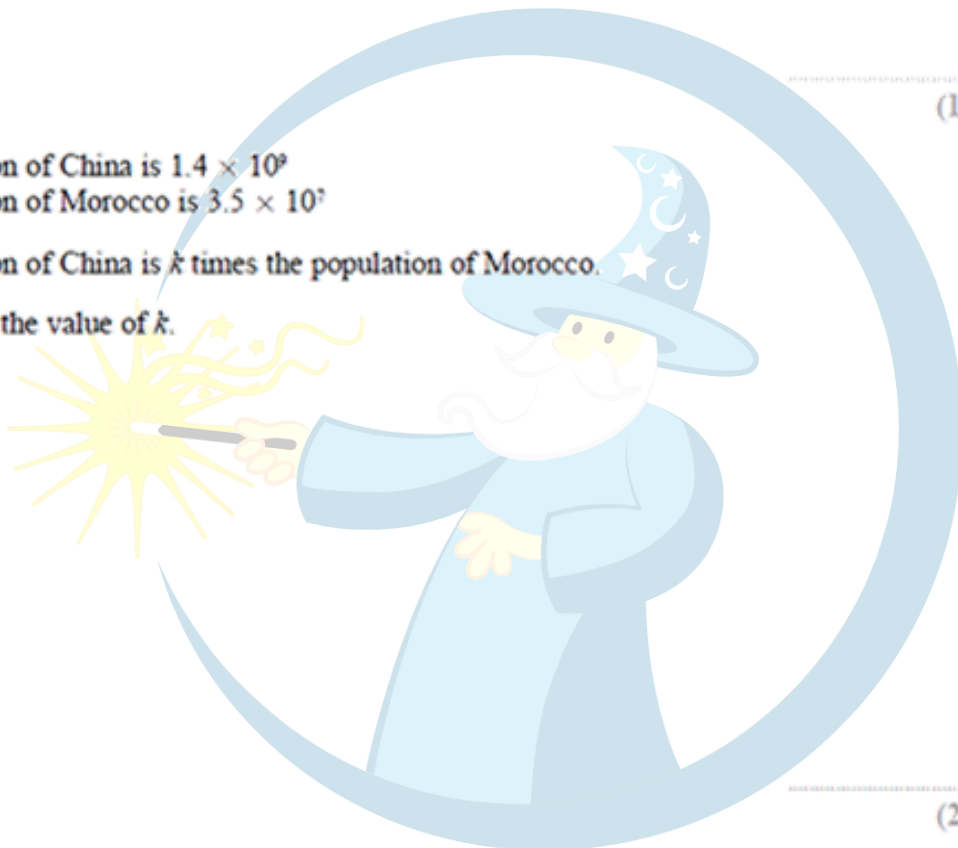
(Total for Question 13 is 4 marks)

13. Jan 2019 (1H) Q7

The table shows the volumes, in km³, of four oceans.

Ocean	Volume (km³)
Arctic Ocean	1.88×10^7
Atlantic Ocean	3.10×10^8
Indian Ocean	2.64×10^8
Southern Ocean	7.18×10^7

(a) Write 7.18×10^7 as an ordinary number.

(1)

(b) Calculate the total volume of these four oceans.

.... km³

(2)
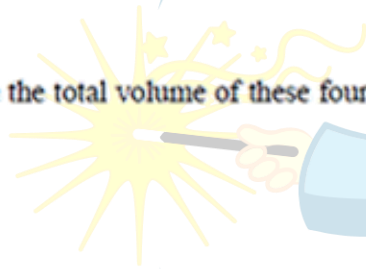
The volume of the South China Sea is 9 880 000 km³

(c) Write 9 880 000 in standard form.

(1)

(Total for Question 7 is 4 marks)

14. Jan 2019 (1HR) Q9

$N = 480 \times 10^9$

(a) Write N as a number in standard form.

(1)

(b) Write N as a product of powers of its prime factors.
Show your working clearly.
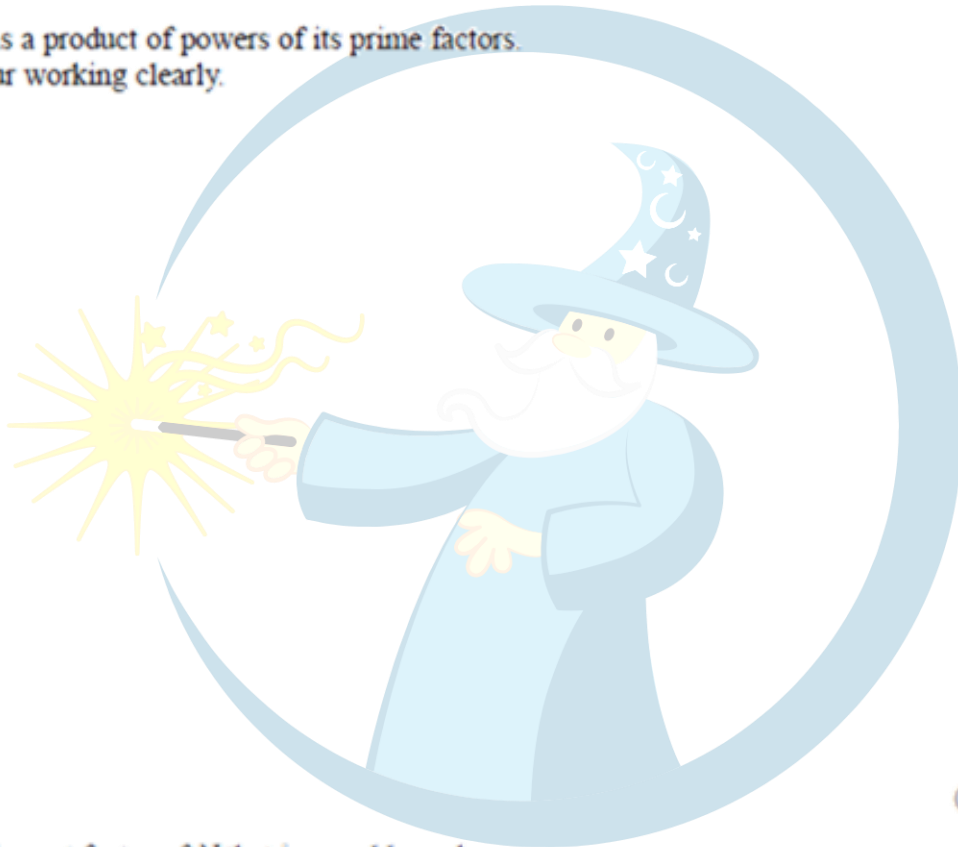
(3)

(c) Find the largest factor of N that is an odd number.

(1)

(Total for Question 9 is 5 marks)

15. June 2017 (4H) Q22

$m = 8 \times 10^{9n}$ where n is an integer.

Express $m^{-\frac{1}{3}}$ in standard form.
Give your answer, in terms of n, as simply as possible.

Sets

Essay questions

1. June 2016 (3H) Q4

$A = \{2, 4, 6, 8, 10, 12, 14\}$
$B = \{1, 3, 5, 7, 9, 11, 13\}$
$C = \{3, 6, 9, 12\}$

(a) List the members of the set

(i) $A \cap C$

....

(ii) $A \cup C$

....

(2)

(b) Explain why $A \cap B = \emptyset$

....

(1)
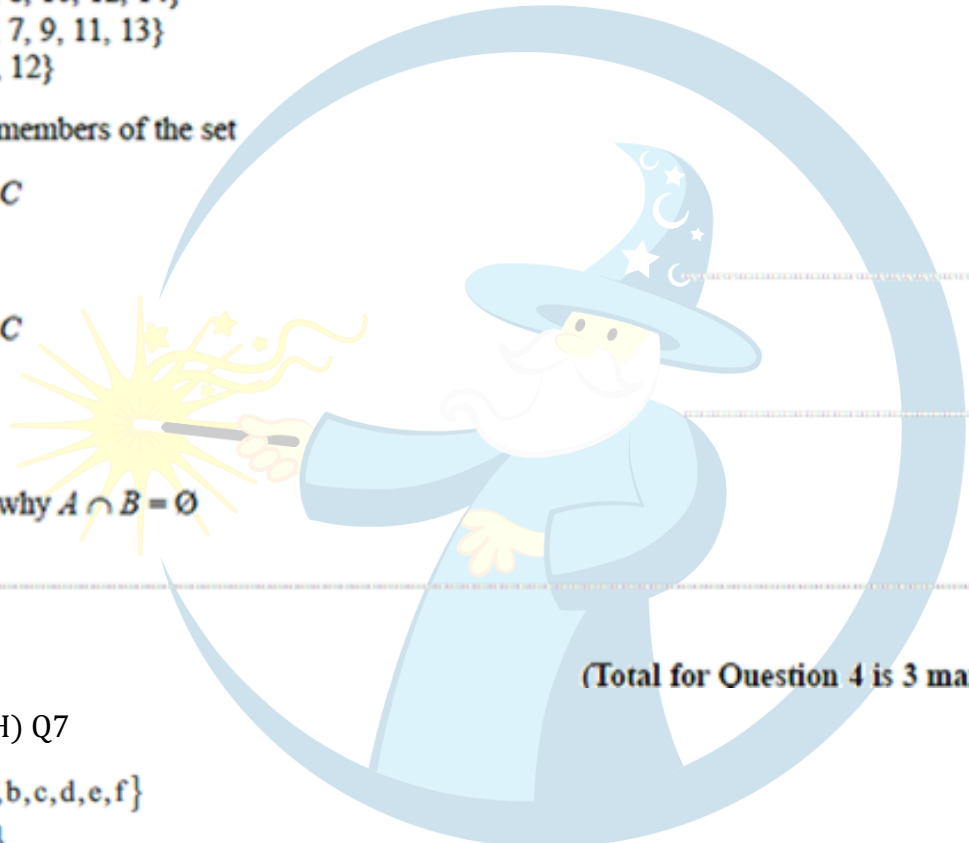
(Total for Question 4 is 3 marks)

2. Jan 2017 (4H) Q7

$P \cup Q = \{a, b, c, d, e, f\}$
$P \cap Q = \{e\}$
$a \in P, \quad c \in Q, \quad f \notin P, \quad \{b, d\} \cap Q = \emptyset$

(a) List the members of the set P.

....

(2)

(b) List the members of the set Q.

....

(1)

(Total for Question 7 is 3 marks)

3. Jan 2017 (4HR) Q5

$\mathscr{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$A = \{2, 3, 5, 7\}$
$B = \{1, 3, 5, 7, 9\}$

(a) List the members of the set

(i) $A \cap B$

(ii) $A \cup B$

(2)

(b) Find $n(A')$

(1)

(Total for Question 5 is 3 marks)

4. June 2017 (4H) Q1

$P = \{p, o, r, t, u, g, a, l\}$
$I = \{i, t, a, l, y\}$

(a) List the members of the set

(i) $P \cap I$

(ii) $P \cup I$

(2)

$F = \{f, r, a, n, c, e\}$

(b) Is it true that $I \cap F = \varnothing$?

Tick (✓) the appropriate box.

Yes ☐   No ☐

Explain your answer.

(1)

(Total for Question 1 is 3 marks)

5. June 2017 (4HR) Q2

$\mathscr{E} = \{4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

$A = \{\text{multiples of 5}\}$

$B = \{\text{odd numbers}\}$

(a) List the members of the set

    (i) $A \cap B$

    (ii) $A \cup B$

                                        (2)

The set C has 6 members and $B \cap C = \varnothing$

(b) List the members of set C.

                                        (2)
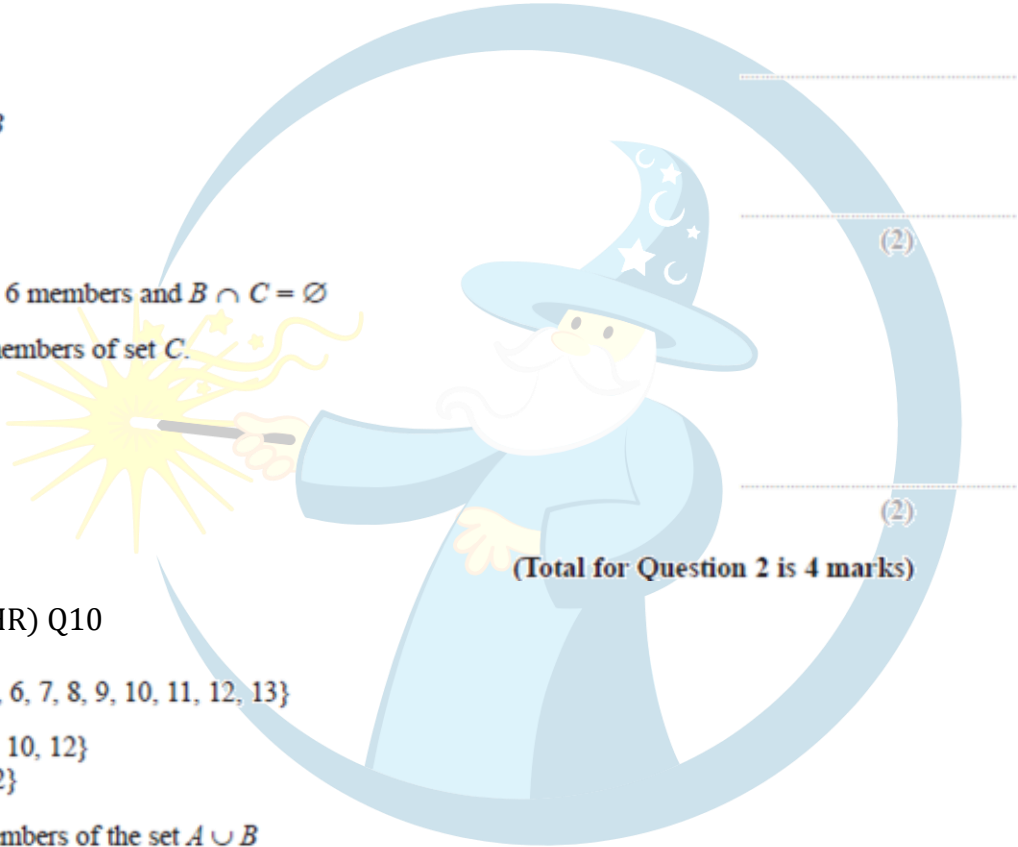
(Total for Question 2 is 4 marks)

6. Jan 2018 (3HR) Q10

$\mathscr{E} = \{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$

$A = \{2, 4, 6, 8, 10, 12\}$
$B = \{3, 6, 9, 12\}$

(a) List the members of the set $A \cup B$

                                        (1)

C is a set with 4 members.

$A \cap C = \varnothing$ and $B \cap C = \varnothing$

(b) List the members of set C

                                        (2)

(Total for Question 10 is 3 marks)

7. June 2018 (3HR) Q6

$\mathscr{E}$ = {fish in Jake's lake}
A = {fish of length greater than 20 cm}
B = {fish that weigh more than 1 kg}
C = {fish less than 1 year old}

A fish in Jake's lake is caught.
The fish is 2 years old, weighs 1.2 kg and is 19 cm in length.

(a) Write down the set, A or B or C, of which this fish is a member.

....
(1)

(b) Describe in words fish that are members of the set $A \cup B$

....

....
(2)

$B \cap C = \varnothing$

(c) Explain what this statement tells us about the fish in Jake's lake.

....

....
(1)

(Total for Question 6 is 4 marks)

8. Jan 2018 (4H) Q9

$\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
$A = \{\text{even numbers}\}$
$B = \{4, 7, 8, 11\}$

(a) List the members of $A \cup B$

(1)

(b) Is it true that $20 \in A$?
Give a reason for your answer.

(1)

C is a set such that $A \cap C = \emptyset$ and $B \cap C = \{7\}$
The set C has 3 members.

(c) List the members of one possible set C.

(2)

(Total for Question 9 is 4 marks)

Venn diagram

1. June 2016 (4H) Q21

Each student in a group of 32 students was asked the following question.

"Do you have a desktop computer (*D*), a laptop (*L*) or a tablet (*T*)?"

Their answers showed that

19 students have a desktop computer
17 students have a laptop
16 students have a tablet
9 students have both a desktop computer and a laptop
11 students have both a desktop computer and a tablet
7 students have both a laptop and a tablet
5 students have all three.

(a) Using this information, complete the Venn diagram to show the number of students in each appropriate subset.
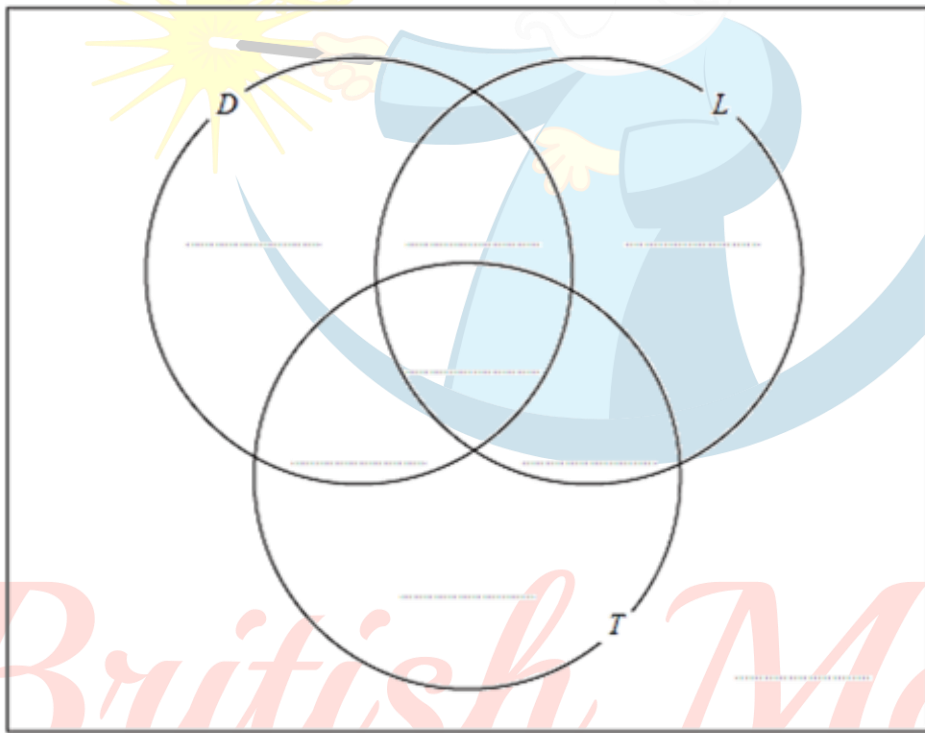
(3)

One of the students with both a desktop computer and a laptop is chosen at random.

(b) Find the probability that this student also has a tablet.

(1)

(Total for Question 21 is 4 marks)

2. June 2016 (4HR) Q18

The Venn diagram shows a universal set $\mathscr{E}$ and three sets X, Y and Z.
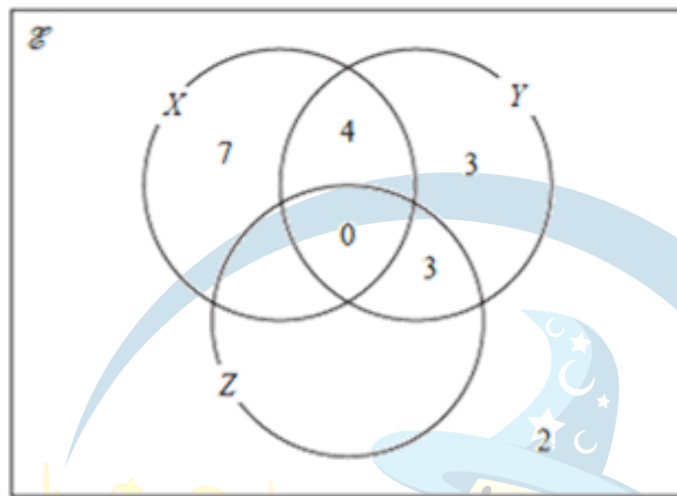
The numbers shown represent numbers of elements.

$n(X') = 14$
$n(Z) = 14$

(a) Complete the Venn diagram.

(2)

(b) Find the value of

(i) $n(X \cup Z)$

(ii) $n(X \cap Y')$

(2)

(Total for Question 18 is 4 marks)

3. Jan 2017 (3H) Q21

The Venn diagram shows a universal set $\mathscr{E}$ and sets A, B and C, where 6, 3, 7, 5, 2, 9, 4 and 8 represent **numbers** of elements.
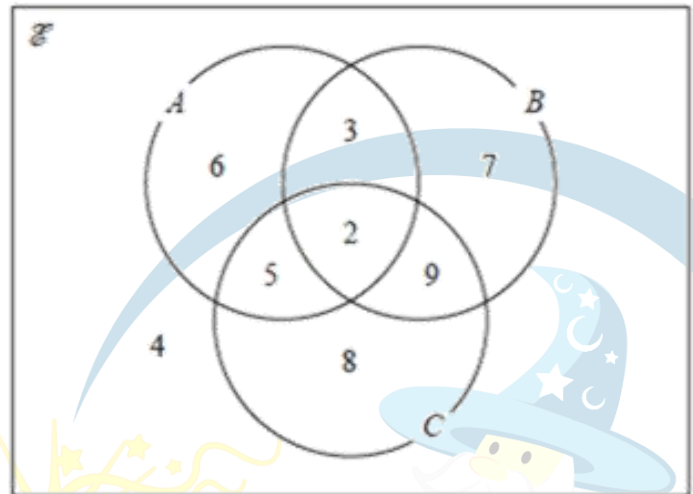
(a) Find $n(A \cup B)'$
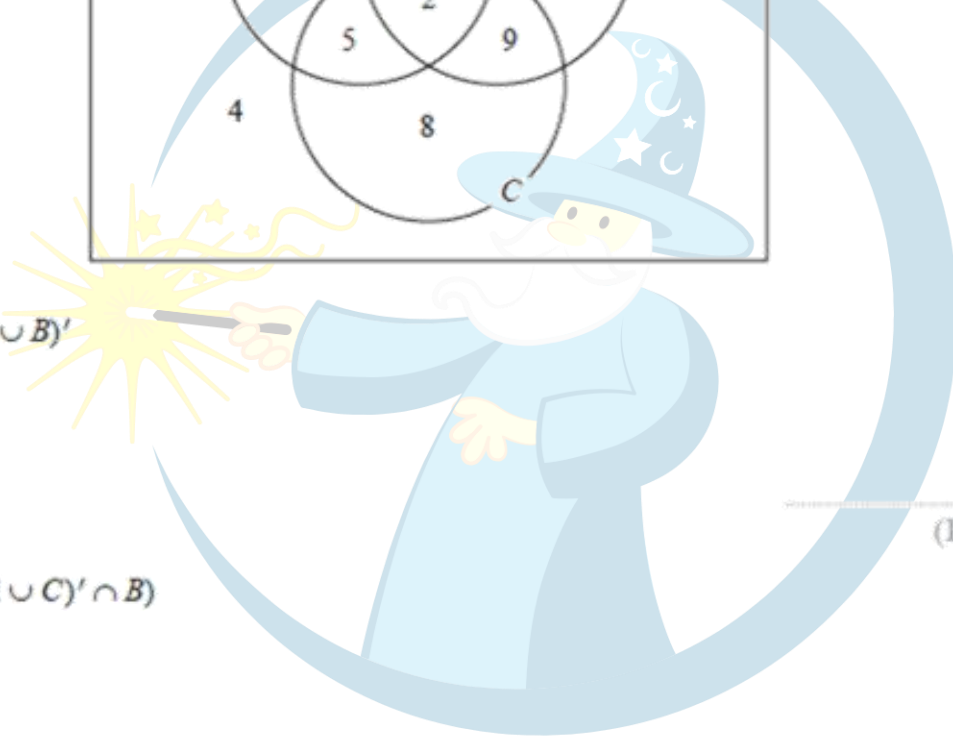
(1)

(b) Find $n((A \cup C)' \cap B)$

(1)

(c) On the Venn diagram, shade the region that represents the set $(A \cup B) \cap C$

(1)

(Total for Question 21 is 3 marks)

4. June 2017 (3H) Q18

A and *B* are two sets.

$$n(\mathscr{E}) = 50$$
$$n(A \cap B) = 4$$
$$n(A) = 5$$
$$n(B) = 9$$

(a) Complete the Venn diagram to show the numbers of elements.
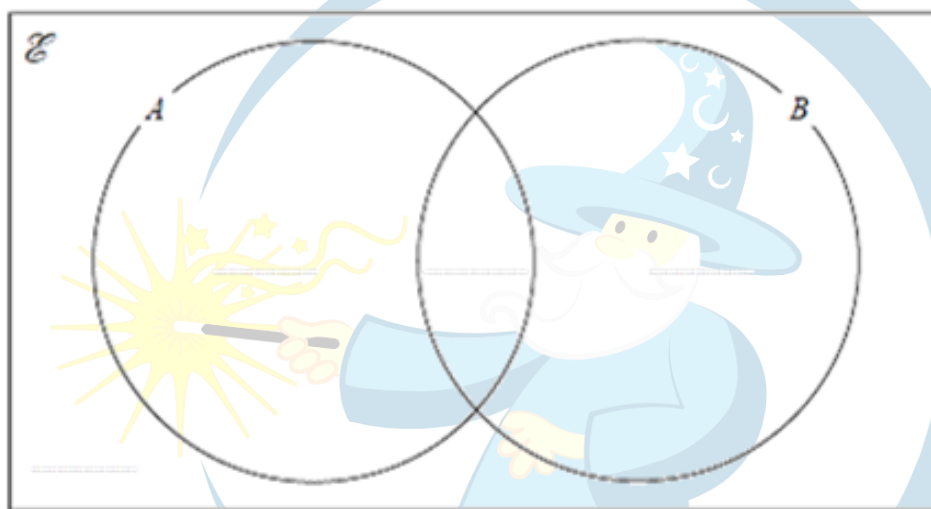
(2)

(b) Find

(i) $n(A \cap B')$

....

(ii) $n(A \cup B')$

....

(2)

(Total for Question 18 is 4 marks)

5. June 2018 (1H) Q4

Here is a Venn diagram.

(a) Write down the numbers that are in the set

(i) A

....

(ii) $B \cup C$

....

(2)

Brian writes down the statement $A \cap C = \emptyset$

(b) Is Brian's statement correct?
You must give a reason for your answer.

....

....

(1)

One of the numbers in the Venn diagram is picked at random.

(c) Find the probability that this number is in set C'

....

(2)

6. June 2018 (2HR) Q15

The Venn diagram shows a universal set, $\mathscr{E}$, and sets A, B and C.
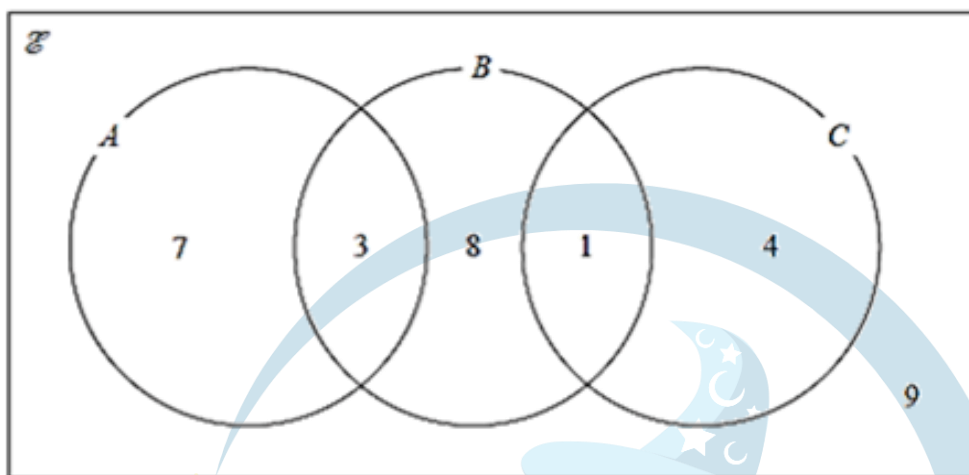
7, 3, 8, 1, 4 and 9 represent the numbers of elements.

Find

(i) $n(A \cup B)$

(ii) $n(A' \cap C)$

(iii) $n(A' \cup B')$

(Total for Question 15 is 3 marks)

7.   June 2018 (4H) Q17

The incomplete Venn diagram shows a universal set $\mathcal{E}$ and 3 sets A, B and C
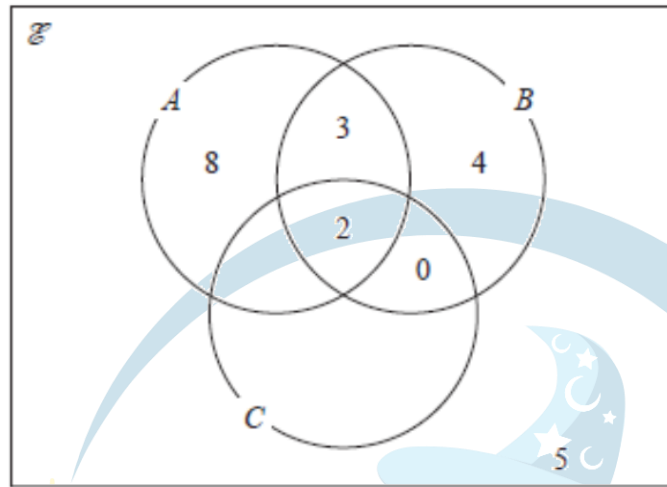
The numbers shown represent **numbers** of elements.

$n(A \cap C) = 9$

$n(A') = 15$

(a) Complete the Venn diagram.

(2)

(b) Find,

(i) $n(A \cup [B \cap C'])$

(ii) $n([A \cup B'] \cap [A \cup C])$

(2)

(Total for Question 17 is 4 marks)

8. Jan 2019 (1H) Q13

All the students in Year 11 at a school must study at least one of Geography (*G*), History (*H*) and Religious Studies (*R*).

In Year 11 there are 65 students.

Of these students

        15 study Geography, History and Religious Studies
        21 study Geography and History
        16 study Geography and Religious Studies
        30 study Geography
        18 study only Religious Studies
        37 study Religious Studies

(a) Using this information, complete the Venn diagram to show the number of students in each region of the Venn diagram.
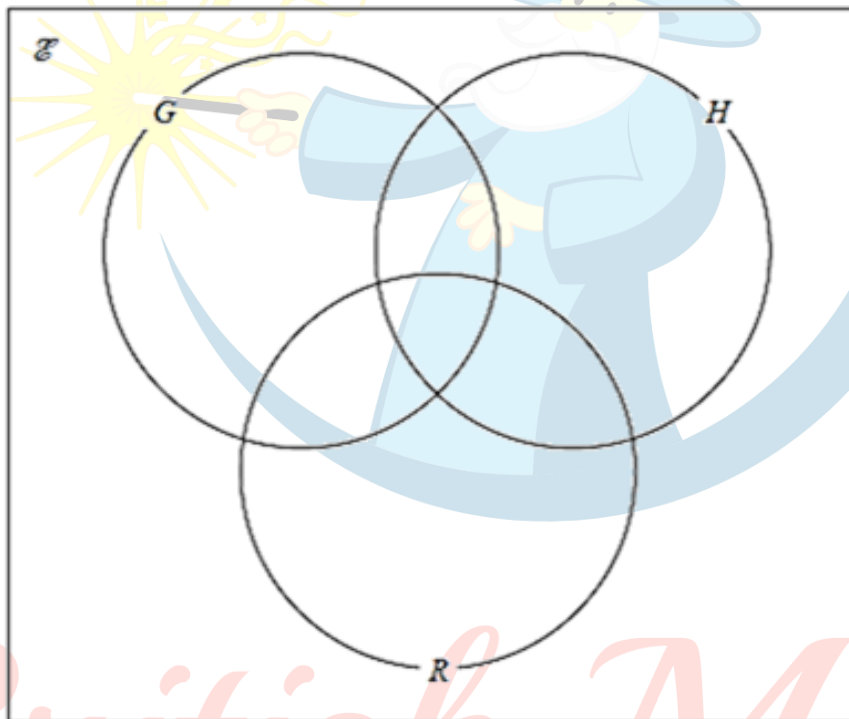
(3)

A student in Year 11 who studies both History and Religious Studies is chosen at random.

(b) Work out the probability that this student does not study Geography.

(2)

(Total for Question 13 is 5 marks)

9. Jan 2019 (2H) Q4

$\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
$A = \{\text{odd numbers}\}$
$A \cap B = \{1, 3\}$
$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 9, 11, 12\}$

Draw a Venn diagram to show this information.
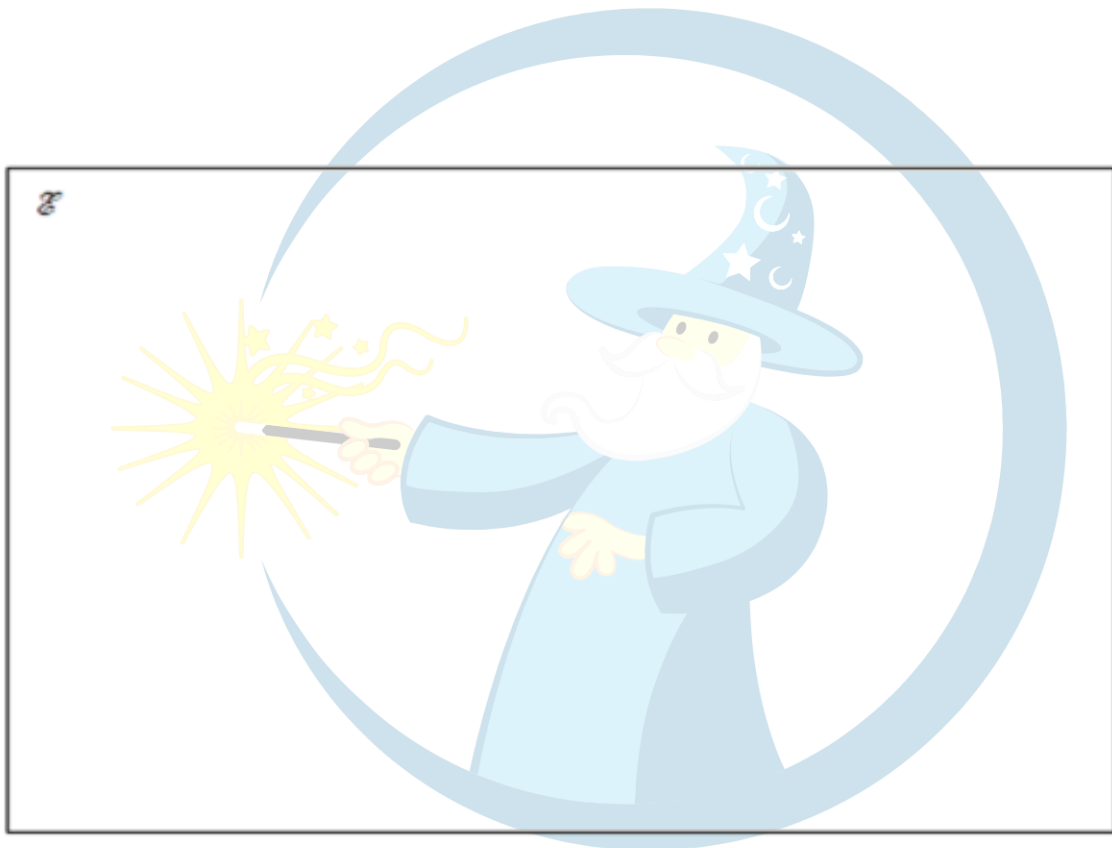
(Total for Question 4 is 4 marks)

10. Jan 2019 (2HR) Q16

120 people who visited a sports centre were asked if they went swimming (*S*), played basketball (*B*) or used the gym (*G*).

Their answers showed that

    28 people went swimming
    16 people played basketball
    27 people used the gym
     3 people went swimming and played basketball
     5 people played basketball and used the gym
     7 people went swimming and used the gym
     2 people went swimming, played basketball and used the gym

(a) Using this information, complete the Venn diagram to show the number of people in each region of the Venn diagram.

(3)
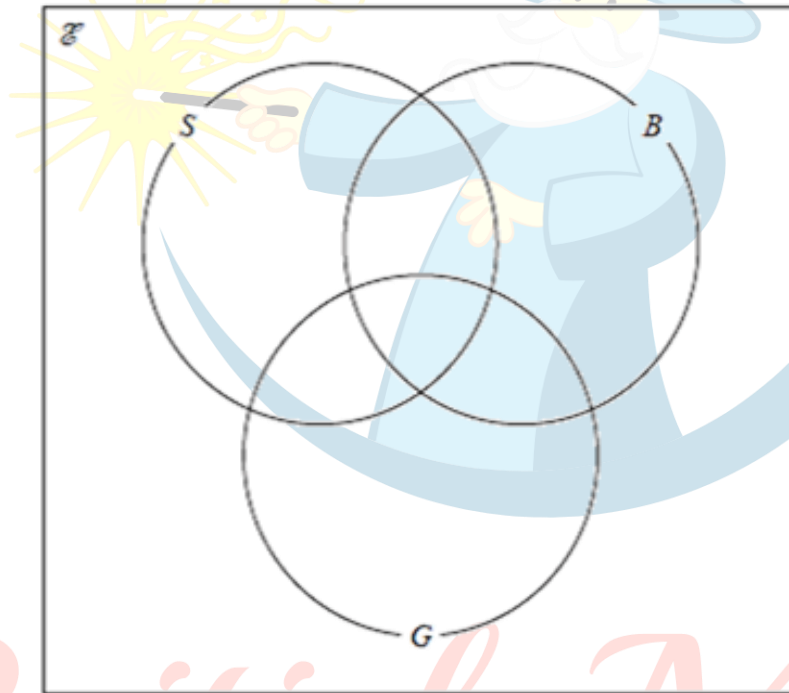
One of the people who went swimming is chosen at random.

(b) Find the probability that this person also played basketball.

(1)

(Total for Question 16 is 4 marks)

ALGEBRA

Indices

1. May 2019 (1H) Q3

(a) Simplify $e^9 \div e^5$

.... (1)

(b) Simplify $(y^2)^8$

.... (1)

2. May 2019 (1HR) Q9

(a) Simplify $t^9 \div t^3$

.... (1)

(b) Simplify $w^5 \times w^7$

.... (1)

(c) Simplify $(5xy^2)^3$

.... (2)

(Total for Question 9 is 4 marks)

3. June 2019 (2HR) Q14

   (a) Simplify fully $(x^{12}y^8)^{\frac{3}{4}}$

   (2)

4. Jan 2019 (1HR) Q15

   (a) Simplify $(3x^2y^5)^4$

   (2)

5. May 2018 (1H) Q3

   (a) Simplify $y^5 \times y^9$

   (1)

   (b) Simplify $(2m^3)^4$

   (2)

6. May 2018 (1H) Q15

(a) Simplify fully $\left(\dfrac{256x^{20}}{y^8}\right)^{-\frac{1}{4}}$

(2)

7. May 2018 (1HR) Q14

(a) Simplify $(2e^2 f^3)^3$

(2)

8. May 2006 (3H) Q13

a. Simplify $(2p^4)^3$

(2 marks)

b. Simplify $(64p^6)^{\frac{2}{3}}$

(2 marks)

9. May 2004 (4H) Q9

    a. Simplify $n \times n \times n \times n$

(**1 mark**)

    b. Simplify $p^2 \times p^5$

(**1 mark**)

    c. Simplify $\dfrac{p^7}{p^3}$

(**1 mark**)

    d. Simplify $\dfrac{p^4 \times p^7}{p^8}$

(**1 mark**)

10. Jan 2019 (2H) Q12

    (a) Simplify n^0

(1)

    (b) Simplify $(3x^2y^5)^3$

(2)

11. Nov 2007 (3H) Q9

    (b) Simplify $\dfrac{w^7 \times w^3}{w^2}$

(**2 marks**)

12. May 2005 (4H) Q4

    a. Simplify

    (i) $p \times p \times p \times p$

    (ii) $2a + 3b - 5a + b - 7$

    (iii) $\dfrac{x^3 \times x^5}{x^2}$

    (4 marks)

13. Jan 2019 (2HR) Q8

(a) Simplify fully $\dfrac{15k^4 m^3}{5km^2}$

    (2)

14. Jan 2019 (2HR) Q10

(a) Simplify fully $(16x^8 y^6)^{\frac{1}{2}}$

    (2)

15. Nov 2009 (4H) Q12

   a. Simplify $4x^3y^5 \times 3x^2y$

                                                 (2 marks)

   b. Simplify $(27q^6)^{\frac{2}{3}}$

                                                 (2 marks)

16. Jan 2018 (3HR) Q1

   (b) Simplify $t^3 \times t^7$

                                                 (1)

   (c) Simplify $(m^4)^3$

                                                 (1)

17. June 2016 (3H) Q7

   (d) Simplify fully $\quad \dfrac{28x^5y^3}{4xy^2}$

18. Jan 2017 (3HR) Q11

   (c) Simplify $\left(\dfrac{y^5}{8x^6y^8}\right)^{-\frac{1}{3}}$

                                                 [3 marks]

19. June 2017 (3H) Q14

(a) Simplify $\left(\sqrt{x}\right)^8$

[1 mark]

20. June 2018 (1H) Q3

3 (a) Simplify $y^5 \times y^9$

.... (1)

(b) Simplify $(2m^3)^4$

.... (2)

21. June 2018 (4H) Q7

7 (a) Expand $x(2x + 5)$

.... (1)

(b) Simplify

(i) $y^5 \times y^3$

(ii) $\dfrac{k^8}{k}$

(iii) $(t^3)^4$

.... (3)

22. June 2018 (2H) Q10

$$\frac{8}{2^7} = 2^n$$

(a) Find the value of n.

$n =$ ....

(2)

$(13^{-6})^4 \times 13^5 = 13^k$

(b) Find the value of k.

$k =$ ....

(2)

(Total for Question 10 is 4 marks)

23. Jan 2019 (1H) Q16

(b) Given that $\left(\sqrt{\dfrac{y}{x}}\right)^{-5} = \dfrac{x^m}{y^m}$ where $x \neq y$

find the value of m.

24. June 2016 (4H) Q15

(b) Simplify $(8a^9e^6)^{\frac{1}{3}}$

25. Jan 2017 (4HR) Q20

$$p^m = \frac{1}{p \times \sqrt[3]{p^2}}$$

(b) Find the value of m.

26. June 2017 (3HR) Q9

(a) Simplify $2e^2f \times 5e^3f$

27. Jan 2012 (4H) Q21

   a. Simplify $(16y^8)^{\frac{3}{4}}$

                                                 (**2 marks**)

   b. Given that $2^p \times 8^q = 2^n$
       Express **n** in terms of **p** and **q**

                                                 (**2 marks**)

28. June 2018 (1H) Q15

   (a) Simplify fully $\left(\dfrac{256x^{20}}{y^8}\right)^{-\frac{1}{4}}$
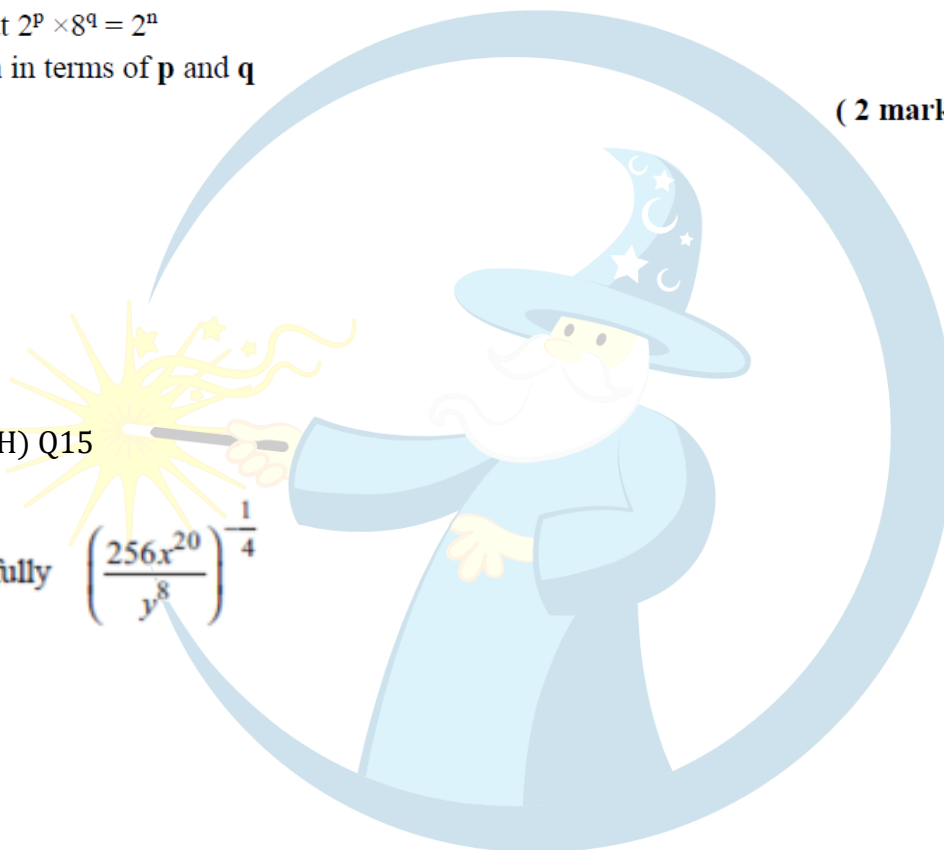
                                                 (2)

29. June 2018 (2HR) Q7

   (a) Simplify fully $\dfrac{20x^2y^6}{4x^2y^2}$

30. Jan 2012 (4H) Q8

$$\frac{y^3 \times y^n}{y} = y^6$$

Find the value of n.

(2 marks)

31. June 2012 (3H) Q17

   a. Simplify $(3a^2b)^4$

(2 marks)

   b. Simplify $(9c^8)^{\frac{1}{2}}$

(2 marks)
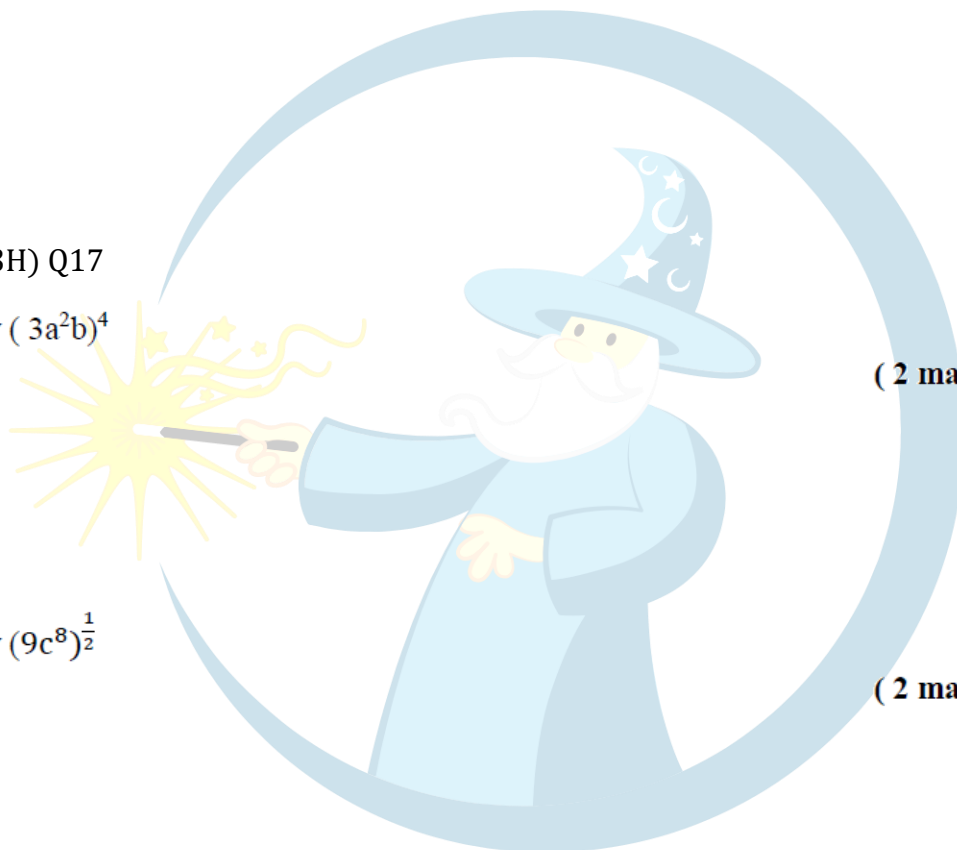
32. Jan 2018 (4HR) Q11

(a) Simplify $2a^3b^4 \times 4a^2b^5$

.... (2)

$c^k = \dfrac{1}{\sqrt[4]{c^2}}$

(b) Work out the value of k

.... (2)

(c) Simplify fully $\dfrac{4(x+2)^2}{6(x+2)}$

.... (2)

(d) Factorise completely $3x^2 - 75y^2$

.... (2)

(Total for Question 11 is 8 marks)

33. Jan 2019 (2HR) Q14

(a) Given that $a = 3^x$ and $b = 3^y$

    express in terms of a or b or a and b,

      (i) 3^{2x}

      (ii) 3^{x+y}

      (iii) 3^{y-1}

(3)

$a = 3^x$ and $b = 3^y$

$ab = 2187$

$a^2b = 177\,147$

(b) Work out the value of x and the value of y.
    Show your working clearly.

$x =$

$y =$

(3)

(Total for Question 14 is 6 marks)

34. June 2016 (4H) Q5

(a) Simplify $m^5 \times m^2$

(1)

(b) Simplify $c^{11} \div c^3$

(1)

(c) Simplify $(a^5)^3$

(1)

(d) Expand and simplify $4(2x + 3) + 2(x + 5)$

(2)

(Total for Question 5 is 5 marks)

35. Jan 2017 (4HR) Q7

(d) Simplify $\dfrac{w^5 \times w^8}{w^4}$

36. May 2004 (4H) Q19

    (b) Simplify $(2x^2\,y^4)^3$

                                                    (2 marks)

    (c) Simplify $(a^4\,b^{-3})^{-2}$

                                                    (2 marks)

    (d) Simplify $(27p^6)^{\frac{1}{3}}$

                                                    (2 marks)

37. May 2006 (3H) Q4

    a. Work out the value of $y^2 - 4y$ when $y = -3$

                                                    (2 marks)

    b. Simplify

  (i) $p^3 \times p^5$

  (ii) $q^7 \div q$

                                                    (2 marks)

38. June 2017 (4H) Q10

(a) Simplify $e^8 \times e^7$

....

(1)

(b) Simplify fully $\dfrac{12g^{10}}{3g^2}$

....

(2)

(c) Write down the value of m^0

....

(1)

(d) Simplify fully $(27x^6)^{\frac{2}{3}}$

....

(2)

(Total for Question 10 is 6 marks)

39. June 2018 (1HR) Q14

(a) Simplify $(2e^2 f^3)^3$

(2)

$\dfrac{\sqrt{a} \times a}{a^{-2}}$ can be written in the form a^k

(c) Find the value of k.

$k = $ _____

(2)

40. May 2009 (4H) Q15

a. Simplify $3c^5 d \times c^2 d^4$

(2 marks)

b. Simplify $(2x^3 y)^4$

(2 marks)

41. Jan 2018 (4H) Q20

(a) Simplify fully $\left(\dfrac{125e^{12}}{27f^3}\right)^{-\frac{2}{3}}$

(3)

(b) Given that $2^{\frac{1}{2}} \times 2^{\frac{n}{3}} = \dfrac{8^x}{4^n}$

express x in terms of n.

(4)

(Total for Question 20 is 7 marks)

42. Jan 2019 (2H) Q12

(a) Simplify n^0

(1)

(b) Simplify $(3x^2y^5)^3$

(2)
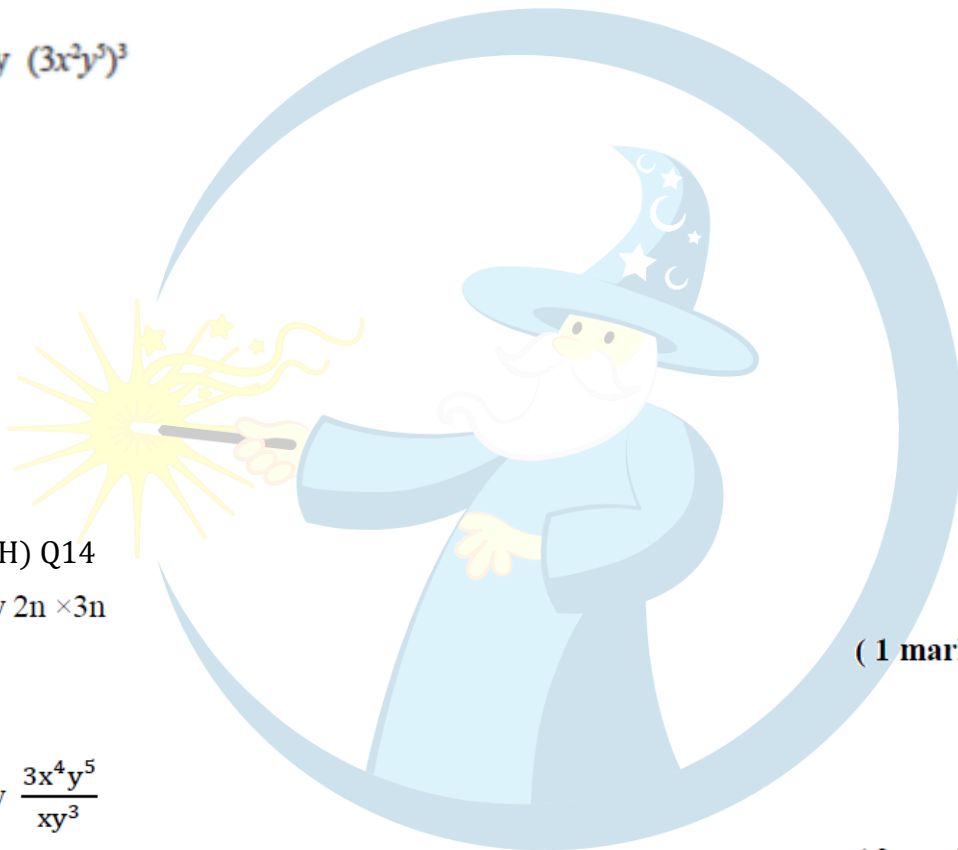
43. Nov 2007 (4H) Q14

   a. Simplify $2n \times 3n$

(1 mark)

   b. Simplify $\dfrac{3x^4y^5}{xy^3}$

(2 marks)

   c. Simplify $(t^3)^4$

(1 mark)

   d. Simplify $(2p^{-2})^{-3}$

(2 marks)

44. June 2016 (3HR) Q21

Solve $3 \times 4^{2k+8} = 24$
Show your working clearly.

45. Jan 2017 (4H) Q16

$$\frac{1}{\sqrt[3]{9^4}} = 3^n$$

(d) Work out the exact value of n.

46. June 2018 (4HR) Q22

$$\frac{5^{n^2}}{5^6} \times \frac{5^{n^2-5n}}{5^3} = 125 \text{ where } n > 0$$

Work out the value of n.
Show clear algebraic working.

47. June 2018 (2HR) Q14

$128 = 4^{2x} \times 2^x$

Work out the value of x.

48. June 2018 (4H) Q20

Given that $\dfrac{12 \times \left(\sqrt{8}\right)^{2y+2}}{6 \times 4^{2y+1}}$ can be written in the form 2^p,

find an expression for p in terms of y.

$p = \underline{\hspace{4cm}}$

(Total for Question 20 is 3 marks)

Expanding, simplifying, and factorising

1. May 2019 (1H) Q3

   (d) Factorise fully $16c^4p^2 + 20cp^3$

   ....

   (2)

2. May 2019 (1H) Q12

   (a) Factorise $2x^2 - 7x + 6$

   ....

   (2)

3. June 2019 (2HR) Q5

   Factorise $x^2 - 5x - 36$

   ....

   (Total for Question 5 is 2 marks)

4. May 2018 (1H) Q3

(d) (i) Factorise $x^2 + 2x - 24$

(2)

(ii) Hence, solve $x^2 + 2x - 24 = 0$

(1)

5. June 2018 (2H) Q1

(c) Factorise fully $18e^2f^3 - 12e^3f$

(2)

6. Jan 2019 (1H) Q1

(a) Factorise fully $4p + 6pq$

(2)

7. Jan 2019 (1HR) Q15

(c) Factorise $4c^2 - 9d^2$

(1)

8. Jan 2019 (2H) Q12

(c) Factorise fully $2e^2 - 18$

(2)

9. Jan 2018 (3H) Q21

Factorise completely $(10a - b)^2 - (2a - 5b)^2$
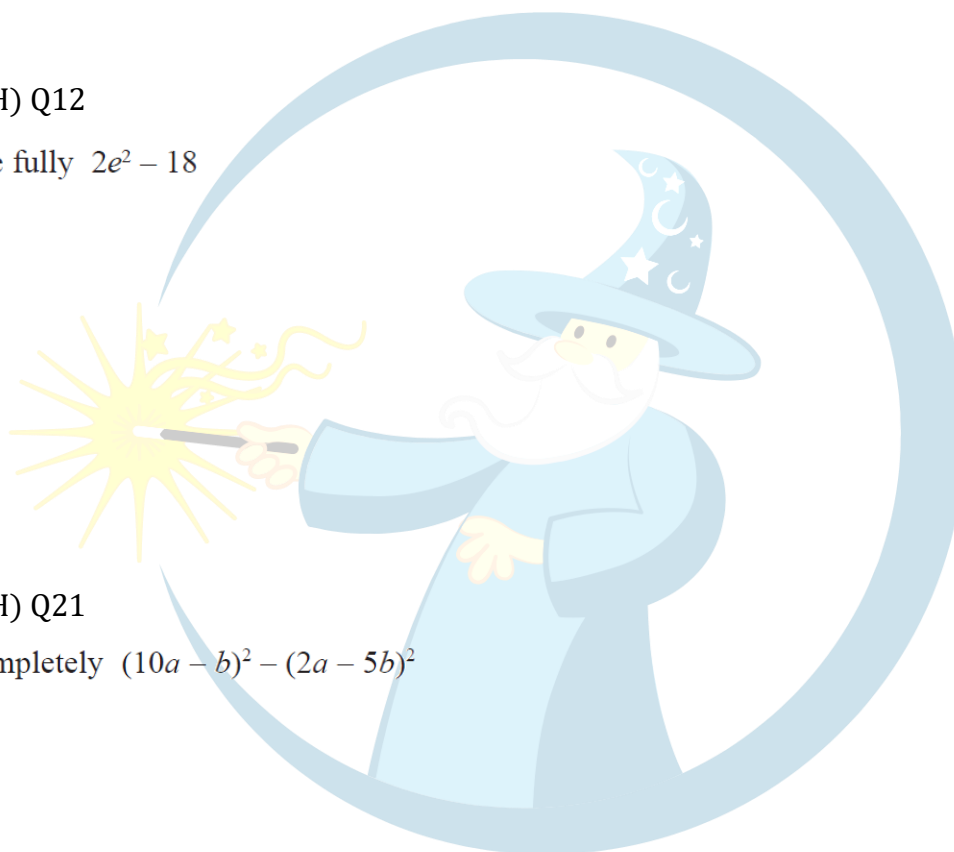
(Total for Question 21 is 3 marks)

10. June 2016 (3H) Q7

(a) Factorise $3y^2 + 2y$

.... (1)

(b) Expand and simplify $(x - 9)(x + 2)$

.... (2)

11. June 2016 (4HR) Q14

(b) Factorise $3x^2 - 8x - 3$

(c) Expand and simplify $4x(x + 3) - (2x - 3)^2$

12. Jan 2017 (3H) Q5

5　(a) Factorise $7h + h^2$

....

(1)

(b) Expand and simplify $4(p + 5) + 7(p - 2)$

....

(2)

$D = 7c^2 + f$

(c) Work out the value of D when $c = -2$ and $f = 5$

$D =$ ....

(2)

13. June 2017 (3HR) Q9

(b) Factorise $x^2 - 5x - 6$

14. June 2018 (1H) Q11

(a) Expand and simplify $(2x - 1)(x + 3)(x - 5)$

(3)

15. Jan 2018 (3H) Q21

Factorise completely $(10a - b)^2 - (2a - 5b)^2$
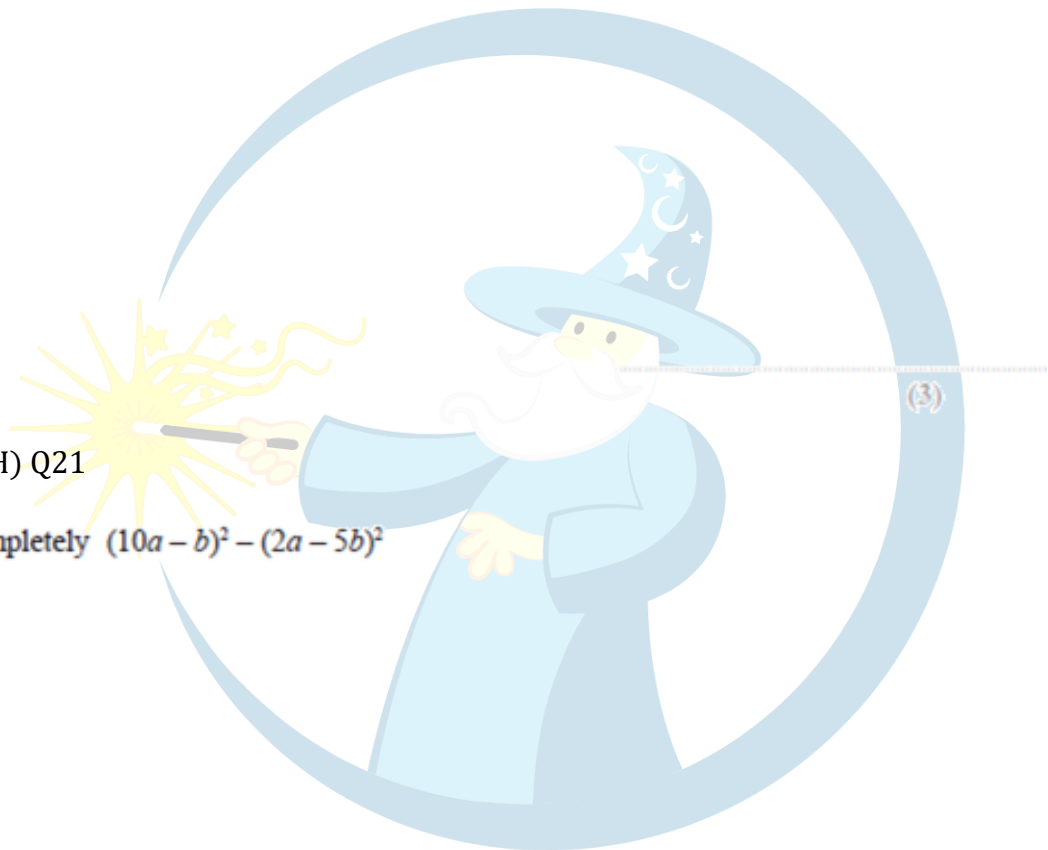
(Total for Question 21 is 3 marks)

16. Jan 2018 (4H) Q10

(a) Factorise $25m + 30n$

.... (1)

(b) Expand $p(2p - 3)$

.... (1)

(c) Simplify fully $\dfrac{y^6 \times y^8}{y^4}$

.... (2)

(d) Expand and simplify $(x + 7)(x - 3)$

.... (2)

(e) Factorise fully $36p^3m^2 + 27p^5m$

.... (2)
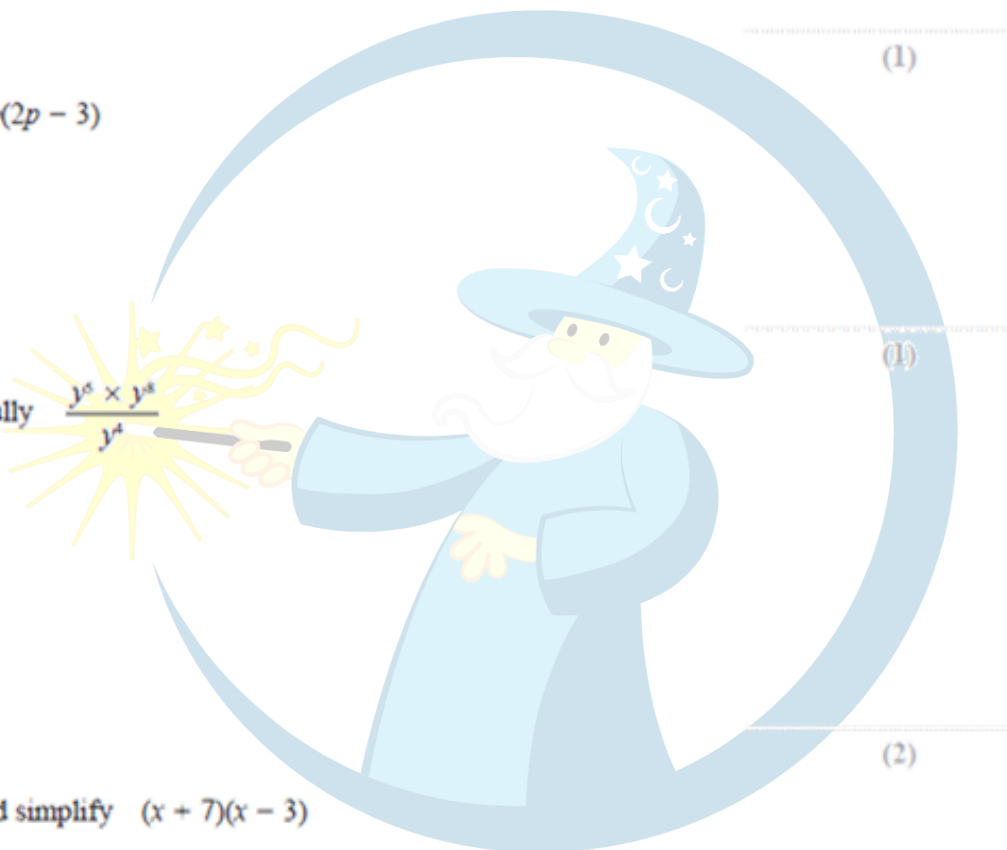
(Total for Question 10 is 8 marks)

17. June 2016 (3HR) Q2

(a) Factorise fully $2x^2 - 4x$

(2)

$A = 2p + 3q$

(b) Work out the value of p when $A = 32$ and $q = 7$

$p = $ ....

(3)
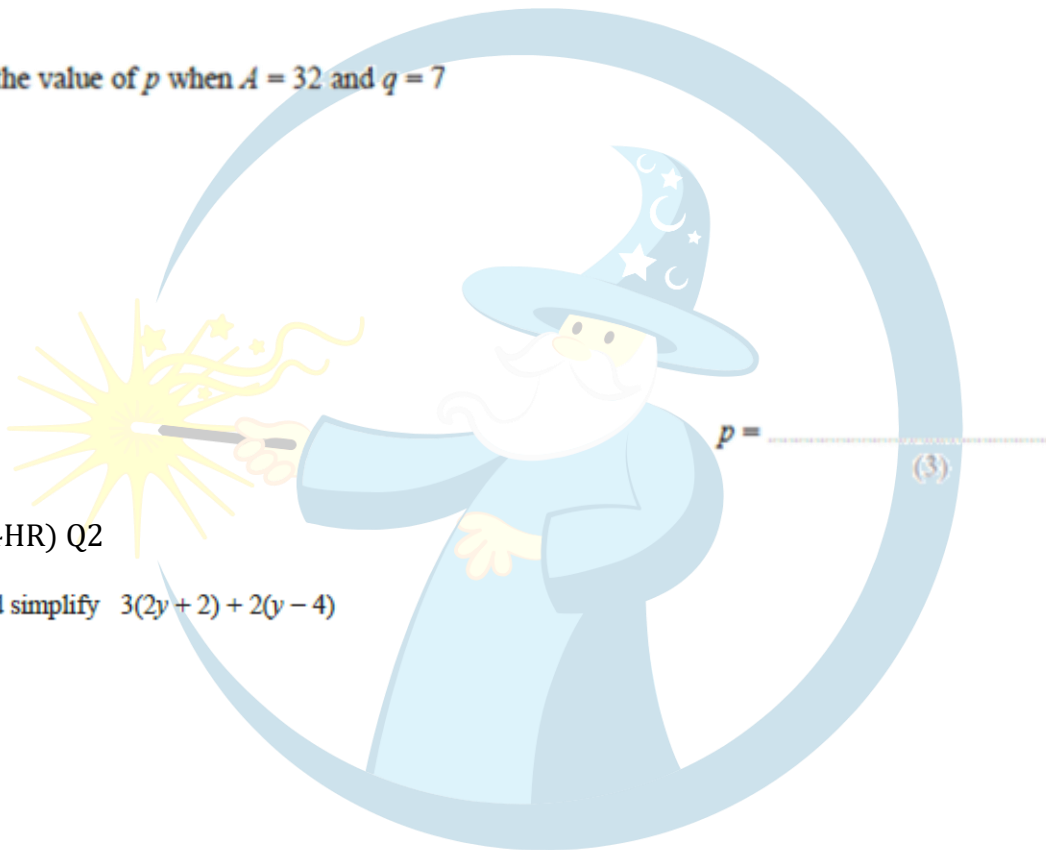
18. June 2016 (4HR) Q2

(b) Expand and simplify $3(2y + 2) + 2(y - 4)$

(c) Simplify fully $4wxy \div (8xy)$

19. Jan 2017 (3HR) Q11

(b) Expand and simplify $(k + 9)(k - 5)$

20. June 2017 (3H) Q1

(a) Factorise $10a + 25$

.... (1)

(b) Factorise $7w^2 - 4w$

.... (1)

(c) Expand $p^2(p - 5)$

.... (2)

(d) Expand and simplify $(x - 3)(x + 7)$

.... (2)

$G = f^3 - 7f$

(e) Work out the value of G when $f = 2$

$G = $ .... (2)

(Total for Question 1 is 8 marks)

21. June 2017 (4HR) Q5

(a) Expand $4(3 - 7c)$

....
(1)

(b) Factorise $y^2 + 8y$

....
(1)

(c) Expand and simplify $(x + 7)(x - 3)$

....
(2)

(d) Solve $5p - 9 = 3p$

$p =$ ....
(2)

(e) Simplify $y^7 \times y^4$

....
(1)

(f) Simplify $h^{12} \div h^4$

....
(1)

(g) Simplify $(e^5)^3$

....
(1)
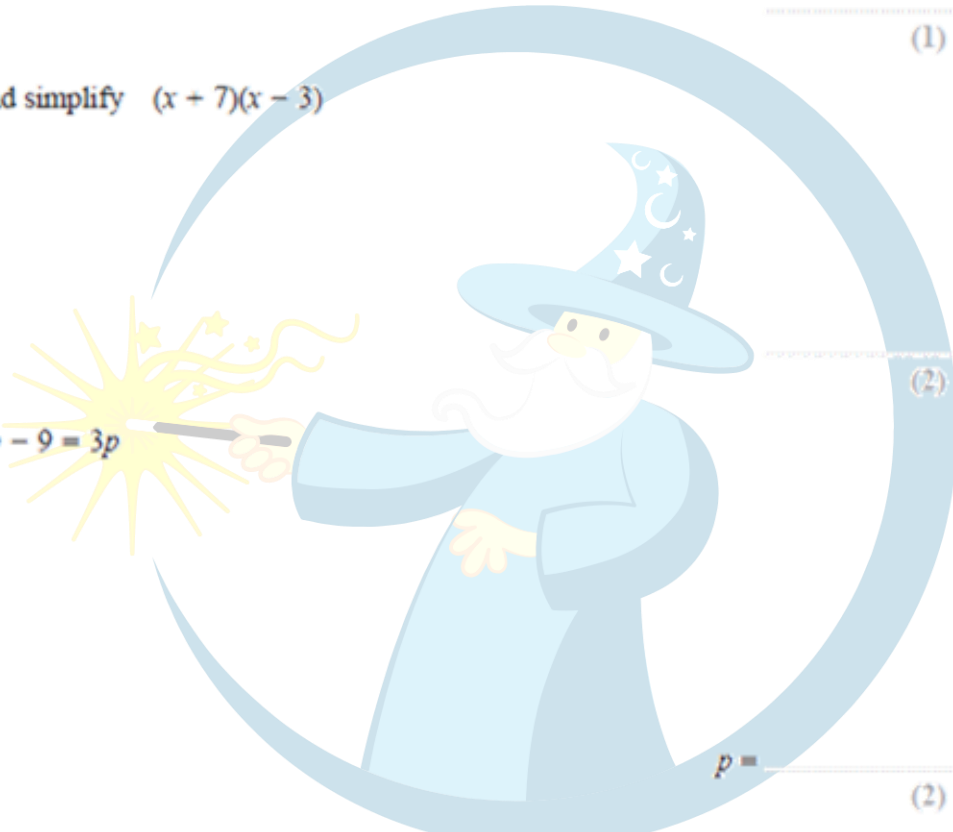
(Total for Question 5 is 9 marks)

22. June 2018 (2HR) Q4

(a) Expand and simplify $3(c - 7) + 2(3c + 4)$

(2)

(b) Expand and simplify $(x + 7)(x - 2)$

(2)

(c) Factorise fully $28y^2 - 21y$

(2)

23. Jan 2018 (4HR) Q7

(a) Factorise $4ab + 7a^2 - a$

(2)

(b) Solve the inequality $4 - 8p > 11$

(2)

(c) Expand and simplify $(x + 3)(x - 6)$

(2)

(d) Simplify $\dfrac{y^{12}}{y^4}$

(1)

(e) Simplify $(3e)^2$

(2)

(Total for Question 7 is 9 marks)

24. June 2018 (3H) Q6

(a) Factorise $m^2 + 7m$

....

(1)

(b) Solve $7(x + 3) = 5x - 4$
Show clear algebraic working.

$x = $ ....

(3)

(c) Expand and simplify $(y + 9)(y - 4)$

....

(2)

(d) Simplify $(4e^3f^2)^3$

....

(2)

(Total for Question 6 is 8 marks)

25. June 2016 (3HR) Q12

(a) Simplify fully $\dfrac{a^{11}}{a^2 \times a^5}$

(2)

(b) Make p the subject of $p + 4q = 3p + 5$

(2)

(c) Expand and simplify $(2y + 3)(4y - 1)$

(2)

(d) Simplify $(8a^6b^3)^{\frac{1}{3}}$

(2)

(Total for Question 12 is 8 marks)

26. Jan 2017 (3H) Q9

Simplify $(2x + 3)^2 - (2x + 3)(x - 5)$

Give your answer in the form $ax^2 + bx + c$

27. Jan 2017 (4HR) Q7

7   (a) Expand $3(4p + 5)$

.... (1)

   (b) Factorise $6r + 14$

.... (1)

   (c) Work out the value of $y^2 - 3y$ when $y = -5$

.... (2)

28. June 2017 (3HR) Q20

$k = 2^p - 1$ where p is an integer > 1

$N = k^2 - 1$

Show that 2^{p+1} is a factor of N

29. June 2018 1HR Q14

(b) Expand and simplify $(3x - 4y)(x + 3y)$

(2)

(d) Simplify $\dfrac{2^n - 1}{4^n - 1}$

(2)
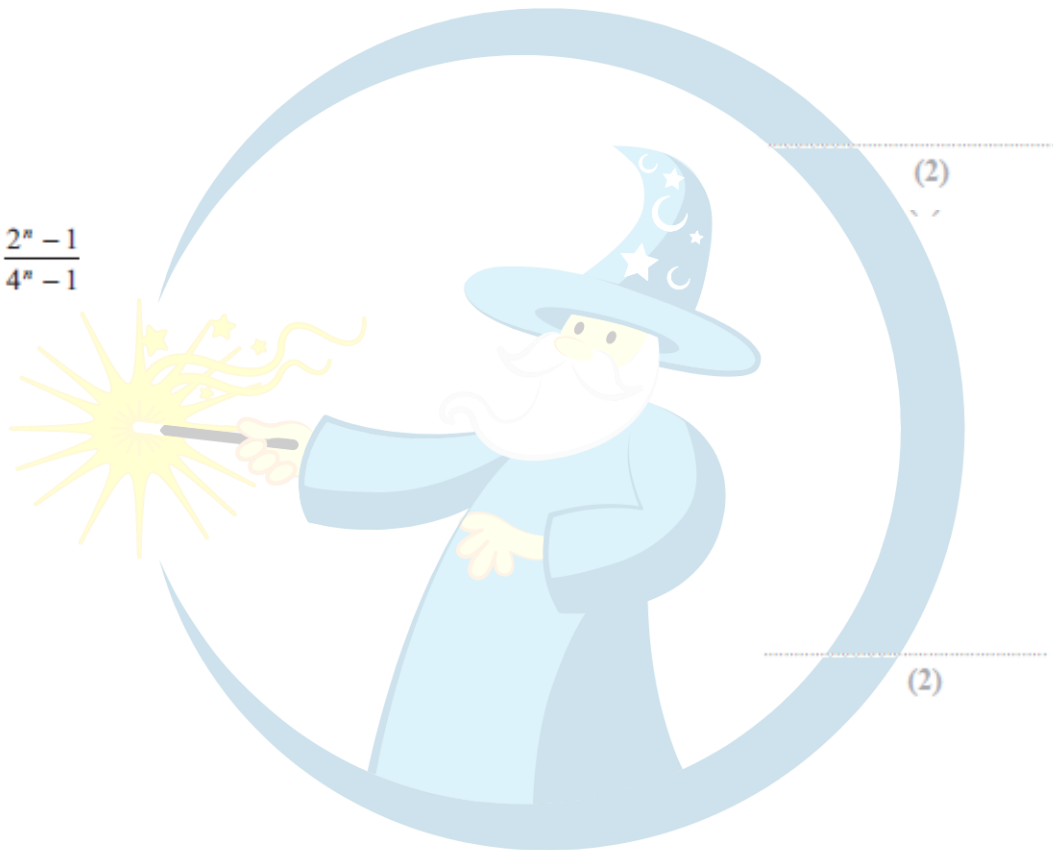
30. Jan 2018 (3H) Q3

$A = p^2 + 7q$

(a) Work out the value of A when $p = -7$ and $q = 5$

$A =$ ....

(2)

$A = p^2 + 7q$

(b) Work out the value of q for which $A = 100$ when $p = 11$

$q =$ ....

(3)
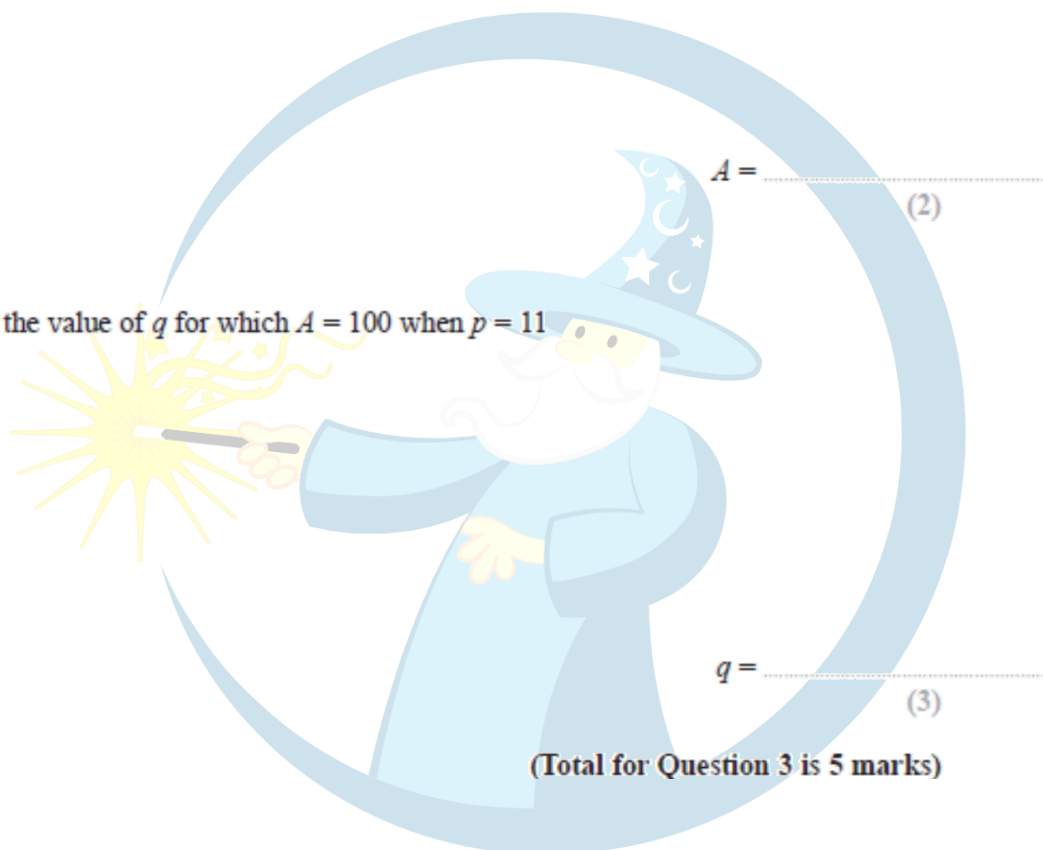
(Total for Question 3 is 5 marks)

31. Jan 2018 (3HR) Q1

(a) Expand and simplify

$$5(x + y) - 3x + 3y$$

(2)

(b) Simplify $t^3 \times t^7$

(1)

(c) Simplify $(m^4)^3$

(1)

(Total for Question 1 is 4 marks)

32. Jan 2018 (4HR) Q11

(d) Factorise completely $3x^2 - 75y^2$

(2)

33. May 2019 (1H) Q3

   (c) Expand and simplify $(x + 9)(x - 2)$

                                                    (2)

34. May 2019 (1HR) Q18

   (a) Expand and simplify $(x + 2)(2x + 3)(x - 7)$
       Show your working clearly.
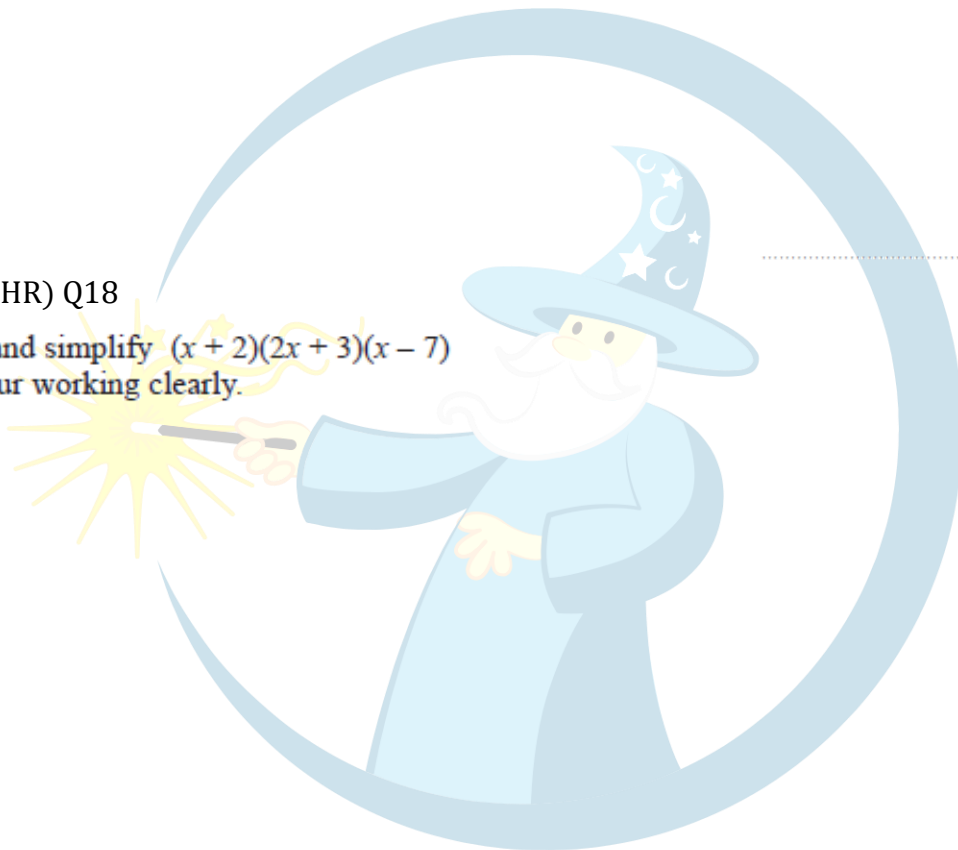
                                                    (3)

35. June 2019 (2H) Q22

Simplify fully $\dfrac{6x^3 + 13x^2 - 5x}{4x^2 - 25}$

....

(Total for Question 22 is 3 marks)

36. May 2018 (1H) Q3

(a) Simplify $y^5 \times y^9$

....

(1)

(b) Simplify $(2m^3)^4$

....

(2)

37. May 2018 (1H) Q11

(a) Expand and simplify $(2x - 1)(x + 3)(x - 5)$

(3)

38. May 2018 (1H) Q15

(a) Simplify fully $\left(\dfrac{256x^{20}}{y^8}\right)^{-\frac{1}{4}}$
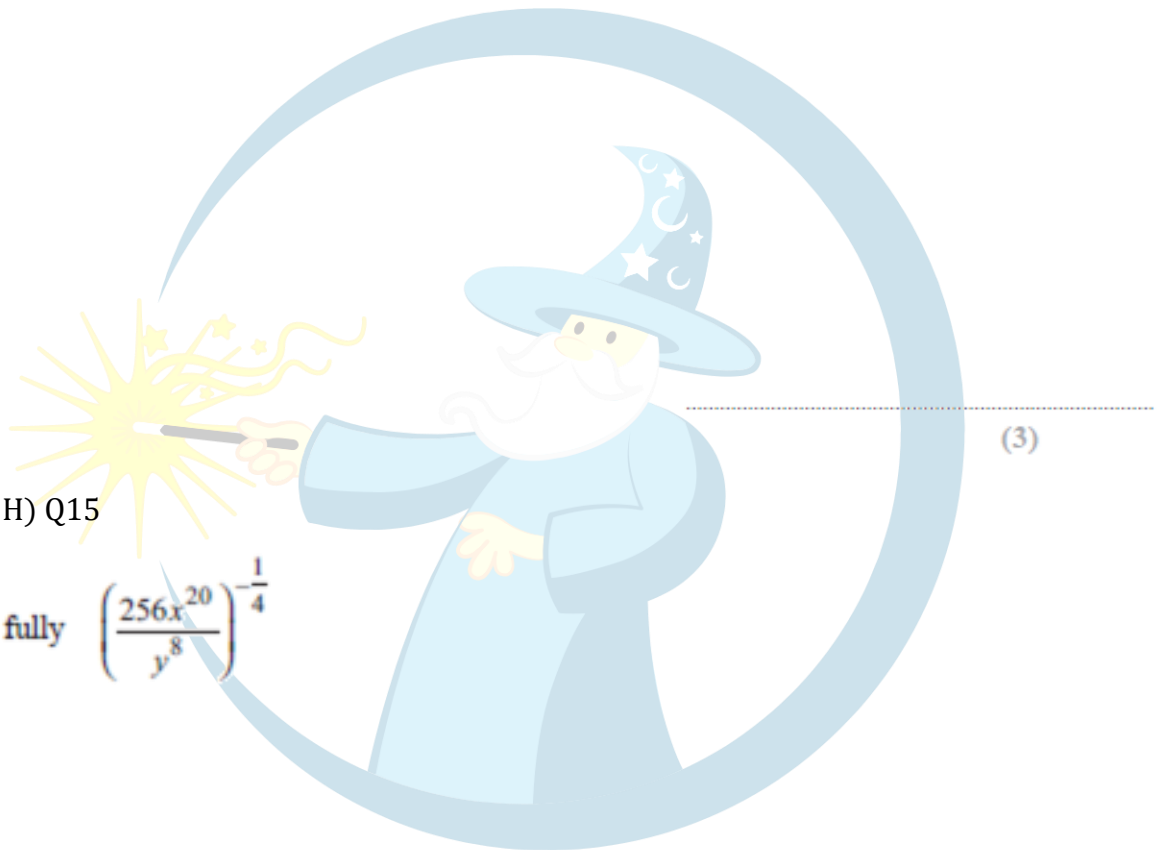
(2)

39. May 2018 (1HR) Q14

(a) Simplify $(2e^2 f^3)^3$

....

(2)

(b) Expand and simplify $(3x - 4y)(x + 3y)$

....
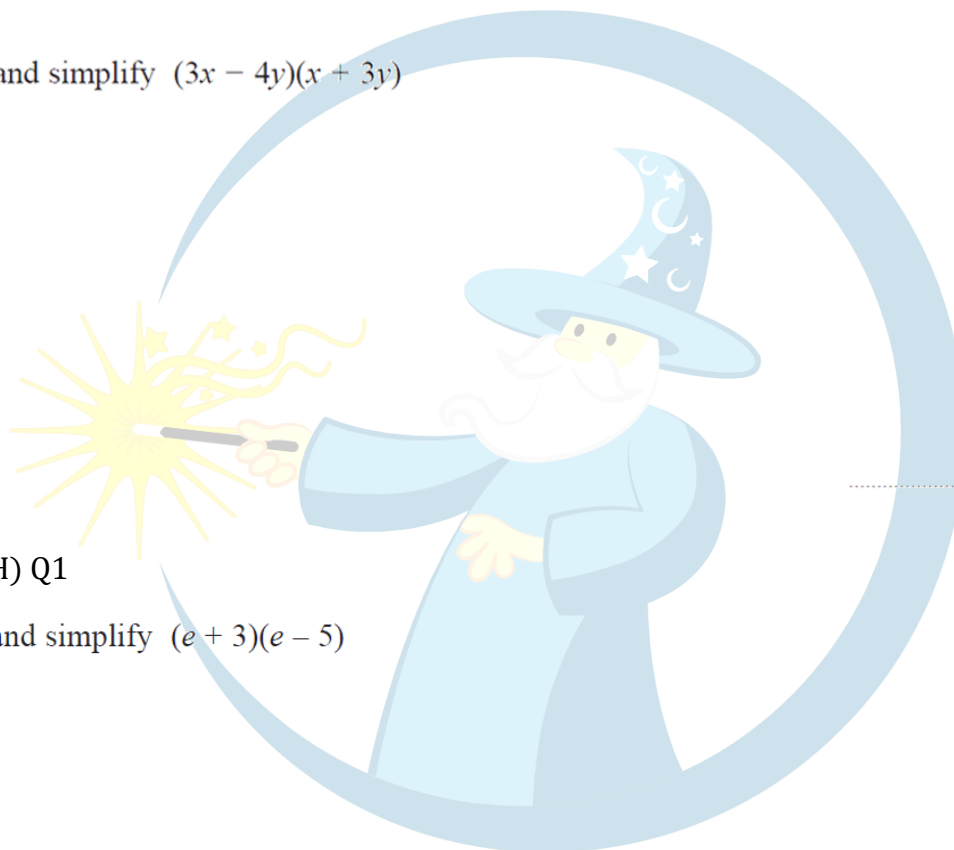
(2)

40. Jan 2019 (1H) Q1

(b) Expand and simplify $(e + 3)(e - 5)$

(2)

41. Jan 2019 (1HR) Q15

(b) Expand and simplify $4n(n-3)(n+5)$

(2)

(d) Simplify fully $\dfrac{x^2 - 7x + 12}{4x - x^2}$
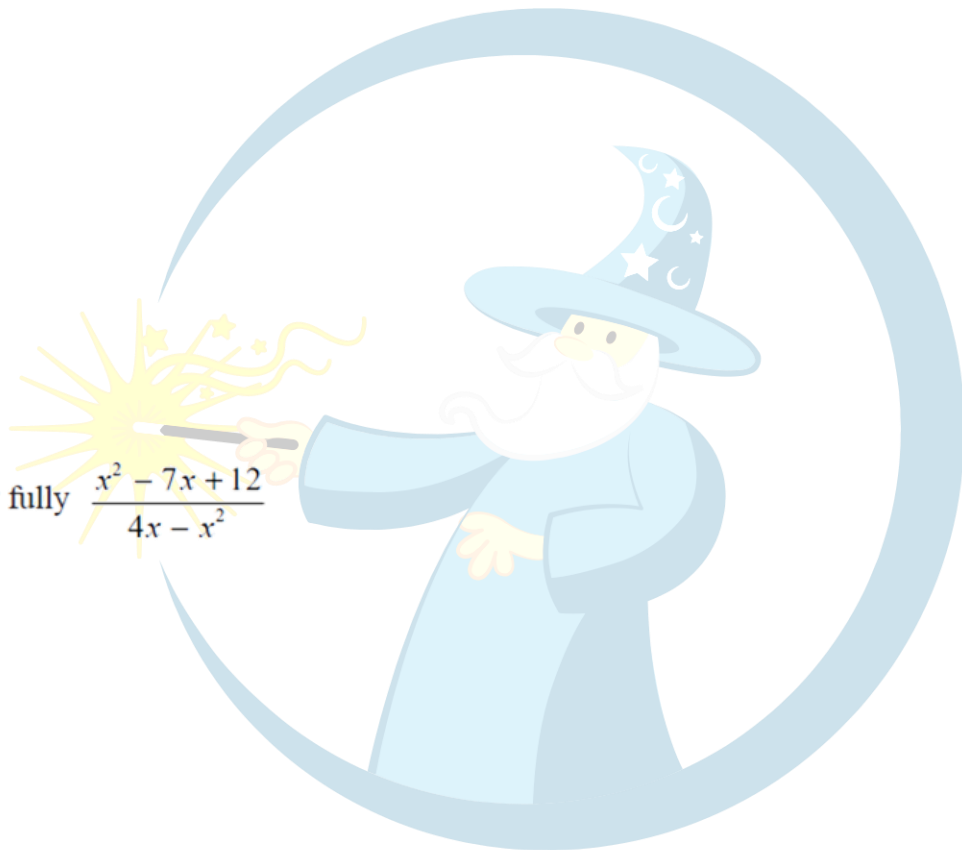
(3)

42. Jan 2019 (2H) Q12

(a) Simplify n^0

(1)

(b) Simplify $(3x^2y^5)^3$

(2)

43. Jan 2019 (2HR) Q8

(a) Simplify fully $\dfrac{15k^4m^3}{5km^2}$

(2)

44. Jan 2019 (2HR) Q10

(a) Simplify fully $(16x^8y^6)^{\frac{1}{2}}$

(2)

Fractions

1. June 2019 (2HR) Q2

Simplify fully $\dfrac{6x^3 + 13x^2 - 5x}{4x^2 - 25}$

....

(Total for Question 22 is 3 marks)

2. Jan 2019 (1H) Q11

(b) Express $\dfrac{1}{9x^2 - 25} - \dfrac{1}{6x + 10}$ as a single fraction in its simplest form.

(3)

3. June 2019 (2H) Q22

Simplify fully $\dfrac{6x^3 + 13x^2 - 5x}{4x^2 - 25}$

(Total for Question 22 is 3 marks)

4. Jan 2019 (1HR) Q15

(d) Simplify fully $\dfrac{x^2 - 7x + 12}{4x - x^2}$

(3)

5. Jan 2019 (2HR) Q10

(b) Solve $\dfrac{8-2x}{3} - \dfrac{2x-3}{2} = 4$

Show clear algebraic working.

x =

(3)

6. Jan 2018 (3H) Q12

Solve $\dfrac{x+4}{3} + \dfrac{2x+3}{4} = 7$

Show clear algebraic working.

$x = $ ....

(Total for Question 12 is 3 marks)

7. June 2018 (1HR) Q14

(d) Simplify $\dfrac{2^n - 1}{4^n - 1}$

....

(2)

8. June 2016 (3HR) Q20

(a) Simplify fully $\dfrac{50x^2 - 8}{10x - 4}$

Show clear algebraic working.

[3 marks]

9. June 2016 (4H) Q14

Simplify $\dfrac{x^2 - 25}{2x^2 - 9x - 5}$

[3 marks]

10. June 2018 (3H) Q15

(b) Simplify fully $\dfrac{9x^2 - 4}{3x^2 - 17x + 10}$

[3 marks]

11. June 2018 (3HR) Q22

Simplify fully $\dfrac{12x^2 - 3}{6x^2 + 5x - 4}$

[3 marks]

12. Jan 2019 (1HR) Q15

(d) Simplify fully $\dfrac{x^2 - 7x + 12}{4x - x^2}$

[3 marks]

13. June 2016 (4H) Q15

(a) Write $\dfrac{x+3}{5} + \dfrac{x-2}{3}$ as a single fraction in its simplest form.

[3 marks]

14. Jan 2017 (4HR) Q15

(c) Simplify fully $\dfrac{3}{x+1} - \dfrac{2}{x-1}$

[3 marks]

15. June 2017 (3H) Q22

Simplify fully $\dfrac{3}{2x+12} - \dfrac{x-15}{x^2-2x-48}$

Show clear algebraic working.
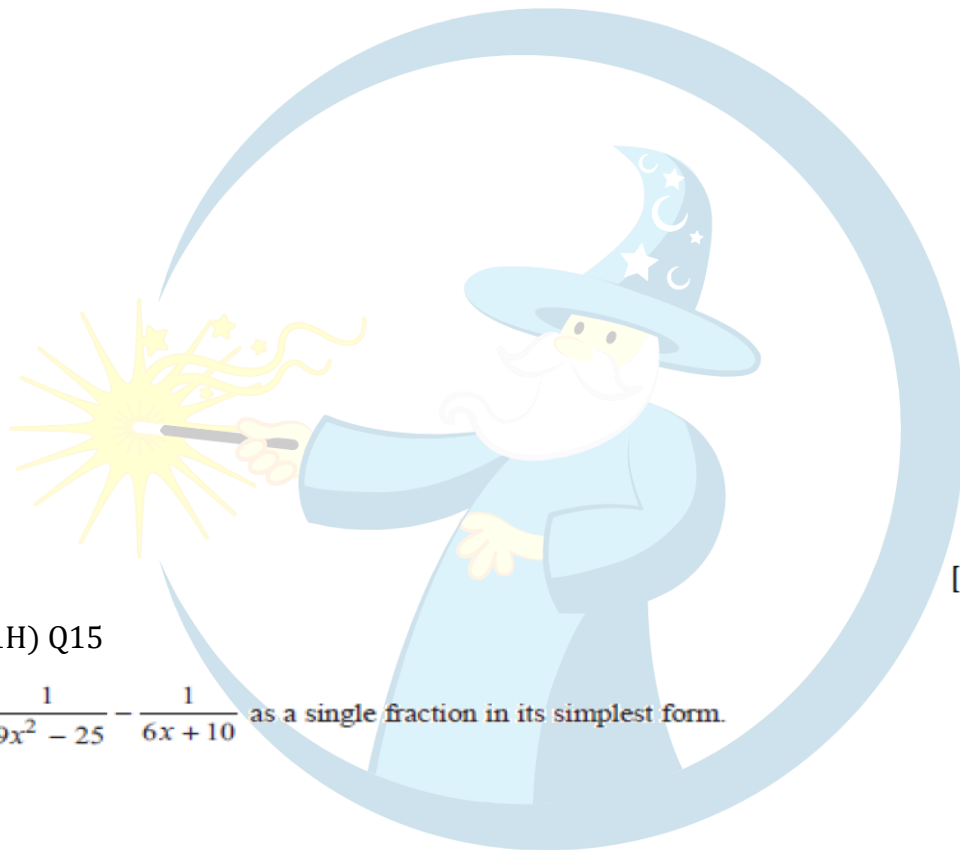
[5 marks]

16. June 2018 (1H) Q15

(b) Express $\dfrac{1}{9x^2-25} - \dfrac{1}{6x+10}$ as a single fraction in its simplest form.

[3 marks]

17. June 2018 (2HR) Q22

Express $\dfrac{4x^2 - 25}{5x^2 + 2x - 7} \times \left(\dfrac{2}{x - 3} - \dfrac{3}{2x - 5} \right)$ as a single fraction in its simplest form.

[4 marks]

18. June 2018 (3H) Q15

(a) Write $\dfrac{2}{x} - \dfrac{1}{x + 3}$ as a single fraction in its simplest form.

[3 marks]

19. June 2018 (3HR) Q17

(a) Show that $\dfrac{x+1}{2x+1} - \dfrac{1}{(2x+1)(x+1)} = \dfrac{x^2+2x}{(2x+1)(x+1)}$

[2 marks]

20. June 2018 (4H) Q12

Express $\dfrac{x-3}{2} - \dfrac{x+4}{3}$ as a single fraction.

Give your answer in its simplest form.

[3 marks]

21. June 2018 (4HR) Q21

Express $\dfrac{x+3}{x-4} - \dfrac{x+4}{x-3}$ as a single fraction.

Simplify your answer.

[3 marks]

22. Jan 2019 (1H) Q11

Express $\dfrac{5}{3} - \dfrac{x+2}{2x}$ as a single fraction in its simplest terms.

[3 marks]

23. May 2004 (3H) Q16

Express the algebraic fraction as simply as possible. $\dfrac{2x^2-3x-20}{x^2-16}$

(3 marks)

24. May 2009 (4H) Q15

   c. simplify fully $\dfrac{2x-6}{x^2-3x}$

(2 marks)

25. Nov 2004 (3H) Q16

   b. Factories the expression $2x^2+5x-3$

(2 marks)

   c. Simplify fully $\dfrac{x^2-9}{x^2-9x+18}$

(3 marks)

26. Nov 2006 (4H) Q23

Simplify fully $\dfrac{2x^2-5x-12}{4x^2-9}$

(3 marks)

27. May 2009 (3H) Q18

Simplify fully $\dfrac{5x^2+14x-3}{50x^2-2}$

(4 marks)

28. May 2010 (3H) Q18

Simplify fully $\dfrac{x^2+6x}{x^2-36}$

(3 marks)
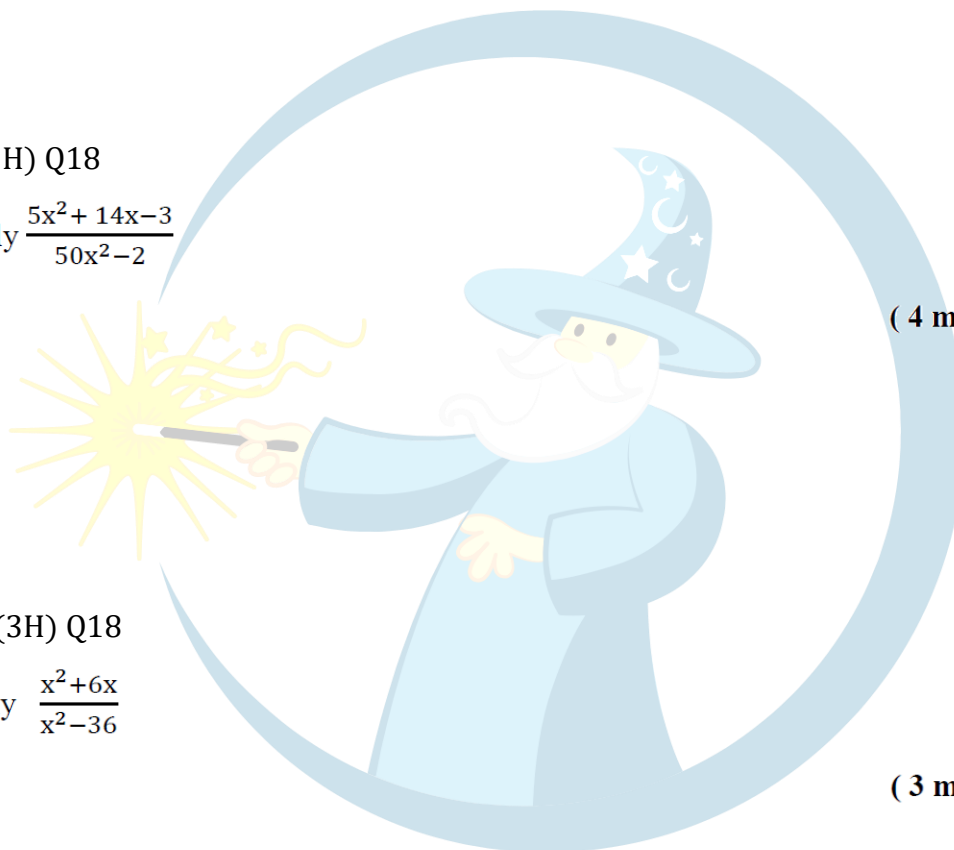
29. Nov 2009 (3H) Q19

a. Simplify $\dfrac{x^2}{x^2-2x}$

(2 marks)

Simplify $\dfrac{2}{2x-1} - \dfrac{1}{x+1}$

(4 marks)
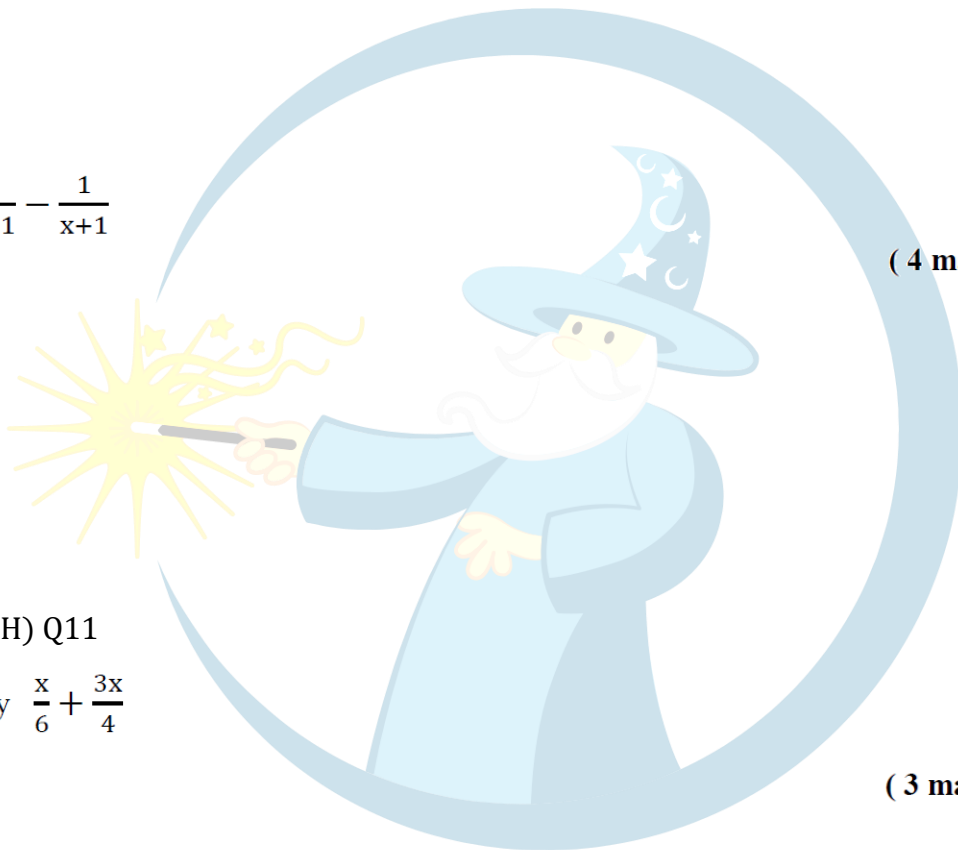
30. May 2010 (4H) Q11

Simplify fully $\dfrac{x}{6} + \dfrac{3x}{4}$

(3 marks)

31. Nov 2008 (3H) Q18

Simplify fully $\dfrac{2}{x+2} + \dfrac{x}{x^2+5x+6}$

(5 marks)

32. May 2005 (3H) Q22

Simplify fully $\dfrac{2}{x-1} + \dfrac{x-11}{x^2+3x-4}$

(6 marks)

33. Nov 2010 (4H) Q22

Simplify fully $1 + \dfrac{x^2 + x - 6}{(x+4)(x-2)}$

(4 marks)

34. Nov 2007 (3H) Q16

Simplify

a. $\dfrac{x^2 - 3x}{2x - 6}$

(3 marks)

b. $\dfrac{2}{x-1} - \dfrac{3}{x}$

(3 marks)

35. Jan 2012 (3H) Q20

Simplify fully $\frac{4}{x} + \frac{3}{2-x}$

(3 marks)

Completing the square

1. June 2018 (2H) Q21
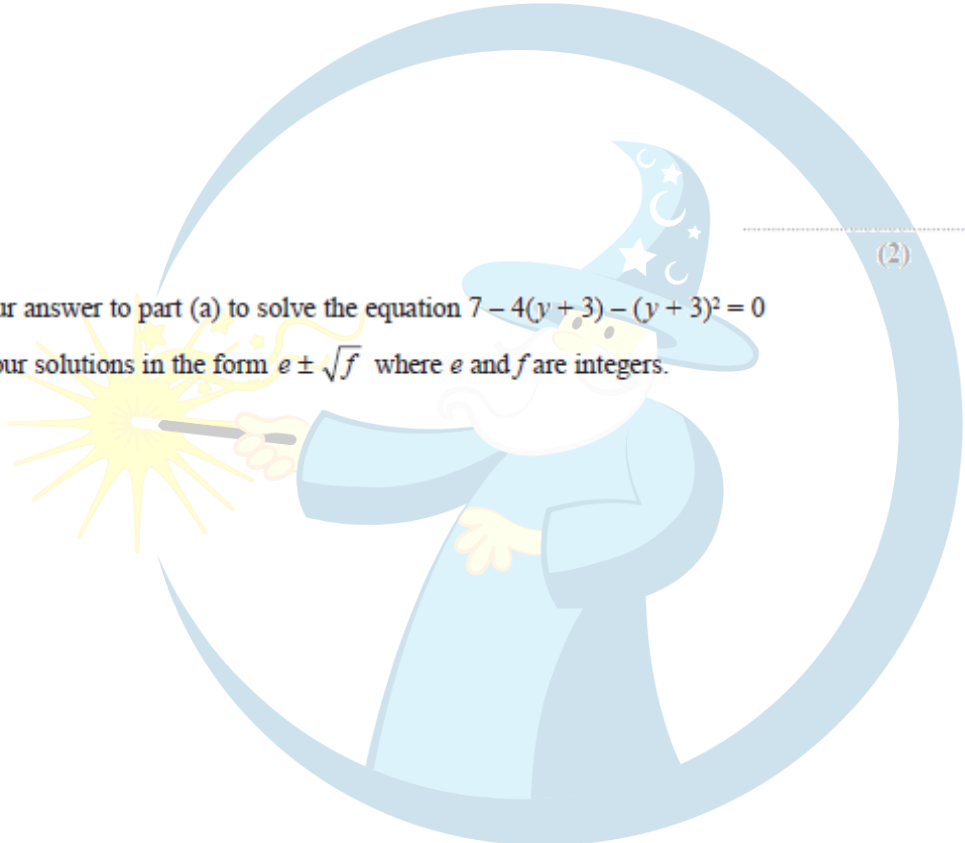
(c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x + a)^2 + b$
Show your working clearly.

(2)

2. June 2018 (2HR) Q24

24 (a) Express $7 - 4x - x^2$ in the form $p - (x + q)^2$ where p and q are constants.

(2)

(b) Use your answer to part (a) to solve the equation $7 - 4(y + 3) - (y + 3)^2 = 0$

Give your solutions in the form $e \pm \sqrt{f}$ where e and f are integers.

(3)

The curve C has equation $y = 3 - 5(x + 1)^2$
The point A is the maximum point on C.

(c) Write down the coordinates of A.

$(\text{.................} , \text{.................})$

(1)

(Total for Question 24 is 6 marks)

3. June 2019 (2HR) Q22

Write $5 + 12x - 2x^2$ in the form $a + b(x + c)^2$ where a, b and c are integers.

....

(Total for Question 22 is 4 marks)

4. Jan 2019 (2HR) Q20

(a) Write $3x^2 - 12x + 7$ in the form $a(x + b)^2 + c$

(3)

The line **L** is the line of symmetry of the curve with equation $y = 3x^2 - 12x + 7$

(b) Using your answer to part (a) or otherwise, write down an equation of **L**.

(1)

(Total for Question 20 is 4 marks)

Expressions and formulae

1. June 2016 3H Q2

   $a = -5$
   $c = -2$

   (a) Work out the value of $2a^2 + 6c$

   (2)

   There are 4 pens in a small box of pens.
   There are 10 pens in a large box of pens.

   Ami buys x small boxes of pens and y large boxes of pens.
   She buys a total of T pens.

   (b) Write down a formula for T in terms of x and y.

   (3)

   (Total for Question 2 is 5 marks)

2. June 2018 (2HR) Q7

   (b) Make e the subject of the formula $h = 3e + f$

   (2)

3. June 2018 (4H) Q7

Pamela, Sophia and Zoe are three friends.

Pamela has x dollars.
Sophia has 4 dollars more than Pamela.
Zoe has three times the number of dollars that Sophia has.

In total, the three friends have T dollars.

(c) Write an expression, in terms of x, for T.
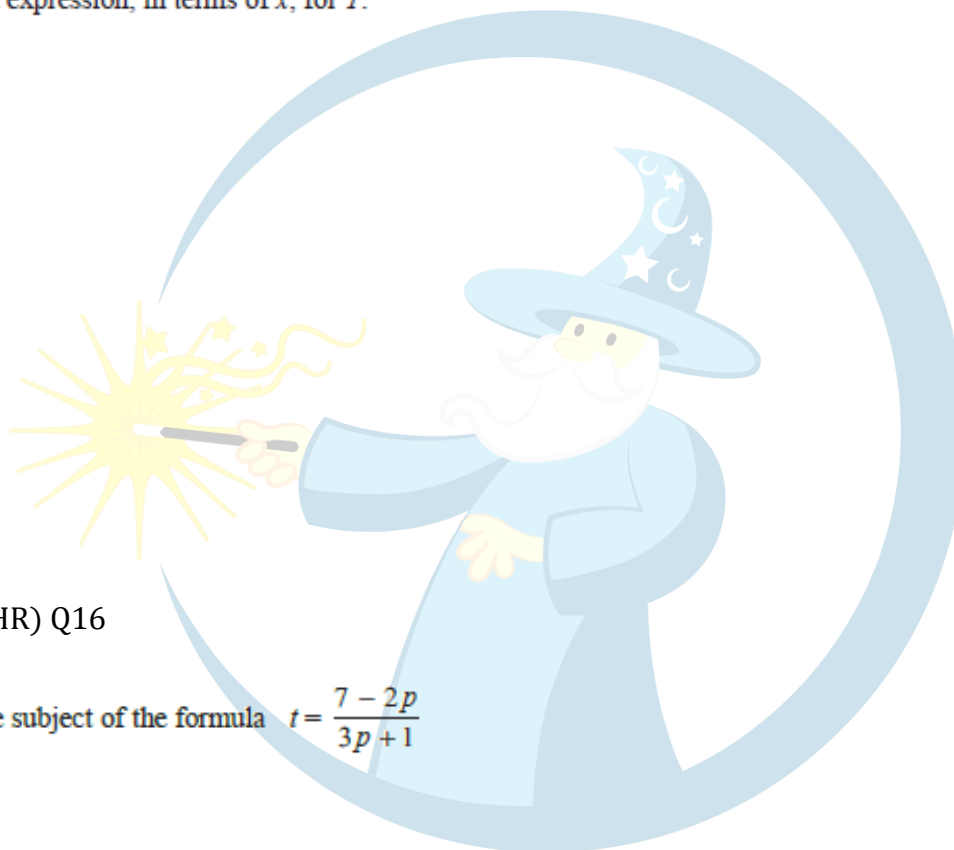
4. Jan 2017 (3HR) Q16

(b) Make p the subject of the formula $t = \dfrac{7 - 2p}{3p + 1}$

5. Jan 2018 (3HR) Q21

$y = 4ax^2$

$z = a^2x^3$

Given that $y = 4a^k z^w$ find

(a) (i) the value of w,

$w =$ ....

(2)

(ii) the value of k.

$k =$ ....

(2)

$m = 10^3$

$N = m \times m^m$

(b) Write N in the form 10^n where n is an integer.

....

(3)

(Total for Question 21 is 7 marks)

6. June 2017 (3HR) Q1

$a = 6$ $b = 2.84$ $c = \sqrt{5}$

Work out the value of $\dfrac{a - b}{c^2}$

7. June 2017 (4H) Q6

There are 6 batteries in a small packet of batteries.
There are 9 batteries in a large packet of batteries.

Chow buys m small packets of batteries and g large packets of batteries.

The total number of batteries Chow buys is T.

Write down a formula, in terms of m and g, for T.

(Total for Question 6 is 3 marks)

8. Jan 2018 (3HR) Q13

A train travels at a constant speed of v kilometres per hour.
The train crosses a bridge.

The length of the bridge is b metres.
The length of the train is x metres.

T seconds is the time between the instant that the front of the train moves onto the bridge
and the instant that the back of the train leaves the bridge.

Find a formula for T in terms of b, x and v.
Give your answer in its simplest form.

(Total for Question 13 is 3 marks)
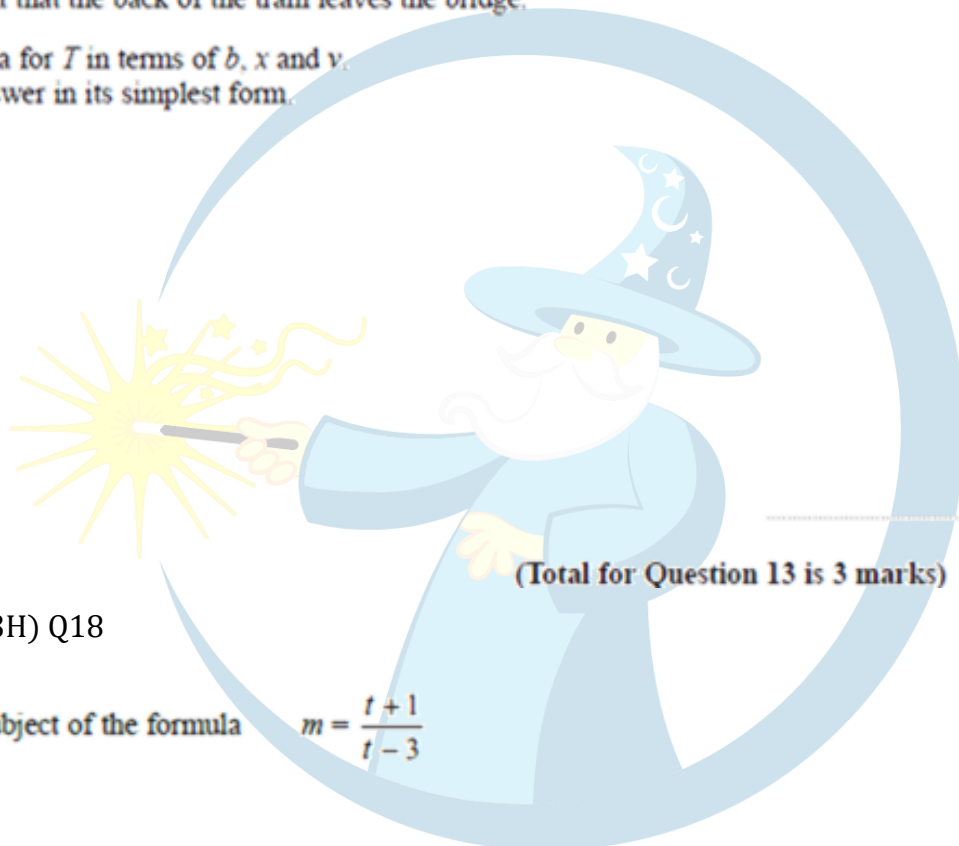
9. June 2016 (3H) Q18

Make t the subject of the formula $m = \dfrac{t+1}{t-3}$

10. June 2017 (3H) Q14

(c) Make g the subject of $g - 1 = gh + 3h$

11. June 2018 (4HR) Q16

Make w the subject of the formula $p = \sqrt{\dfrac{w+4}{w-2}}$
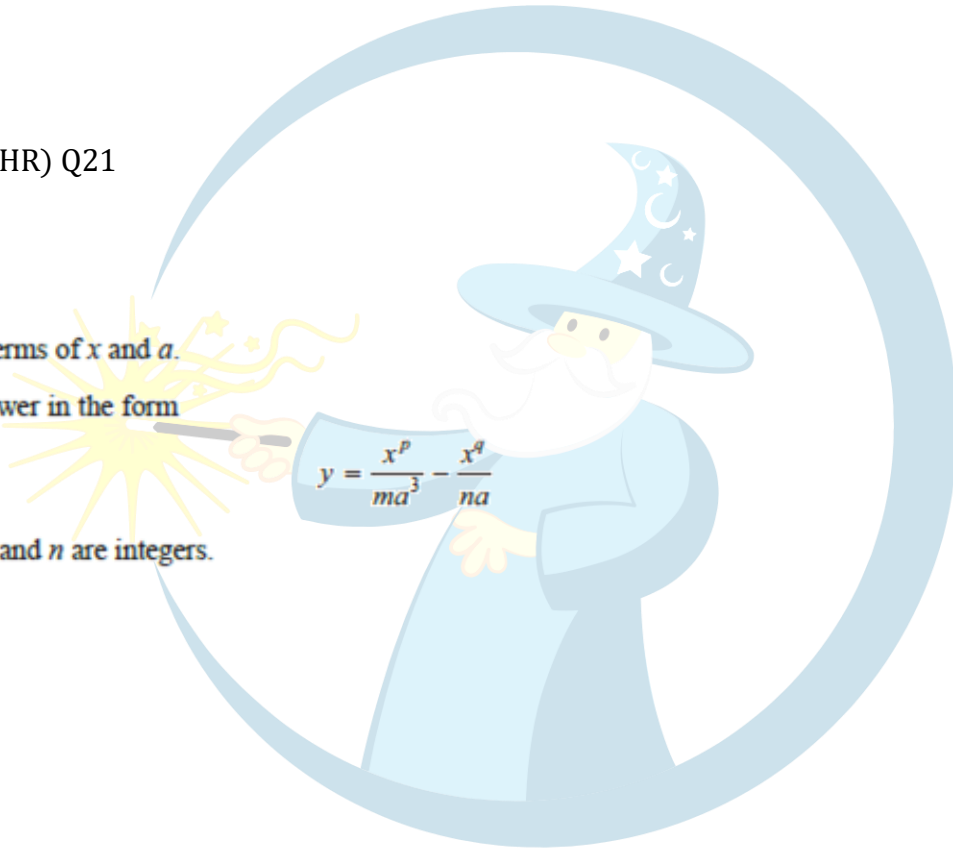
12. June 2016 (4HR) Q21

$y = at^2 - 2at$

$x = 2a\sqrt{t}$

Express y in terms of x and a.

Give your answer in the form

$$y = \frac{x^p}{ma^3} - \frac{x^q}{na}$$

where p, q, m and n are integers.

13. Jan 2018 (4H) Q1

Mike buys c pens and r rulers.

Each pen costs 24 cents.
Each ruler costs 37 cents.

Mike spends a total of T cents buying pens and rulers.

Write down a formula for T in terms of c and r.

(Total for Question 1 is 3 marks)

14. Jan 2017 (3H) Q19

Make e the subject of $\quad k = \sqrt{\dfrac{5m + 2e}{3e}}$

15. June 2017 (3HR) Q16

Make x the subject of the formula $\quad y = \dfrac{ax + b}{cx + d}$

16. June 2019 (2H) Q15

Make x the subject of the formula $y = \sqrt{\dfrac{3x - 2}{x + 1}}$

....
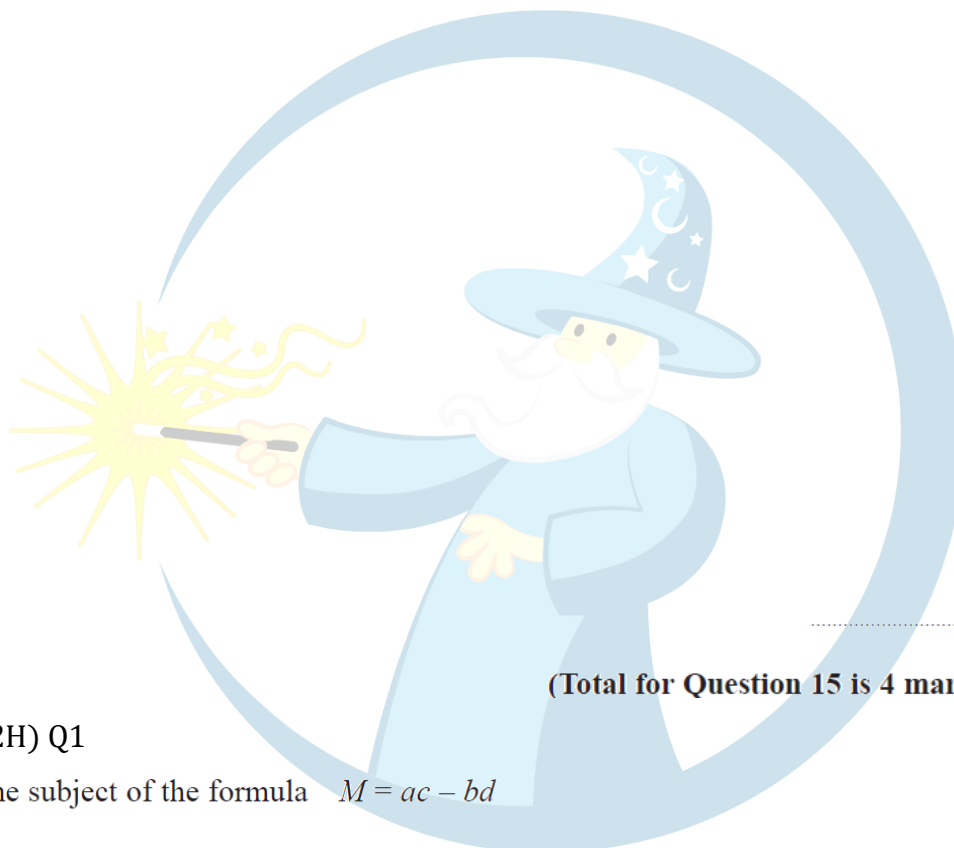
(Total for Question 15 is 4 marks)

17. June 2018 (2H) Q1

(a) Make a the subject of the formula $M = ac - bd$

....

(2)

18. May 2019 (1HR) Q18

(b) Make m the subject of $p^2 = \dfrac{x + m}{2m - y}$

....

(3)

(Total for Question 18 is 6 marks)

19. Jan 2019 (2H) Q12

(d) Make r the subject of $m = \sqrt{\dfrac{6a + r}{5r}}$

(4)

20. Jan 2019 (2HR) Q10

(c) Make f the subject of $m = \sqrt{\dfrac{1}{3}ef}$
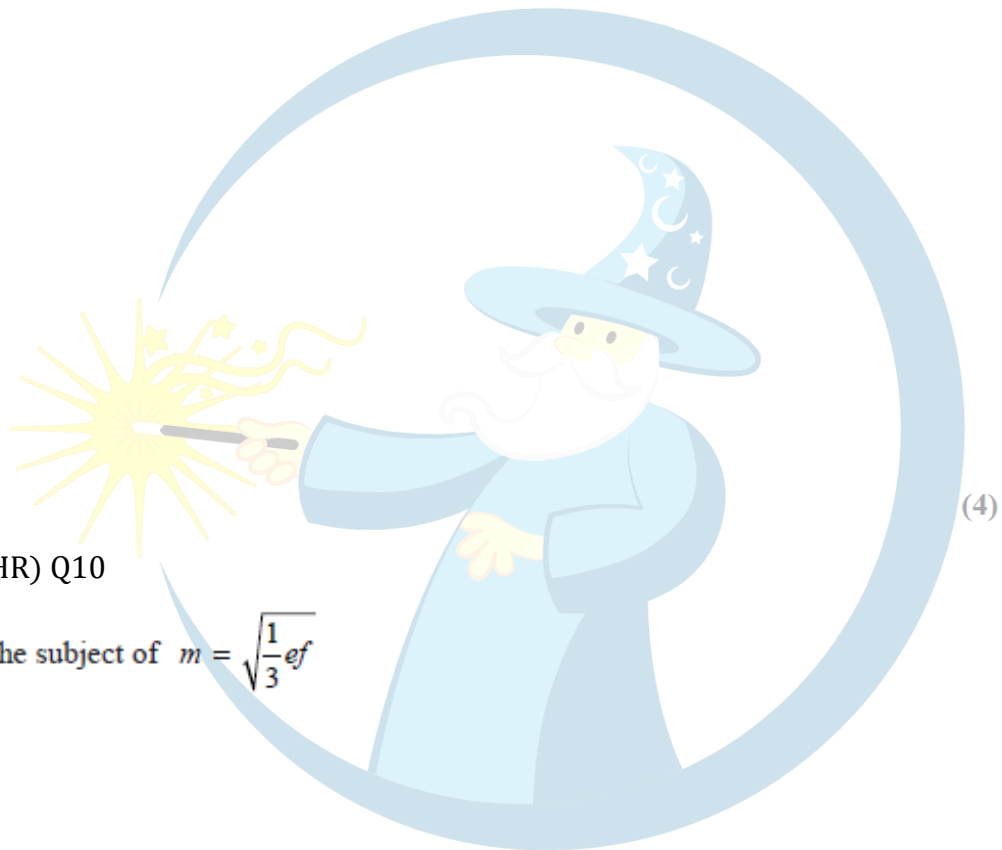
(2)

21. Jan 2018 (3H) Q17

Make a the subject of $x = \sqrt{\dfrac{2b - a}{7 - am}}$

(Total for Question 17 is 4 marks)

Solving algebraic equations

<u>Linear equations</u>

1. June 2016 (4H) Q2

    Solve $8y - 18 = 3(y + 3)$
    Show clear algebraic working.

2. June 2016 (4H) Q15

    (c) Solve $\frac{2}{3}y + \frac{3}{8}y = 5$

    Show clear algebraic working.

3. June 2017 (3HR) Q2

    Solve $5x - 8 = x - 10$
    Show clear algebraic working.

4. June 2016 (4HR) Q14

    (a) Solve $2y + \frac{2 - 3y}{4} = \frac{1}{4}$

    Show clear algebraic working.

5. June 2016 (4HR) Q2

(a) Solve $6t - 5 = 2t + 9$
Show clear algebraic working.

6. Jan 2017 (3H) Q5

(d) Solve $5(q - 3) = 12 - q$
Show clear algebraic working.

7. Jan 2017 (3HR) Q16

(a) Solve $\dfrac{3x + 1}{5} - \dfrac{x - 4}{3} = 2$
Show clear algebraic working.

8. Jan 2017 (4HR) Q15

(b) Solve $\dfrac{4}{e - 3} = 5$

9. June 2017 (3H) Q14

(b) Solve $\dfrac{6 + 4y}{3} = 5 - 2y$

Show clear algebraic working.

10. Jan 2017 (4HR) Q8

The diagram shows a parallelogram *ABCD*.
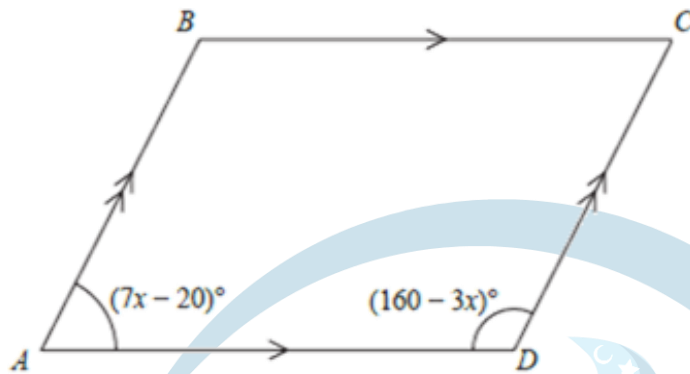
Diagram **NOT** accurately drawn

Angle $BAD = (7x - 20)°$
Angle $ADC = (160 - 3x)°$

Work out the value of x.
Show clear algebraic working.
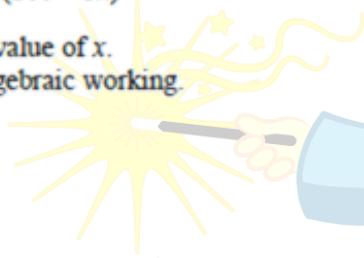
11. June 2018 (1H) Q3

(c) Solve $5(x + 3) = 3x - 4$
Show clear algebraic working.

$x =$ ....

(3)

12. June 2017 (4H) Q2

$M = 2t^2 - 7t$

(a) Work out the value of M when $t = -3$

$M =$ ....

(2)

(b) Solve $4(x + 3) = 9x - 10$
Show clear algebraic working.
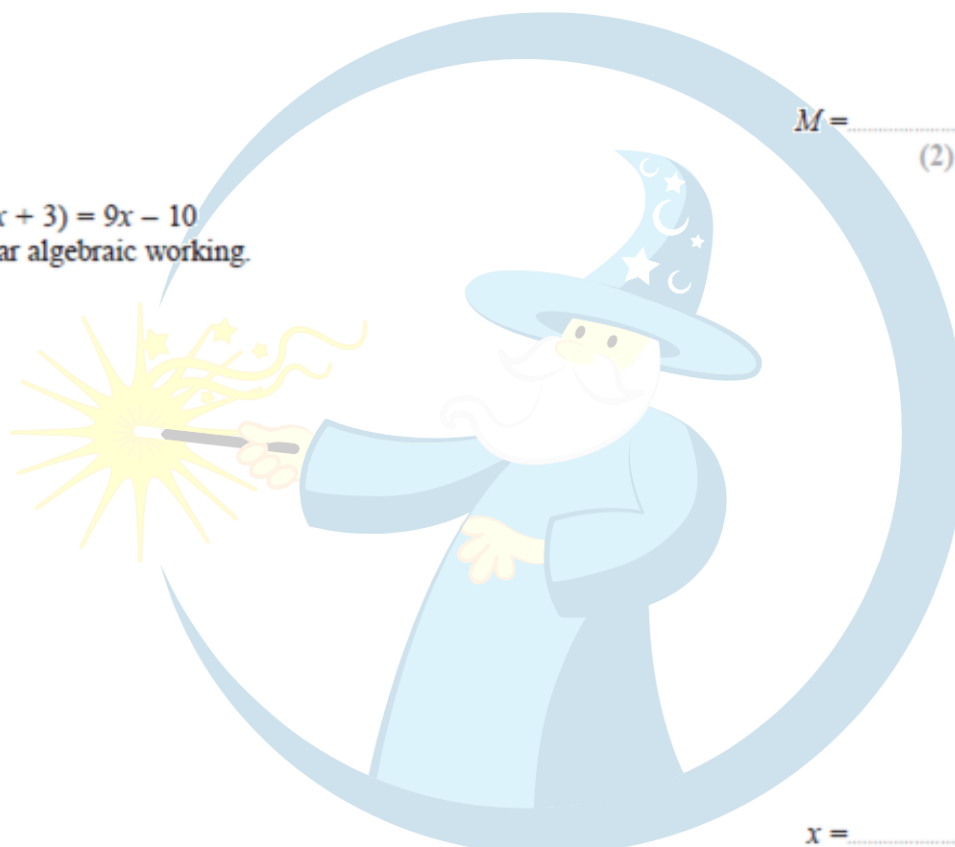
$x =$ ....

(3)

13. June 2017 (4HR) Q14

Solve $\dfrac{5 - x}{2} - \dfrac{x - 1}{3} = 1$

Show clear algebraic working.

14. June 2018 (2HR) Q4

(d) Solve $\dfrac{7x - 2}{4} = 3x + 1$

Show clear algebraic working.

$x = $ ....

(3)

15. Jan 2018 (3H) Q5

(a) Solve the equation $3(1 - 2y) = 2y - 7$
Show clear algebraic working.

$y = $ ....

(3)
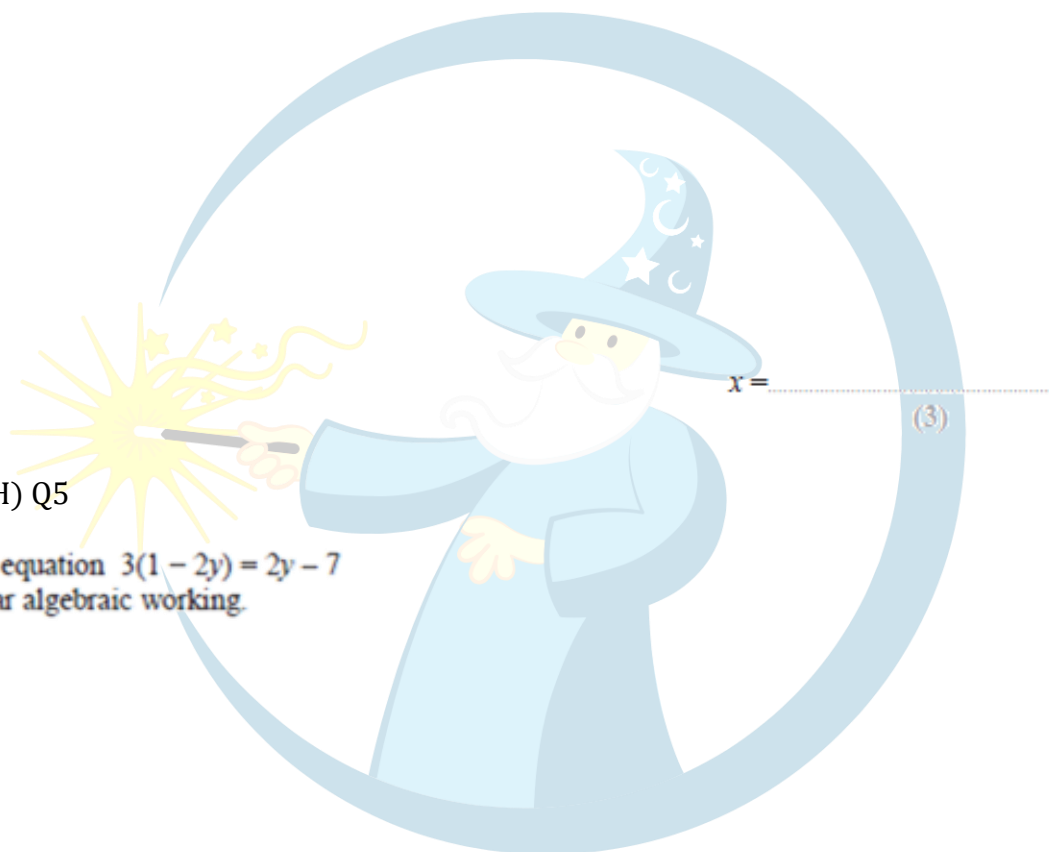
16. Jan 2018 (3H) Q12

Solve $\dfrac{x + 4}{3} + \dfrac{2x + 3}{4} = 7$

Show clear algebraic working.

17. June 2018 (3HR) Q7

The diagram shows a rectangle and an isosceles triangle.
All measurements are in centimetres.

Diagram **NOT** accurately drawn

$2x + 2$

$4x + 1$

$x + 3$ $x + 3$

$2x$
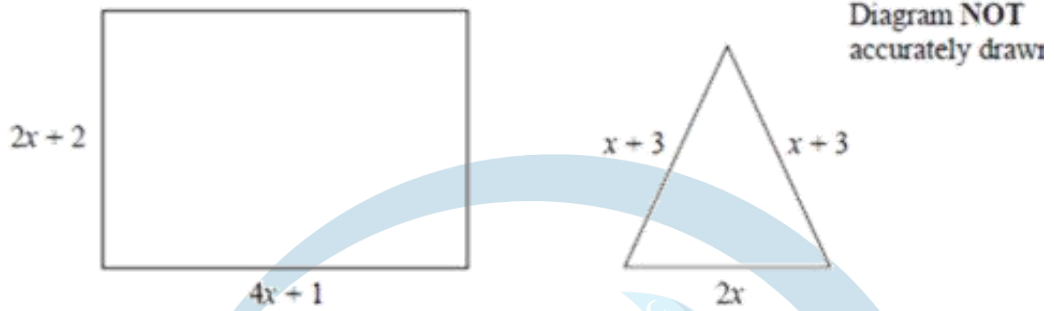
(a) Write down an expression in terms of x for

   (i) the perimeter of the rectangle.

.... cı

   (ii) the perimeter of the triangle.

.... cı

(2)
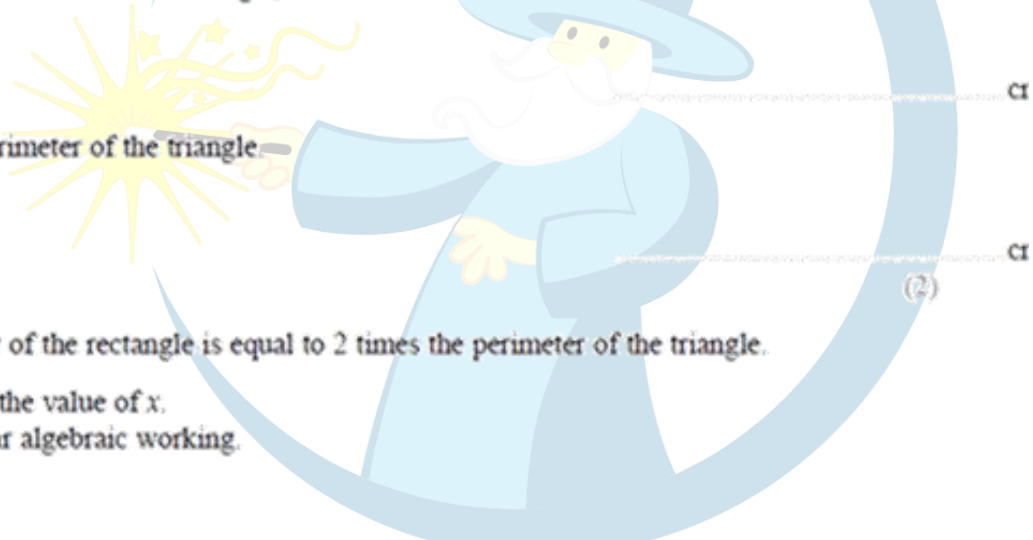
The perimeter of the rectangle is equal to 2 times the perimeter of the triangle.

(b) Work out the value of x.
    Show clear algebraic working.

(4)

(Total for Question 7 is 6 marks)

18. June 2018 (4HR) Q12

Solve $\dfrac{5x-2}{3} + \dfrac{3-5x}{4} = 2$

Show clear algebraic working.

$x = $ _____

(Total for Question 12 is 4 marks)

19. Jan 2019 (1H) Q1

(c) Solve $y = \dfrac{2y+1}{5}$

Show clear algebraic working.

$y = $

(3)

20. Jan 2019 (1HR) Q6

The diagram shows the triangle *PQR*.
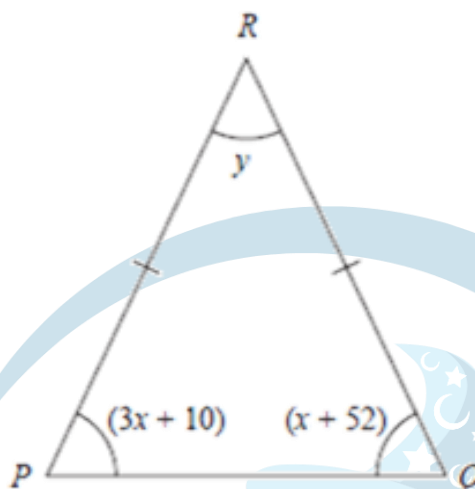
Diagram **NOT** accurately drawn

In the diagram, all the angles are in degrees.

$RP = RQ$

Find the value of *y*.
Show clear algebraic working.

21. Jan 2019 (2HR) Q10

(b) Solve $\dfrac{8-2x}{3} - \dfrac{2x-3}{2} = 4$

Show clear algebraic working.

22. May 2019 (1H) Q12

(b) Solve $\dfrac{4m + 9}{3} = 7 - 2m$

Show clear algebraic working.

$m = $ _____

(4)

23. May 2019 (1HR) Q4

Solve $4x - 13 = 17 + 8x$

$x = $ _____

(Total for Question 4 is 2 marks)

24. May 2018 (1H) Q3

(c) Solve $5(x + 3) = 3x - 4$
Show clear algebraic working.

$x = $ ....

(3)

Quadratic equations

1. June 2016 (3H) Q17

The diagram shows a trapezium.

$x + 6$

Diagram **NOT**
accurately drawn

$x - 1$

$3x - 4$
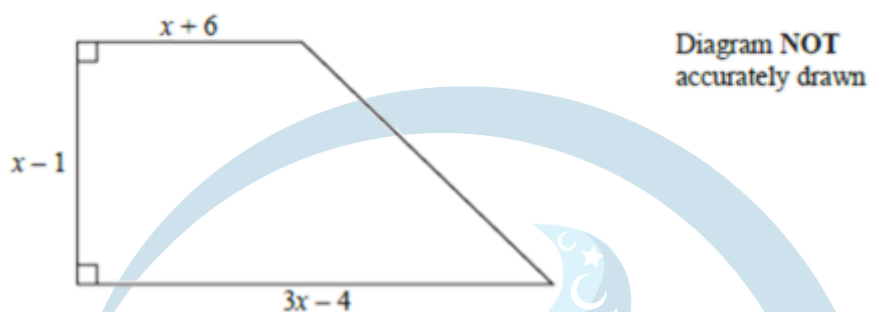
All measurements on the diagram are in centimetres.

The area of the trapezium is 119 cm²

(i) Show that $2x^2 - x - 120 = 0$

(ii) Find the value of x.
Show your working clearly.

$x = $ ....

(Total for Question 17 is 6 marks)

2. Jan 2017 (4HR) Q21

A rectangular piece of card has length $(3x - 13)$ cm and width $(x - 2)$ cm.
A square, with sides of length 25 cm, is removed from each corner of the card.

Diagram **NOT** accurately drawn
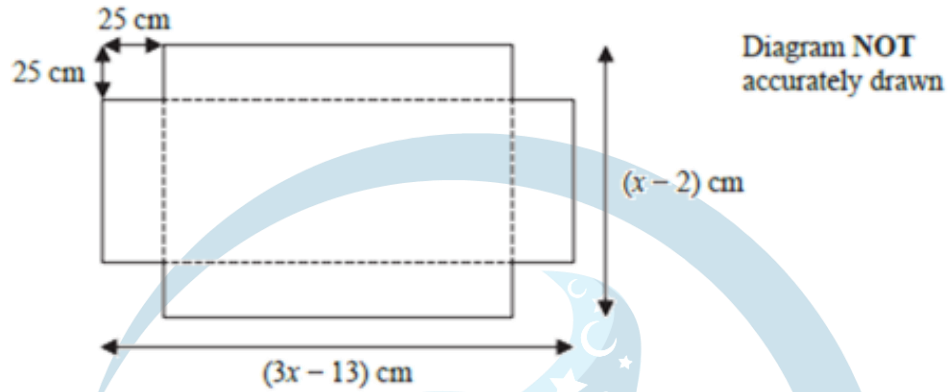
The card is then folded along the dashed lines to make an open box with height 25 cm as shown below.

Diagram **NOT** accurately drawn
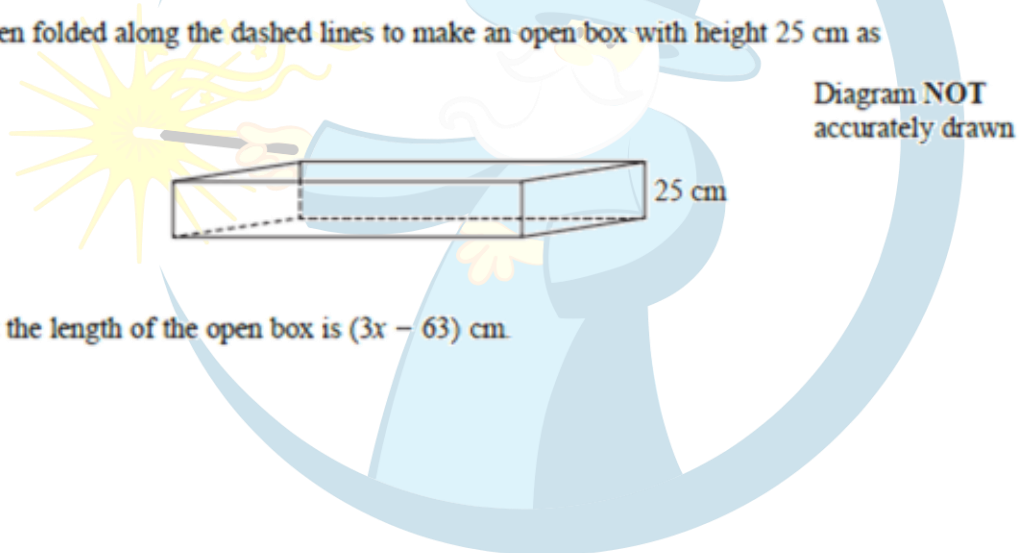
(a) Show that the length of the open box is $(3x - 63)$ cm.

The volume of the open box is 81 900 cm³

(b) Find the value of x.
   Show clear algebraic working.

3. June 2018 (1H) Q3

(d) (i) Factorise $x^2 + 2x - 24$

.... (2)

(ii) Hence, solve $x^2 + 2x - 24 = 0$

.... (1)

4. Jan 2018 (4HR) Q19

The four angles, in degrees, of quadrilateral $ABCD$ are

angle $A = (x^2 - 105)$

angle $B = (x^2 - 65)$

angle $C = (470 - 30x)$

angle $D = (510 - 30x)$

Show that $ABCD$ is a trapezium.
Show clear algebraic working.

5. Jan 2019 (2H) Q15

The diagram shows a trapezium.

Diagram **NOT** accurately drawn
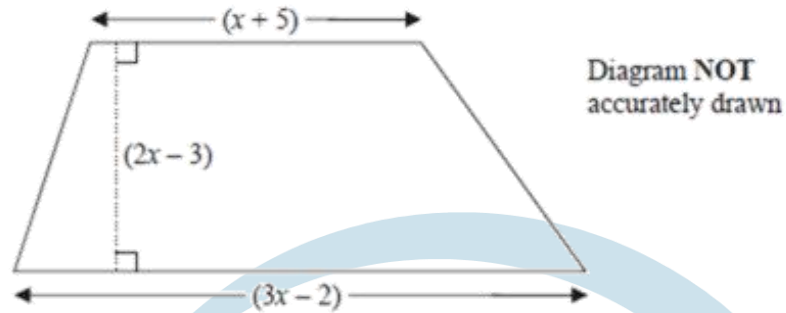
All measurements shown on the diagram are in centimetres.

The area of the trapezium is $133\,cm^2$

(a) Show that $8x^2 - 6x - 275 = 0$
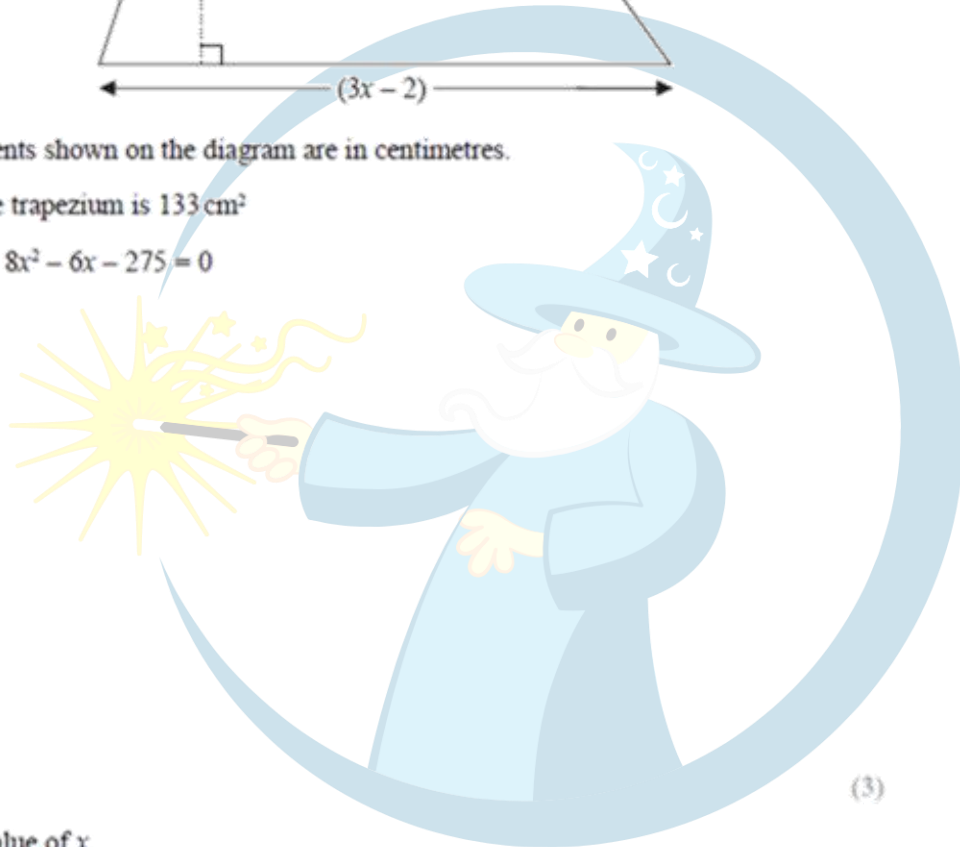
(3)

(b) Find the value of x.
Show your working clearly.

$x =$

(3)

(Total for Question 15 is 6 marks)

Solving quadratic equations by formula

1. June 2016 (4HR) Q16

Solve $2x^2 - 6x + 3 = 0$

Give your solutions correct to 3 significant figures.
Show your working clearly.

2. Jan 2017 (3H) Q17

Solve the equation $5x^2 + 8x - 23 = 0$
Show your working clearly.
Give your solutions correct to 3 significant figures.

3. June 2017 (4HR) Q17

Solve $11x^2 - 3x - 5 = 0$
Show your working clearly.
Give your solutions correct to 2 decimal places.

4. June 2018 (4HR) Q19

$(2x + 1)\,\text{cm}$

Diagram **NOT** accurately drawn

$3\,\text{cm}$

$(x + 3)\,\text{cm}$

$2\,\text{cm}$
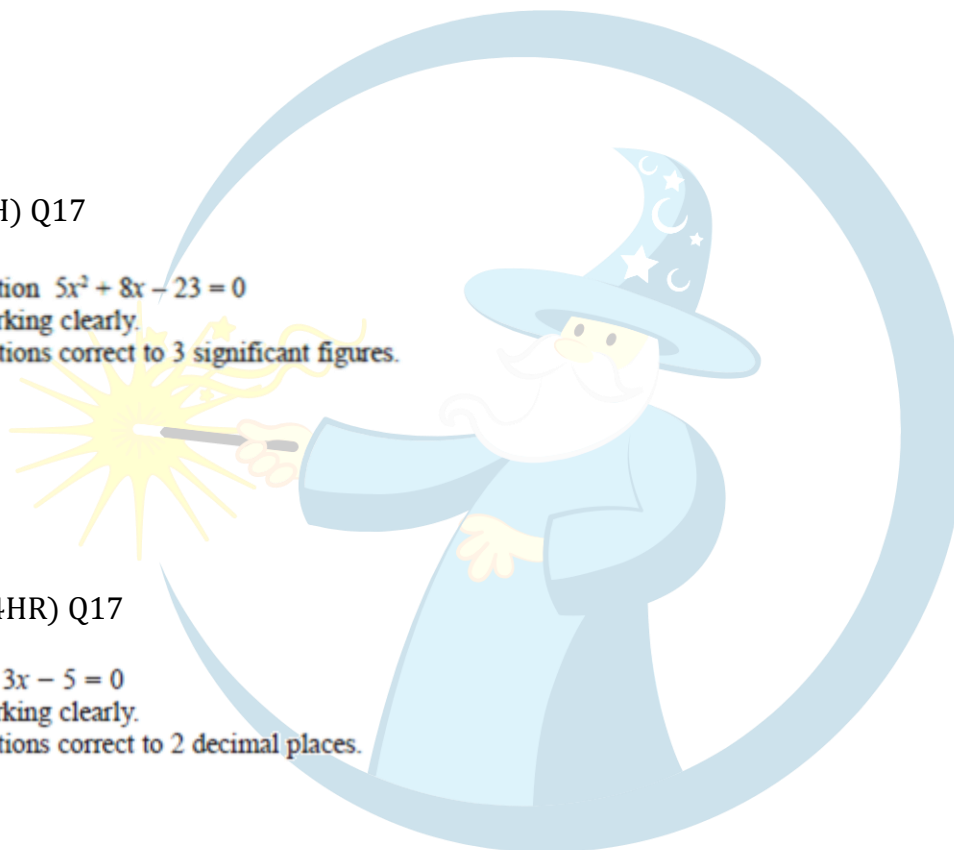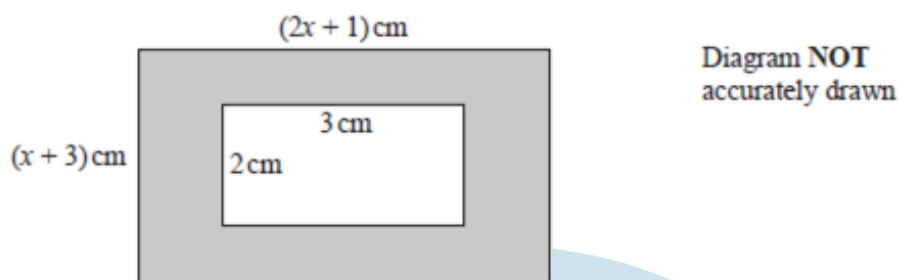
The diagram shows a rectangular piece of card with length $(2x + 1)\,\text{cm}$ and width $(x + 3)\,\text{cm}$.
A rectangle of length $3\,\text{cm}$ and width $2\,\text{cm}$ is cut out of the card.
The area of card that remains, shown shaded in the diagram, is $45\,\text{cm}^2$

(a) Show that $2x^2 + 7x - 48 = 0$

(2)
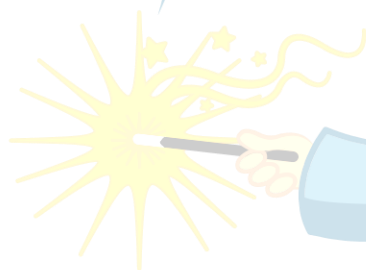
(b) Find the value of x.
Show your working clearly.
Give your value of x correct to 3 significant figures.

(3)

(Total for Question 19 is 5 marks)

5. June 2017 4HR Q15

Here is a trapezium.

(2x − 4)

(x + 3)

(x + 5)

Diagram **NOT** accurately drawn
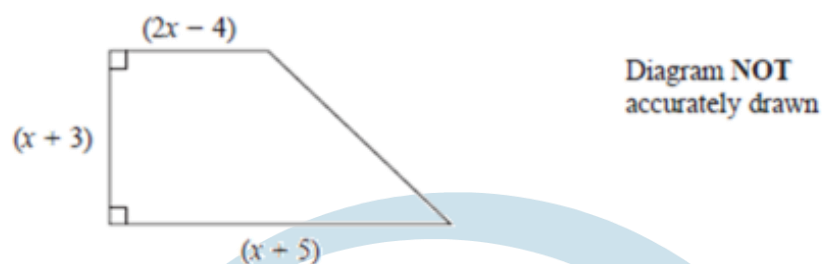
All measurements are in centimetres.

The area of the trapezium is 60 cm²

(a) Show that $3x^2 + 10x - 117 = 0$
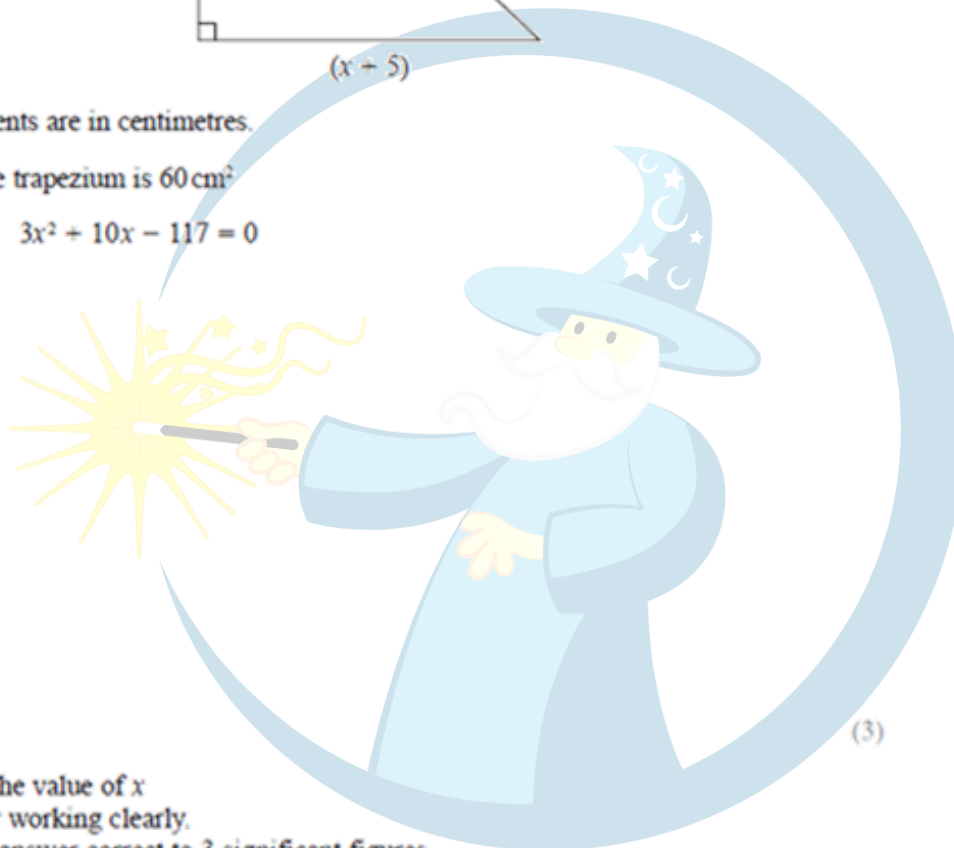
(3)

(b) Work out the value of x
Show your working clearly.
Give your answer correct to 3 significant figures.

....

(3)

(Total for Question 15 is 6 marks)

6. June 2018 (1H) Q11

(b) Solve $3x^2 + 6x - 5 = 0$
Show your working clearly.
Give your solutions correct to 3 significant figures.

(3)

7. June 2018 (3H) Q13

Solve $4x^2 + 6x - 1 = 0$
Show your working clearly.
Give your solutions correct to 3 significant figures.

(Total for Question 13 is 3 marks)

8. Jan 2018 (3HR) Q17

(a) Show that $\dfrac{x+1}{2x+1} - \dfrac{1}{(2x+1)(x+1)} = \dfrac{x^2+2x}{(2x+1)(x+1)}$

(2)

(b) Hence, solve $\dfrac{x+1}{2x+1} - \dfrac{1}{(2x+1)(x+1)} = \dfrac{1}{(2x+1)(x+1)}$

Give your solutions correct to 3 significant figures.
Show your working clearly.

(4)
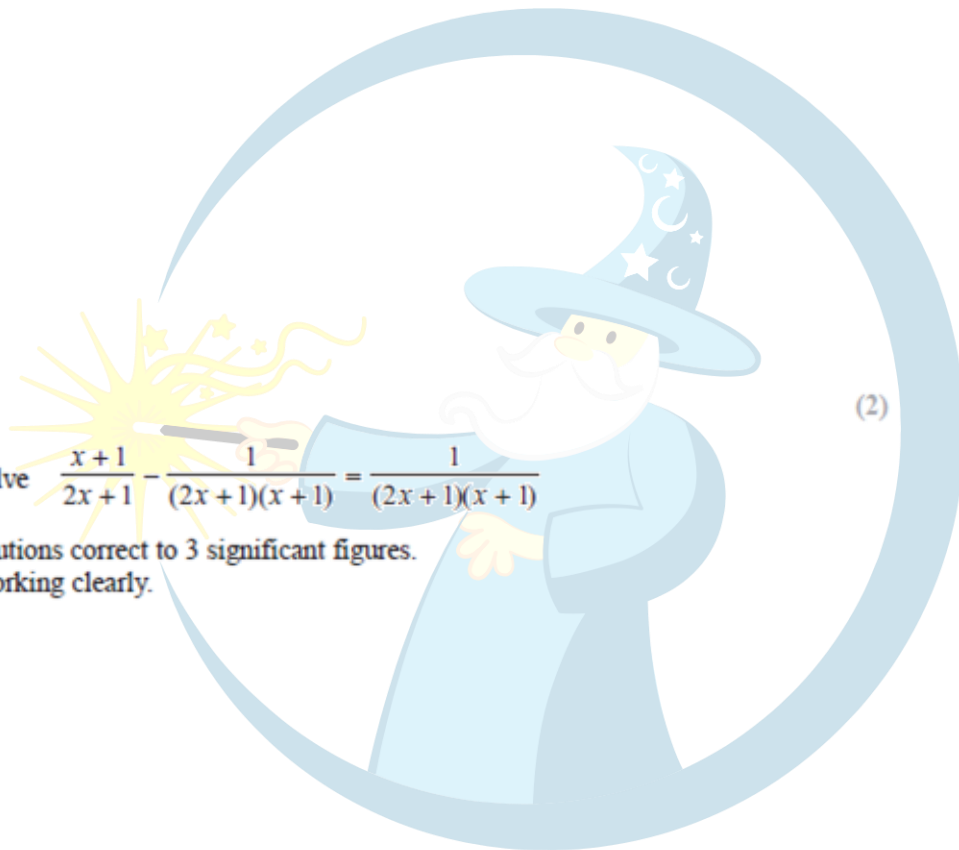
(Total for Question 17 is 6 marks)

Solving simultaneous equations

<u>Linear equations</u>

1. June 2016 (3H) Q12

    Solve the simultaneous equations $4x + 5y = 13$
                                             $3x - 2y = 27$

    Show clear algebraic working.

2. June 2016 (4HR) Q10

    Solve $4x + 3y = 6$

            $3x + 5y = -1$

    Show clear algebraic working.

3. Jan 2017 (3HR) Q11

    (a) Solve $7x + 2y = 16$
                       $5x - 2y = 20$

        Show clear algebraic working.

4. Jan 2017 (4H) Q10

Solve the simultaneous equations

$$5x - 2y = 33$$
$$5x + 8y = 18$$

Show clear algebraic working.

5. June 2017 (3H) Q10

Solve the simultaneous equations

$$2x + 7y = 31$$
$$5x - 3y = 16$$

Show clear algebraic working.

$x =$ ....

$y =$ ....
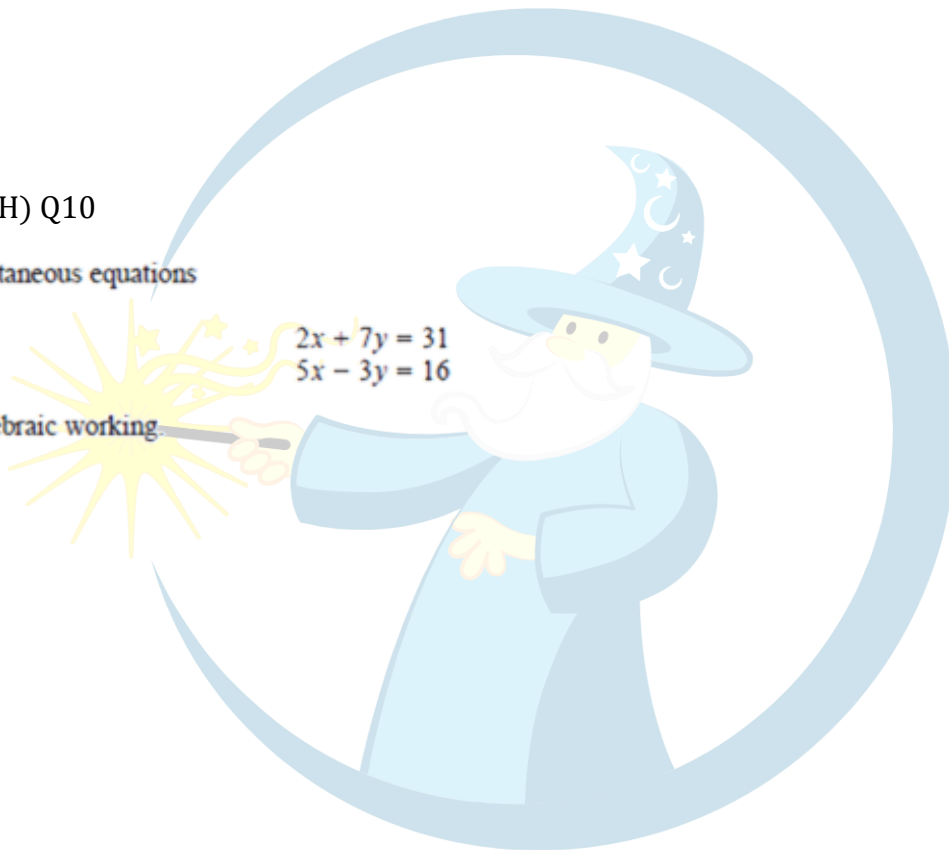
(Total for Question 10 is 4 marks)

6. June 2017 (4HR) Q9

Solve the simultaneous equations.

$$5x - 2y = 9.5$$

$$4x + 2y = 13$$

Show clear algebraic working.

7. June 2018 (1HR) Q10

Solve

$$3x + 2y = 15$$
$$10x - 4y = 2$$

Show clear algebraic working.

$x = $ ....

$y = $ ....
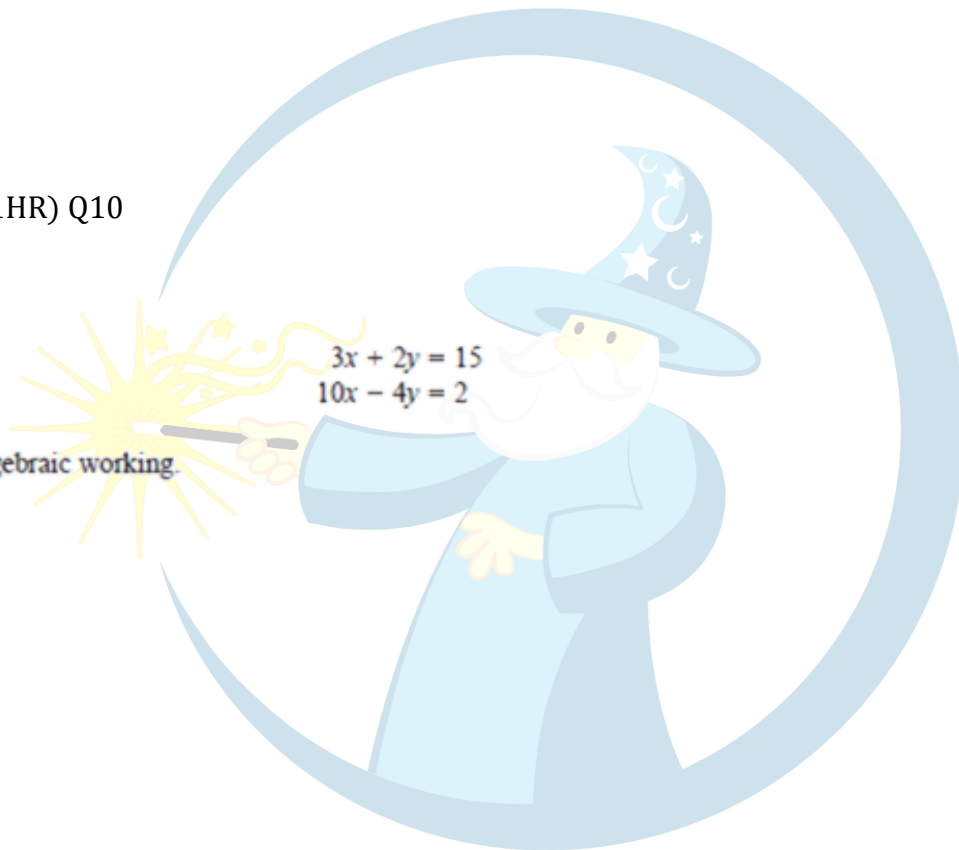
(Total for Question 10 is 3 marks)

8. June 2018 (2H) Q9

Solve the simultaneous equations

$$x + y = 15$$
$$7x - 5y = 3$$

Show clear algebraic working.

$x = $ ....

$y = $ ....

(Total for Question 9 is 3 marks)

9. June 2018 (3H) Q11

Solve the simultaneous equations

$$7x - 2y = 41$$
$$4x + 3y = 11$$
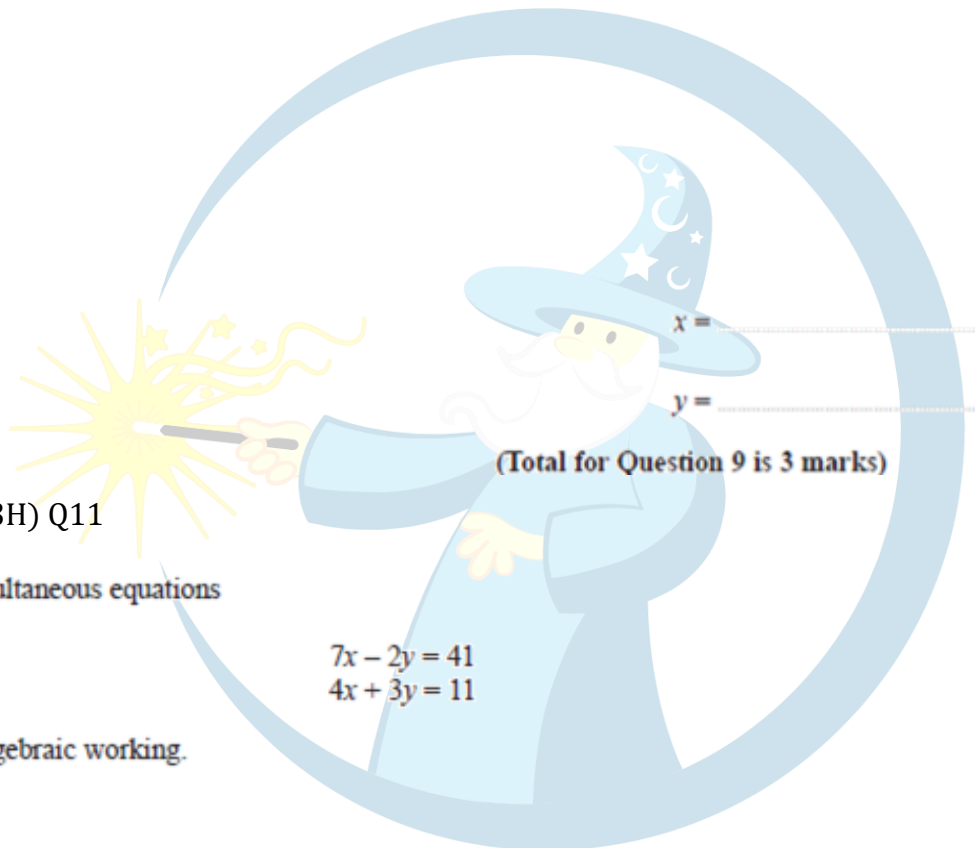
Show clear algebraic working.

10.   Jan 2018 (3HR) Q15

Solve

$$3x - 4y = 8$$
$$5x - 2y = 11$$

Show clear algebraic working.

$x = $ ....

$y = $ ....

(Total for Question 15 is 3 marks)

11. June 2018 (4HR) Q7

Solve the simultaneous equations

$$y = 4x$$
$$7x - y = -13.5$$

Show clear algebraic working.

$x =$ ....

$y =$ ....

(Total for Question 7 is 3 marks)

12. Jan 2019 (1HR) Q8

Solve the simultaneous equations

$$4x + 2y = 9$$
$$x - 4y = 9$$

Show clear algebraic working.

$x =$

$y =$

(Total for Question 8 is 3 marks)

13. Jan 2019 (2H) Q5

Calvin has 12 identical rectangular tiles.
He arranges the tiles to fit exactly round the edge of a shaded rectangle, as shown in the diagram below.

Diagram **NOT** accurately drawn

67 cm

123 cm
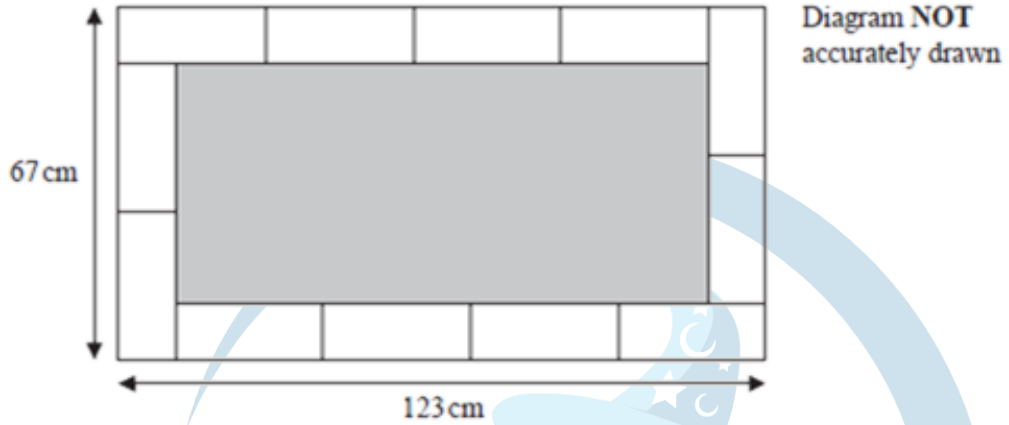
Work out the area of the shaded rectangle.
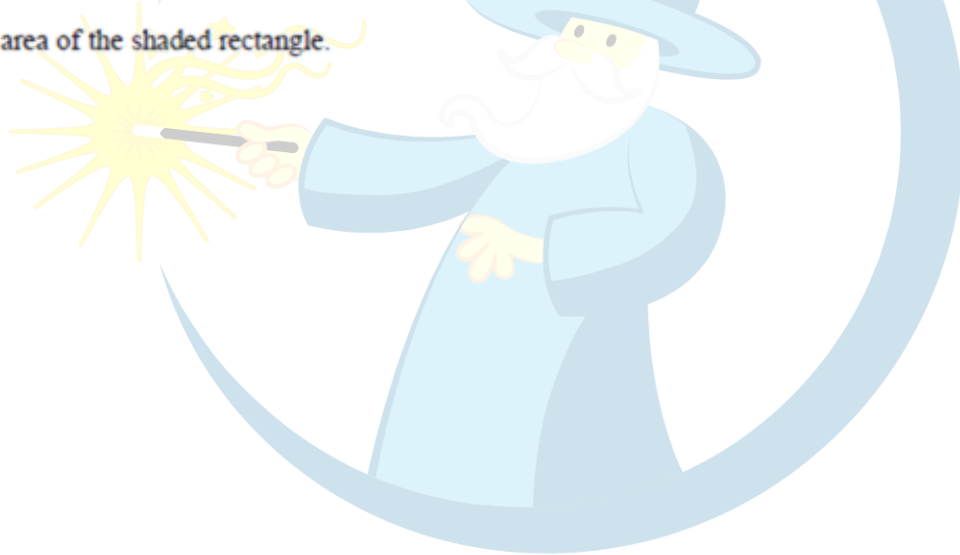
14. Jan 2019 (2H) Q9

Solve the simultaneous equations

$$4x + 5y = 4$$
$$2x - y = 9$$

Show clear algebraic working.

$x =$

$y =$

(Total for Question 9 is 3 marks)

15. June 2019 (2H) Q9

Solve the simultaneous equations

$$x + 2y = -0.5$$
$$3x - y = 16$$

Show clear algebraic working.

$x = $ ....

$y = $ ....

(Total for Question 9 is 3 marks)

16. May 2018 (1H) Q12

The diagram shows two straight lines drawn on a grid.
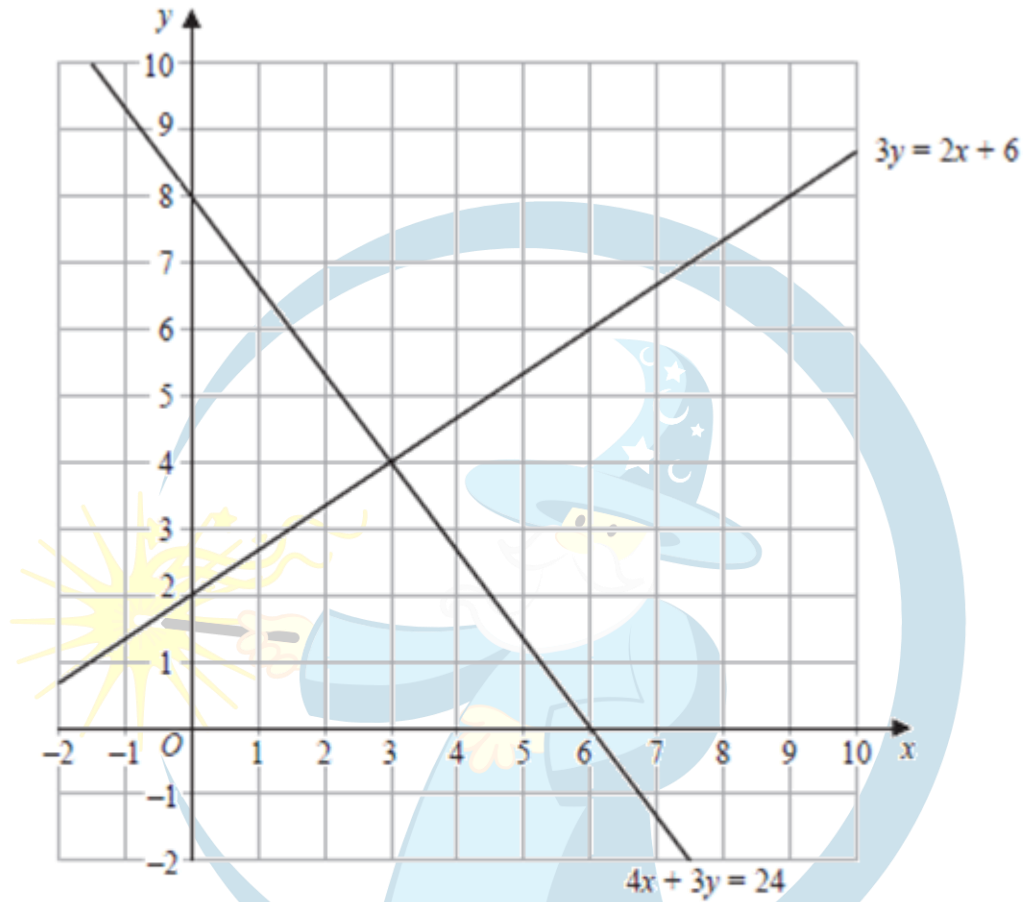
(a) Write down the solution of the simultaneous equations

$$3y = 2x + 6$$
$$4x + 3y = 24$$

$x =$ ....

$y =$ ....

(1)

17. May 2018 (1HR) Q10

Solve

$$3x + 2y = 15$$
$$10x - 4y = 2$$

Show clear algebraic working.

$x =$ ....

$y =$ ....

(Total for Question 10 is 3 marks)

Quadratic equations

1. June 2016 4HR Q20

    The sketch shows the curve with equation $y = x^2 + 4$ and the line with equation $y = x + 10$
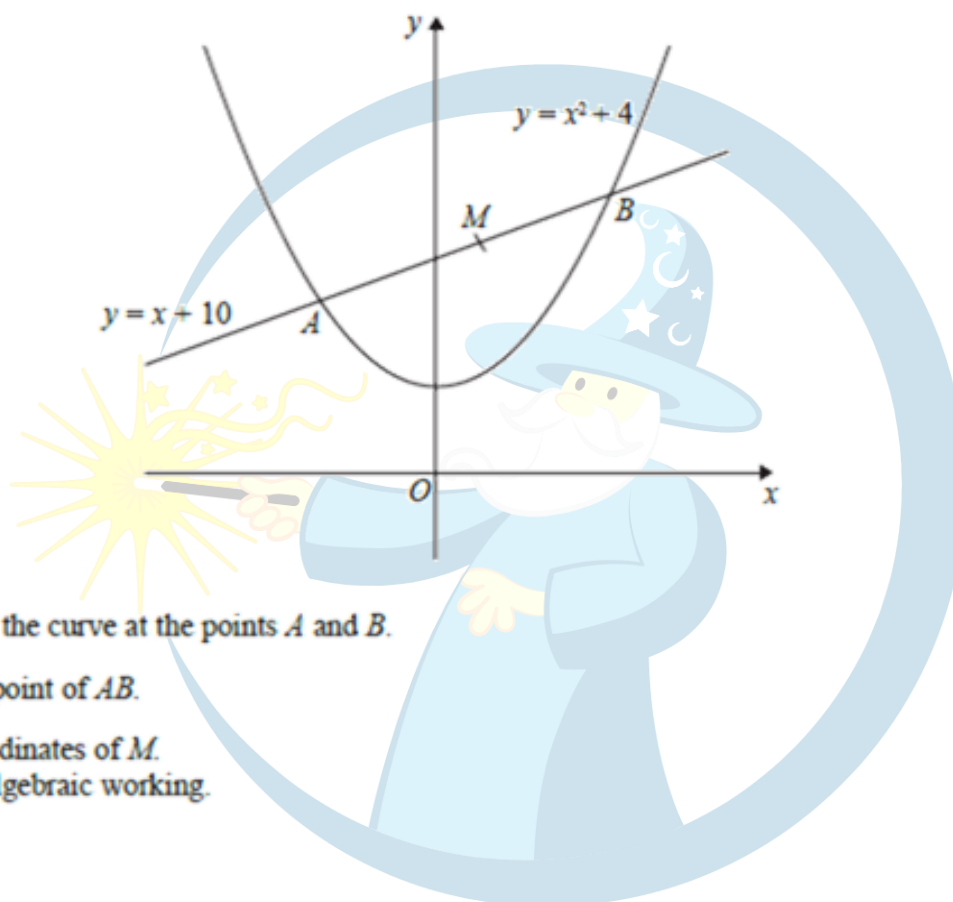
    The line cuts the curve at the points A and B.

    M is the midpoint of AB.

    Find the coordinates of M.
    Show clear algebraic working.

2. Jan 2017 (3H) Q23

    Solve the simultaneous equations
    $$x^2 + y^2 = 52$$
    $$2x + y = 8$$

    Show clear algebraic working.

3. June 2018 (2HR) Q18

Solve the simultaneous equations

$$2x^2 + 3y^2 = 14$$

$$x = 2y - 3$$

Show clear algebraic working.

4. June 2017 (3HR) Q18

Solve the simultaneous equations

$$y^2 + 4x = 12$$

$$2x + 3y = 10$$

Show clear algebraic working.
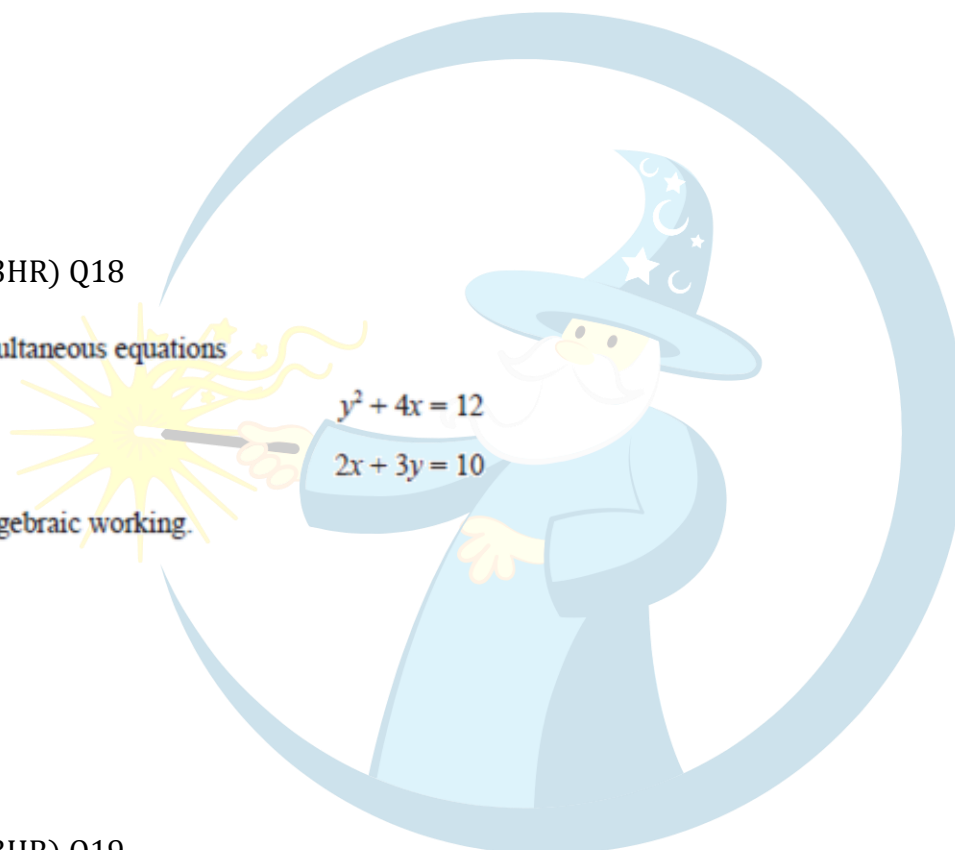
5. June 2018 (3HR) Q19

Solve the simultaneous equations

$$y = 5x^2$$

$$y - 4 = 3x$$

Show your working clearly.
Give your solutions correct to 2 decimal places.

6. Jan 2018 (4H) Q22

Solve the simultaneous equations

$$y + 2x = 3$$
$$x^2 + y^2 = 18$$

Show clear algebraic working.

7. Jan 2019 (2HR) Q21

The curve with equation $y = (10x - 3)(x + 1)$ and the line with equation $y - 6x = 0$ intersect at the points A and B.

Find the coordinates of the midpoint of AB.
Show your working clearly.

8. May 2019 (1HR) Q22

Solve the simultaneous equations

$$2x^2 + 3y^2 = 5$$
$$y = 2x + 1$$

Show clear algebraic working.

Solving algebraic inequalities

Linear equations

1. June 2016 (3H) Q7

    (c) (i) Solve $6k + 5 < 20$

    (ii) n is an integer and $6n + 5 < 20$

    Write down the largest possible value of n
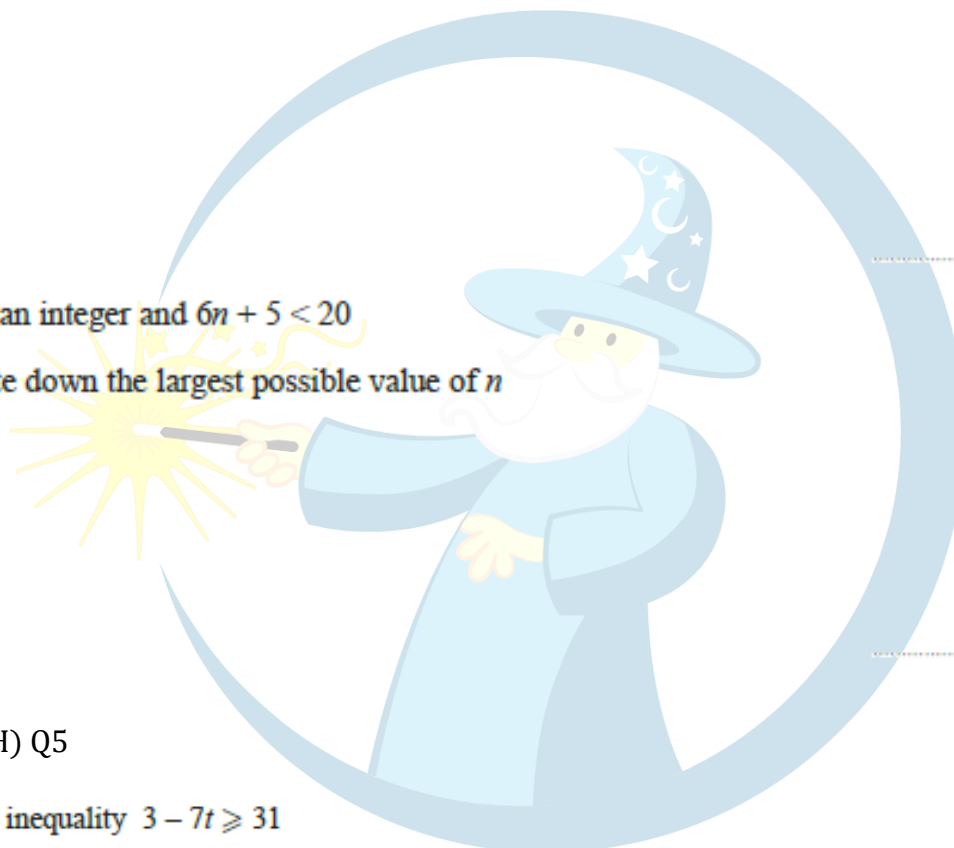
    (3)

2. Jan 2017 (3H) Q5

    (e) Solve the inequality $3 - 7t \geqslant 31$

3. Jan 2017 (4HR) Q7

    (e) Write down the inequality shown on the number line.
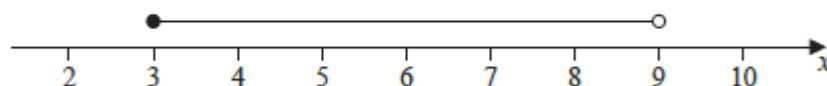
4. June 2016 (3HR) Q6

(a) Solve the inequalities $-4 < 3x + 5 \leqslant 11$

(3)

(b) Write down the integer values of x which satisfy $-4 < 3x + 5 \leqslant 11$

(2)

(Total for Question 6 is 5 marks)
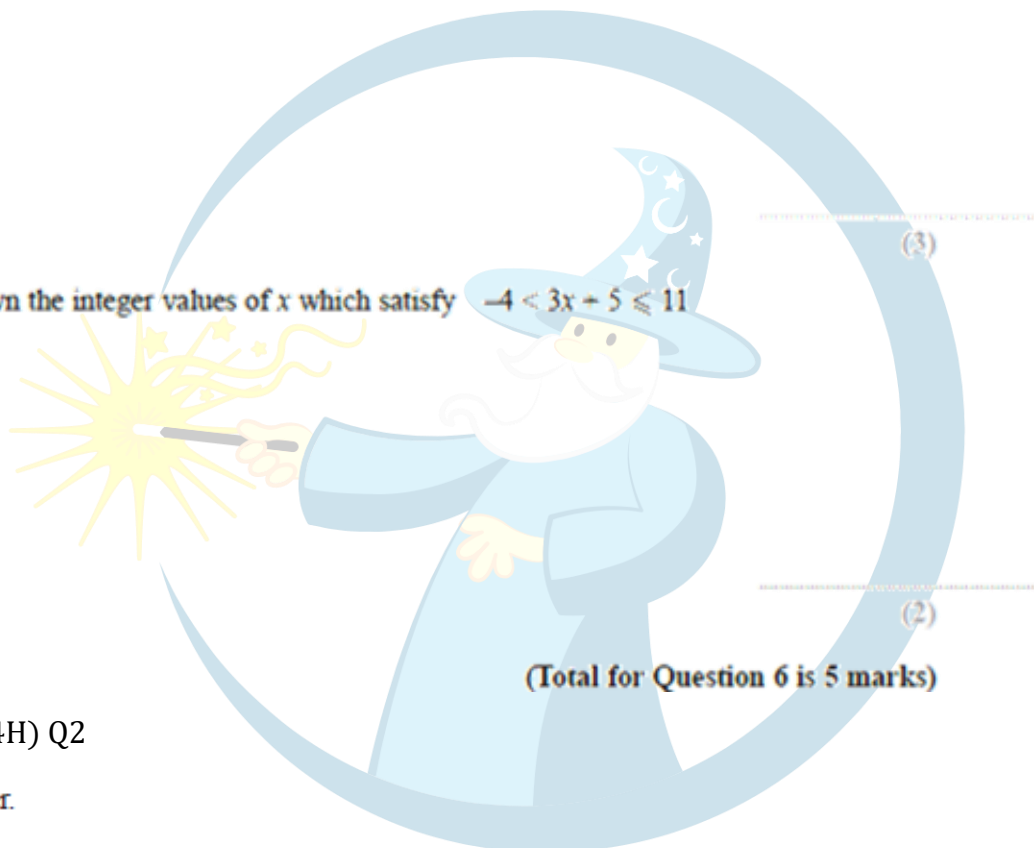
5. June 2017 (4H) Q2

y is an integer.
$-2 < y \leqslant 3$

(c) Write down all the possible values of y.

(2)

6. June 2017 (4HR) Q7

(a) Solve the inequality $4x + 13 \geqslant 27$

(2)

(b) On the number line, represent the inequality $y \geqslant -1$
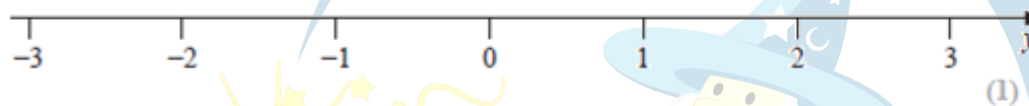
(1)

n is an integer.

(c) Write down all the values of n that satisfy $-3 < n \leqslant 2$

(2)

(Total for Question 7 is 5 marks)

7. June 2018 (2H) Q1

(b) Solve the inequality $5x - 4 < 39$

(2)

8. June 2018 (3H) Q5

(b) Write down the inequality shown on the number line.

(2)
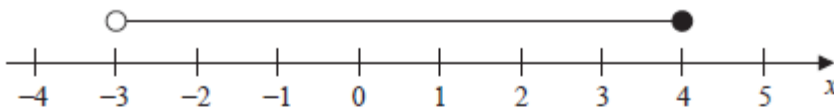
(c) Solve the inequality $2m + 13 \geqslant 8$

(2)

9. Jan 2019 (2HR) Q8

(b) Solve the inequality $7 < 4x - 1 \leqslant 17$

10. June 2018 (3H) Q8

(a) Solve the inequalities $-3 < x + 4 < 9$

(2)

(b) On the number line, represent $-2 < y \leqslant 5$

(2)
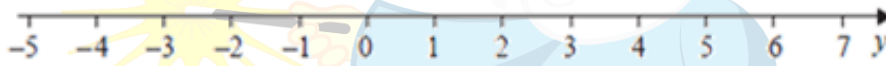
(Total for Question 8 is 4 marks)

11. June 2018 (4HR) Q9

(a) Simplify $(3a^2b^4)^3$

(2)

(b) Expand and simplify $4(g - 2h) + 5(2g - 3h)$

(2)

(c) Expand and simplify $(y - 7)(y + 5)$

(2)

(d) Solve the inequalities $-5 \leqslant 2p + 3 < 13$

(3)

(Total for Question 9 is 9 marks)

12. June 2019 (2H) Q10

(b)
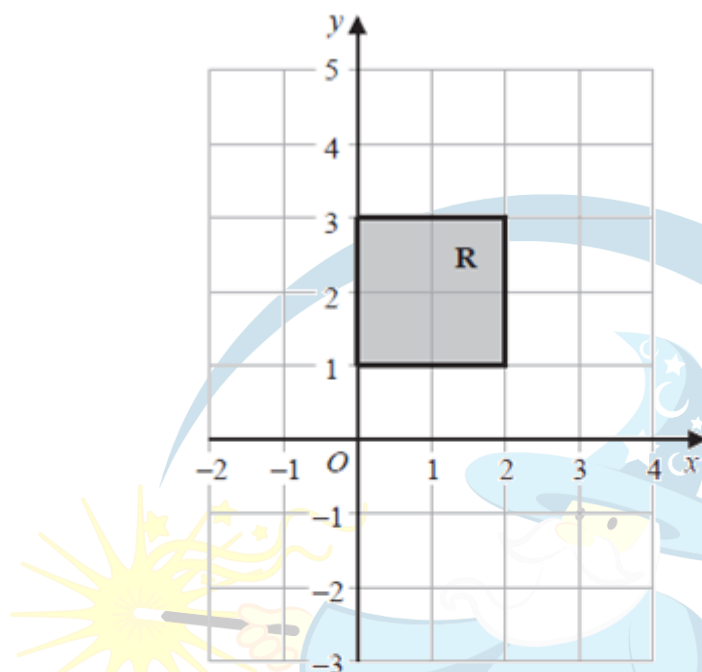
The region **R**, shown shaded in the diagram, is bounded by four straight lines.

Write down the inequalities that define **R**.

(2)

(Total for Question 10 is 4 marks)

13. June 2019 (2HR) Q1

(a)

Write down the inequality shown on the number line.

.... (1)
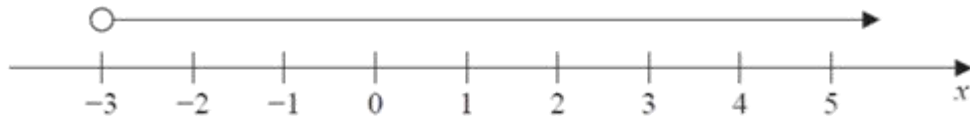
(b) Solve the inequality $4y - 13 \leqslant y + 8$

.... (2)

(Total for Question 1 is 3 marks)

14.

15. May 2018 (1H) Q12

The diagram shows two straight lines drawn on a grid.
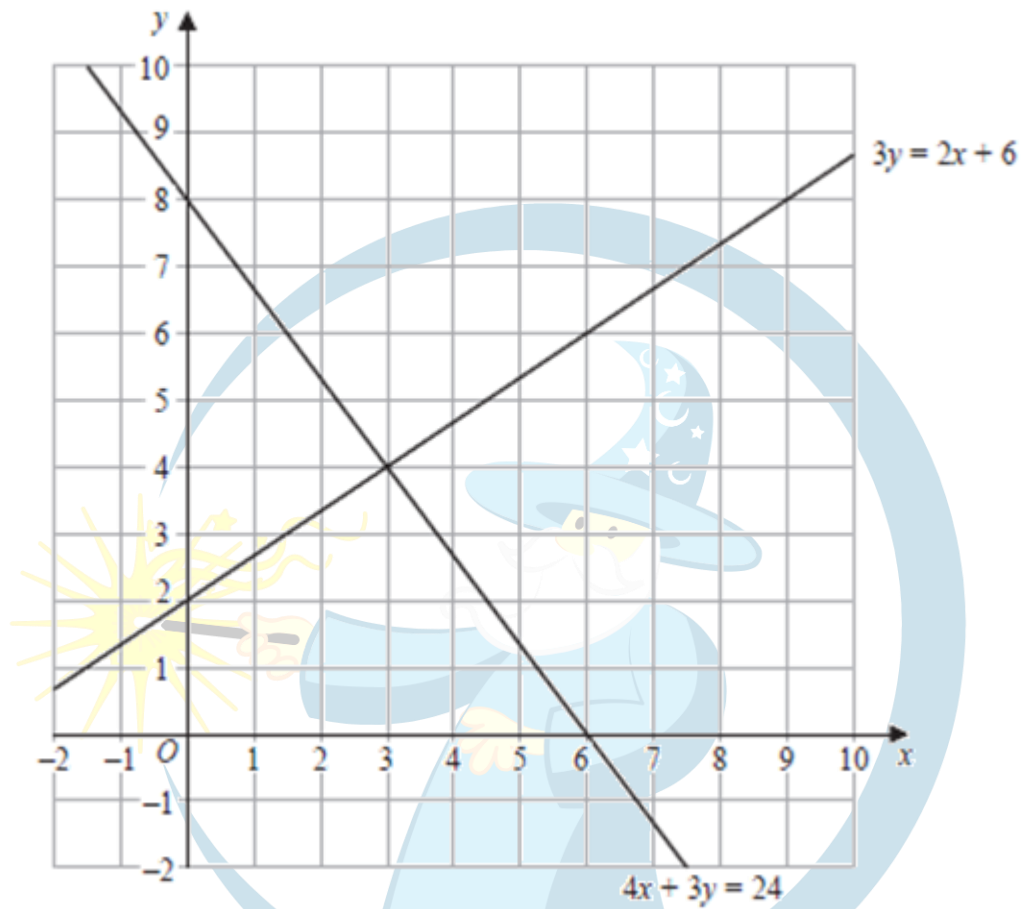
(b) Show, by shading on the grid, the region defined by all five of the inequalities

$$x \geqslant 0 \qquad y \geqslant 0 \qquad x + y \geqslant 4 \qquad 3y \leqslant 2x + 6 \qquad 4x + 3y \leqslant 24$$

Label the region R.

Quadratic equations

1. June 2018 2HR (Q20)

   Solve the inequality $4x^2 - 5x - 6 > 0$

2. June 2018 (3HR) Q14

   (a) Solve the inequality $\frac{1}{4}p < 7$

   ....

   (1)

   (b) Solve the inequality $16q^2 > 9$

   ....

   (3)

   (Total for Question 14 is 4 marks)

Patterns and sequences

1. June 2016 (4H) Q1

   Here are the first five terms of an arithmetic sequence.

   $$7 \qquad 10 \qquad 13 \qquad 16 \qquad 19$$

   Find an expression for the nth term of the sequence.

2. June 2018 (1HR) Q7

   Here are the first four terms of an arithmetic sequence.

   $$6 \qquad 10 \qquad 14 \qquad 18$$

   (a) Find an expression, in terms of n, for the nth term of this sequence.

   (2)

   (b) Write down an expression, in terms of n, for the $(n - 1)$th term of this sequence.

   (1)
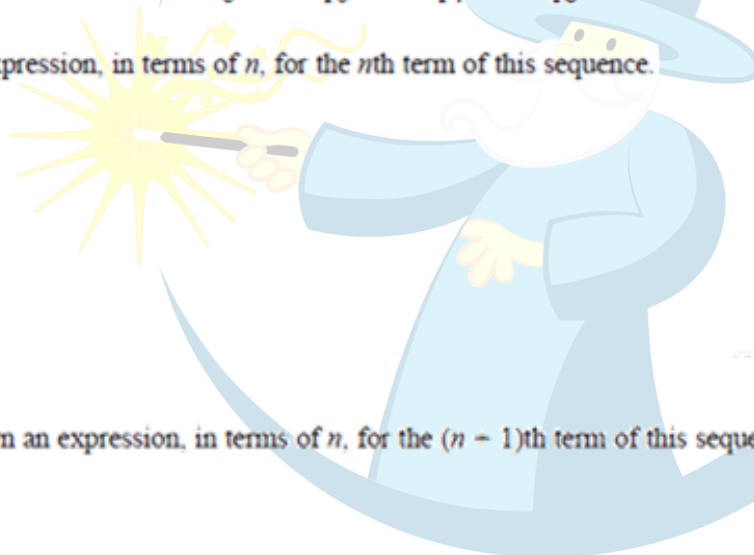
   (Total for Question 7 is 3 marks)

3. June 2018 (1HR) Q23

   Work out the sum of the multiples of 3 between 1 and 1000

4. Jan 2019 (1H) Q21

$(2x + 23)$, $(8x + 2)$ and $(20x - 52)$ are three consecutive terms of an arithmetic sequence.

Prove that the common difference of the sequence is 12

5. June 2018 (2H) Q23

The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

Find the sum of the first 30 terms of this series.

6. Jan 2019 (2H) Q2

Here are the first five terms of an arithmetic sequence.

7   11   15   19   23

Write down an expression, in terms of n, for the nth term of this sequence.

(Total for Question 2 is 2 marks)

7. Jan 2019 (1HR) Q12

Here are the first four terms of a sequence of fractions.

$$\frac{1}{1} \qquad \frac{2}{3} \qquad \frac{3}{5} \qquad \frac{4}{7}$$

The numerators of the fractions form the sequence of whole numbers 1 2 3 4 ...
The denominators of the fractions form the sequence of odd numbers 1 3 5 7 ...

(a) Write down an expression, in terms of n, for the nth term of this sequence of fractions.

(2)

(b) Using algebra, prove that when the square of any odd number is divided by 4 the remainder is 1

(3)

(Total for Question 12 is 5 marks)

8. Jan 2019 (2HR) Q3

Here are the first five terms of a number sequence S.

10   16   22   28   34

(a) Find an expression, in terms of n, for the nth term of this sequence.

(2)

The nth term of a sequence T is given by $n^2 - 3$

There are numbers that are terms in both the sequence S and the sequence T.

(b) Find one of these numbers.

(2)

(Total for Question 3 is 4 marks)
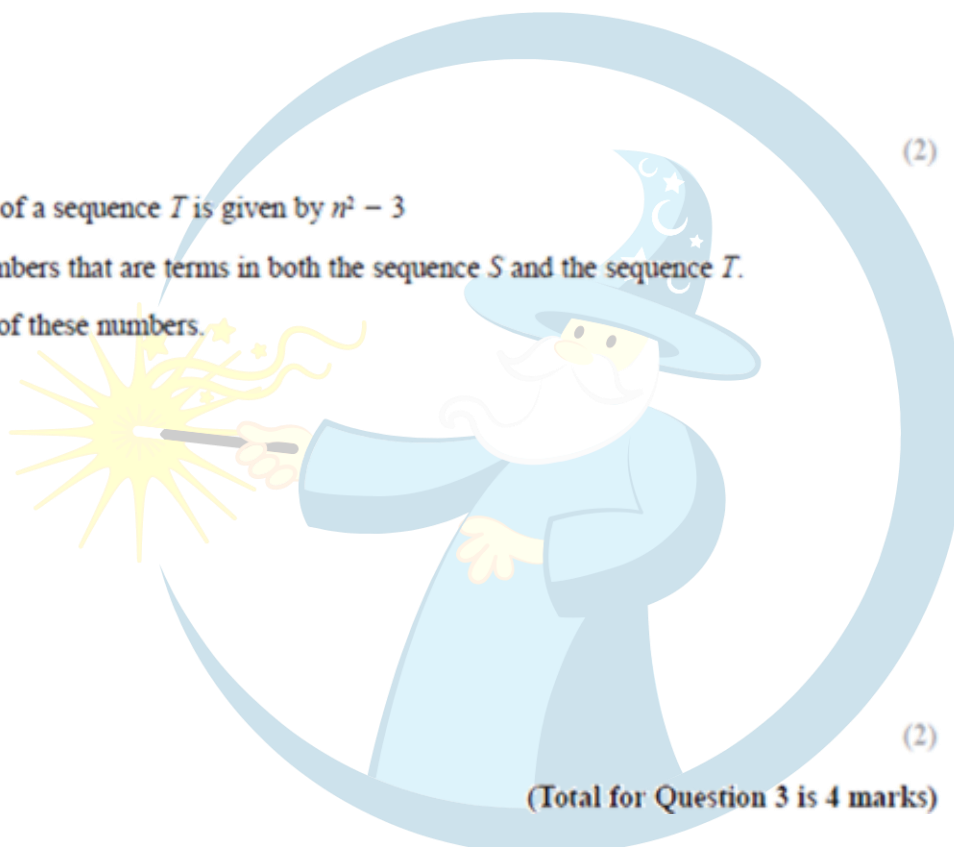
9. Jan 2019 (2HR) Q23

The 10th term of an arithmetic series, S, is 66
The sum of the first 20 terms of S is 1290

Find the 5th term of S.
Show your working clearly.

10. May 2019 (1H) Q16

Here are the first five terms of an arithmetic sequence.

$$7 \quad 10 \quad 13 \quad 16 \quad 19$$

Find the sum of the first 100 terms of this sequence.

(Total for Question 16 is 2 marks)

11. May 2018 (1HR) Q7

Here are the first four terms of an arithmetic sequence.

$$6 \qquad 10 \qquad 14 \qquad 18$$

(a) Find an expression, in terms of n, for the nth term of this sequence.

....
(2)

(b) Write down an expression, in terms of n, for the $(n + 1)$th term of this sequence.

....
(1)

(Total for Question 7 is 3 marks)
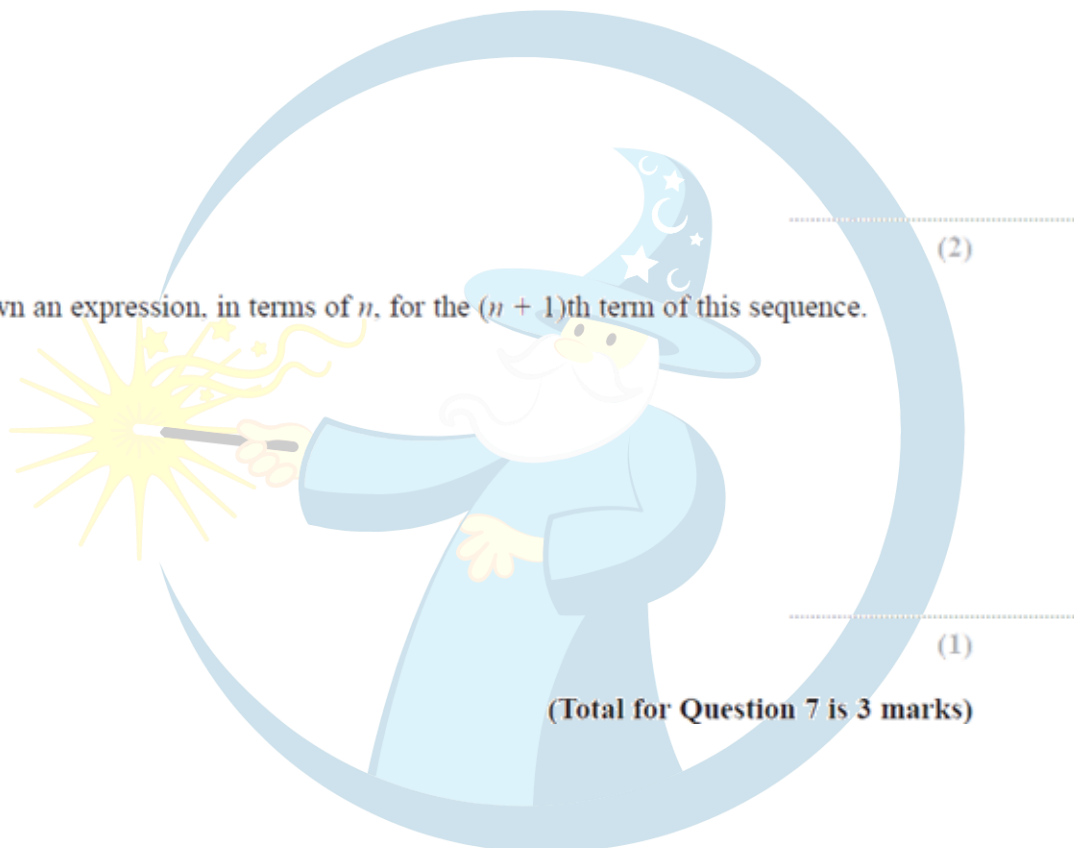
12. June 2019 (2HR) Q17

The table gives information about the first six terms of a sequence of numbers.

Term number	1	2	3	4	5	6
Term of sequence	$\dfrac{1 \times 2}{2}$	$\dfrac{2 \times 3}{2}$	$\dfrac{3 \times 4}{2}$	$\dfrac{4 \times 5}{2}$	$\dfrac{5 \times 6}{2}$	$\dfrac{6 \times 7}{2}$

Prove algebraically that the sum of any two consecutive terms of this sequence is always a square number.

(Total for Question 17 is 4 marks)

13. May 2019 (1HR) Q19

The 25th term of an arithmetic series is 44.5
The sum of the first 30 terms of this arithmetic series is 765

Find the 16th term of the arithmetic series.
Show your working clearly.

(Total for Question 19 is 5 marks)

Algebraic proof

1. June 2018 (1HR) Q5

   $E = n^2 + n + 5$

   Ali thinks that the value of E will be a prime number for any whole number value of n.

   Is Ali correct?
   You must give a reason for your answer.

   (Total for Question 5 is 2 marks)

2. June 2018 (4H) Q13

   n is a whole number.

   Use algebra to show that $(2n + 1)^2 + (n - 2)^2$ is always a multiple of 5

3. June 2018 (1HR) Q21

(a) Show that $x(x - 1)(x + 1) = x^3 - x$

(1)

(b) Prove that the difference between a whole number and the cube of this number is always a multiple of 6

(3)

(Total for Question 21 is 4 marks)
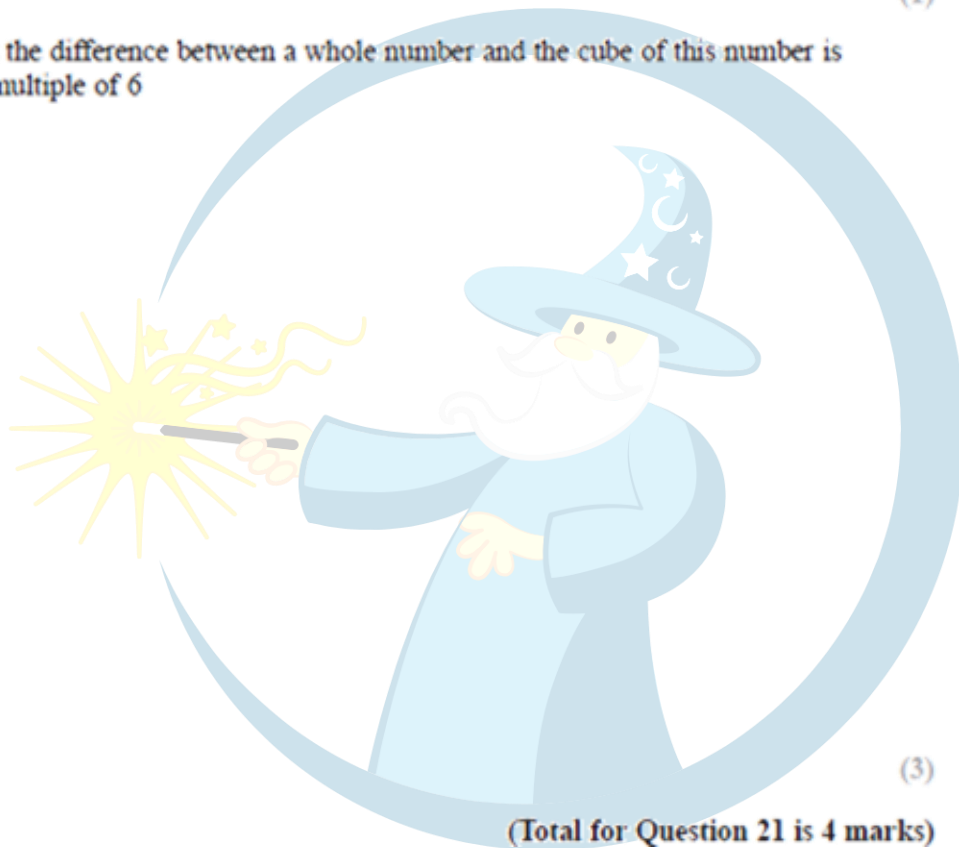
Function notation

1. June 2016 (3HR) Q18

f is the function such that

$$f(x) = \frac{x}{3x + 1}$$

(a) Find   f(0.5)

....

(1)

(b) Find   ff(−1)

....

(2)

(c) Find the value of x that cannot be included in any domain of f

....

(1)

(d) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$
     Show clear algebraic working.

$f^{-1}(x) = $ ....

(3)
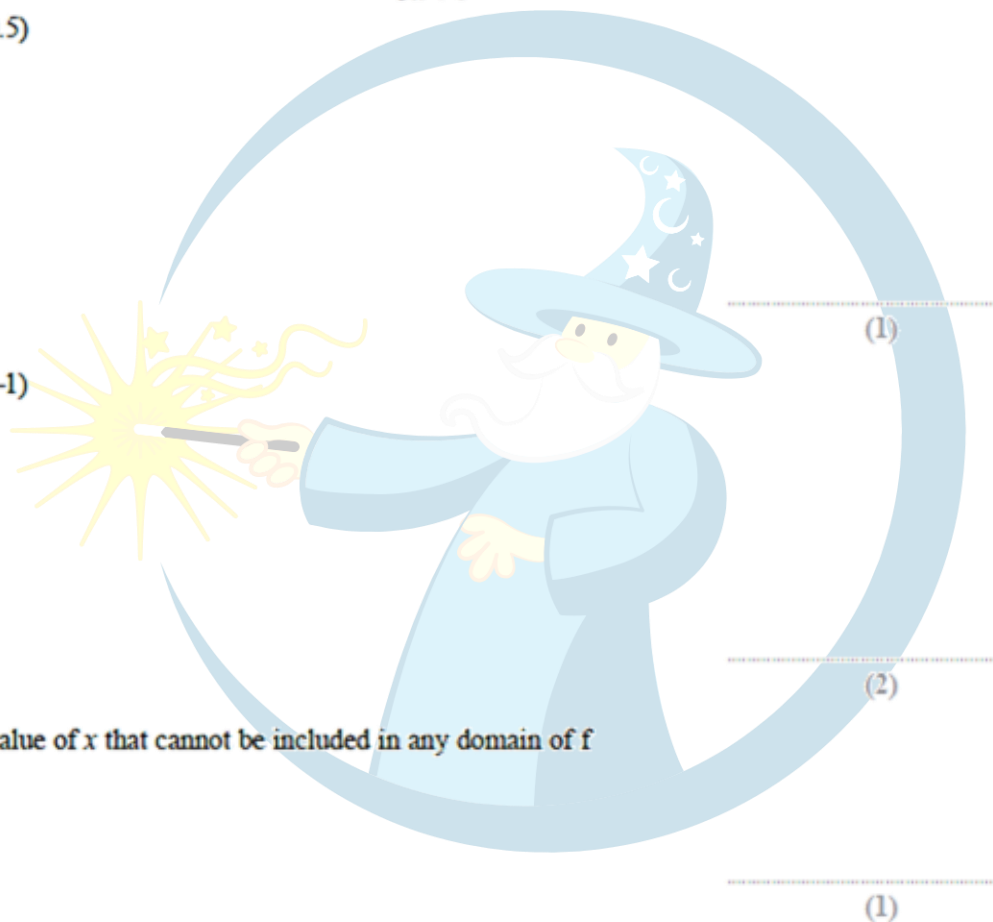
(Total for Question 18 is 7 marks)

2. June 2016 (4H) Q17

f is the function such that f(x) = 2x − 5

g is the function such that g(x) = x² − 10

(a) Find f(4)

$$\text{..................................}$$
(1)

(b) Find fg(−4)

$$\text{..................................}$$
(2)

(c) Express the inverse function f⁻¹ in the form f⁻¹(x) = ...

$$f^{-1}(x) = \text{..................................}$$
(2)

(d) Solve gf(x) = −1

$$\text{..................................}$$
(4)

(Total for Question 17 is 9 marks)

3. Jan 2017 (3HR) Q19

The function f is defined as $f(x) = \dfrac{3}{2 - x}$

(a) State the value of x which cannot be included in any domain of f.

....

(1)

(b) Find f(−4)

....

(1)

(c) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ ....
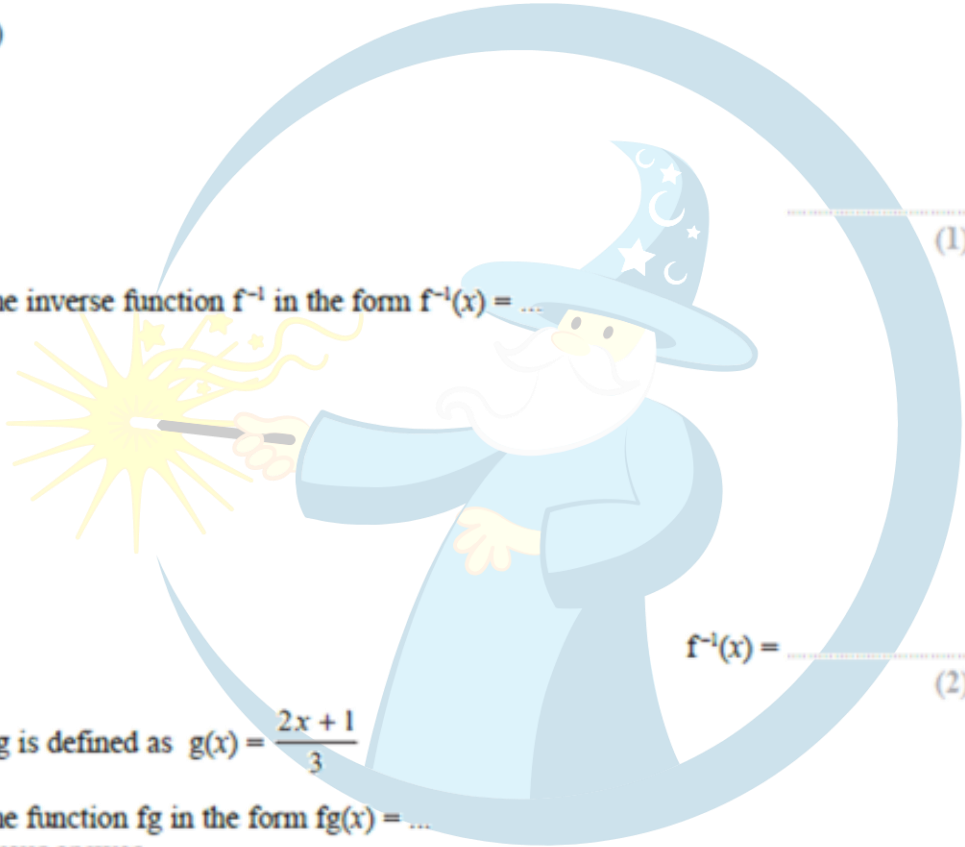
(2)

The function g is defined as $g(x) = \dfrac{2x + 1}{3}$

(d) Express the function fg in the form $fg(x) = ...$
Simplify your answer.

$fg(x) =$ ....

(2)

(Total for Question 19 is 6 marks)

4. Jan 2017 (4H) Q18

The function f is such that $f(x) = \dfrac{2x}{3x+5}$

(a) Find $f(-2)$

(1)

The function g is such that $g(x) = \dfrac{3}{x+4}$

(b) Find $g^{-1}(6)$

(2)

(c) Find $fg(-5)$

(2)

(d) Solve the equation $f(x) = g(x)$
Show clear algebraic working.
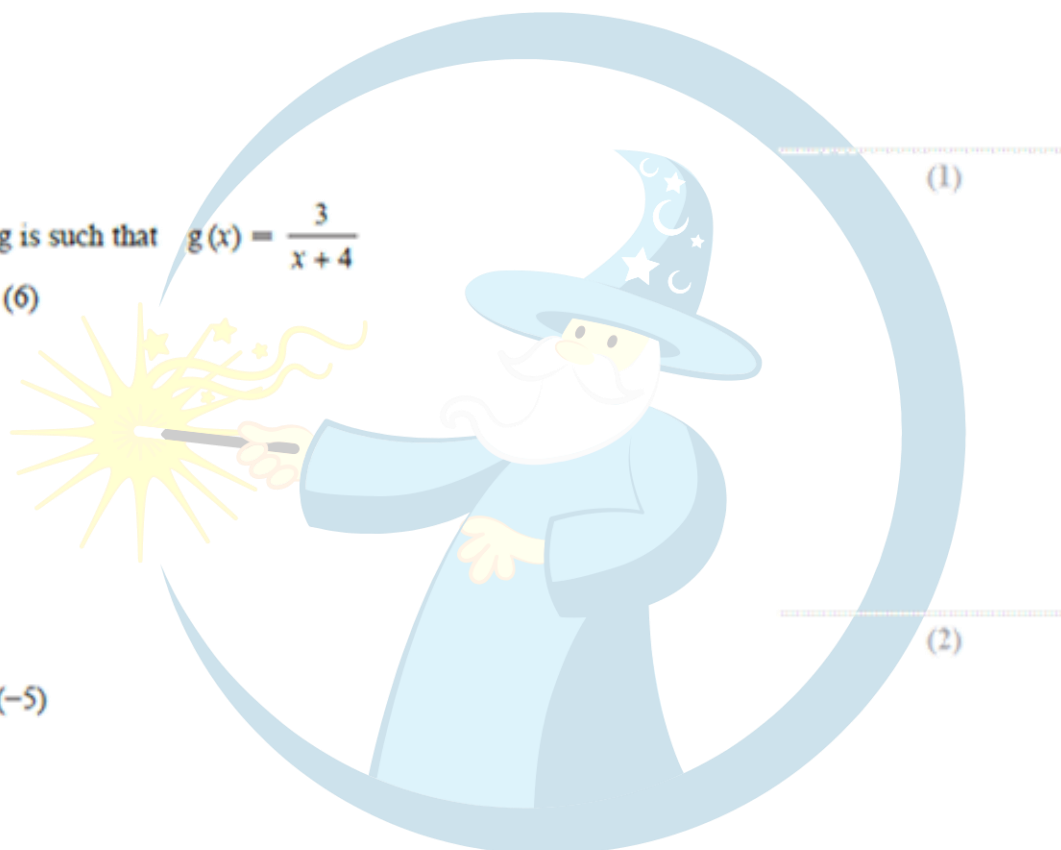
5. June 2017 (3H) Q19

$f(x) = \dfrac{4}{x - 3}$

$g(x) = \dfrac{x - 2}{x}$

(a) Express the inverse function f^{-1} in the form $f^{-1}(x) = \ldots$

$f^{-1}(x) = $ _____

(3)

(b) Solve $fg(a) = 1$

Show clear algebraic working.

$a = $ _____

(3)

(Total for Question 19 is 6 marks)

6. June 2017 (4HR) Q20

The functions f and g are such that

$$f(x) = \frac{1}{x+5} \quad \text{and} \quad g(x) = 2x + 3$$

(a) State which value of x must be excluded from any domain of f.

....

(1)

(b) Find g(10)

....

(1)

(c) Calculate gf(−7)

....

(2)

(d) Express the inverse function g^{-1} in the form $g^{-1}(x) = \ldots$

$g^{-1}(x) = $ ....

(2)

(Total for Question 20 is 6 marks)

7. June 2018 (1H) Q14

The function f is such that

$$f(x) = \frac{3x - 5}{4}$$

(a) Find f(−7)

....

(1)

(b) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ ....
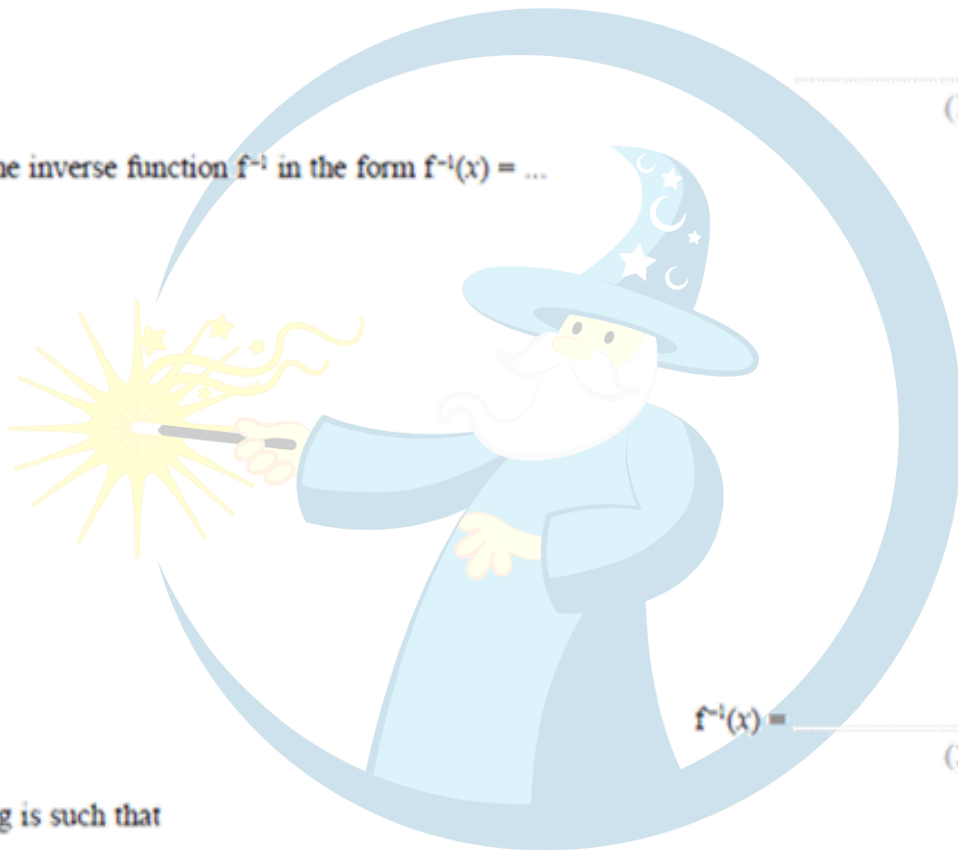
(2)

The function g is such that

$$g(x) = \sqrt{19 - x}$$

(c) Find fg(3)

....

(2)

(d) Which values of x cannot be included in any domain of g?

....

(2)

8. June 2018 (1HR) Q20

Two functions, f and g are defined as

$$f : x \mapsto 1 + \frac{1}{x} \quad \text{for } x > 0$$

$$g : x \mapsto \frac{x+1}{2} \quad \text{for } x > 0$$

Given that h = fg

express the inverse function h^{-1} in the form $h^{-1} : x \mapsto \dots$
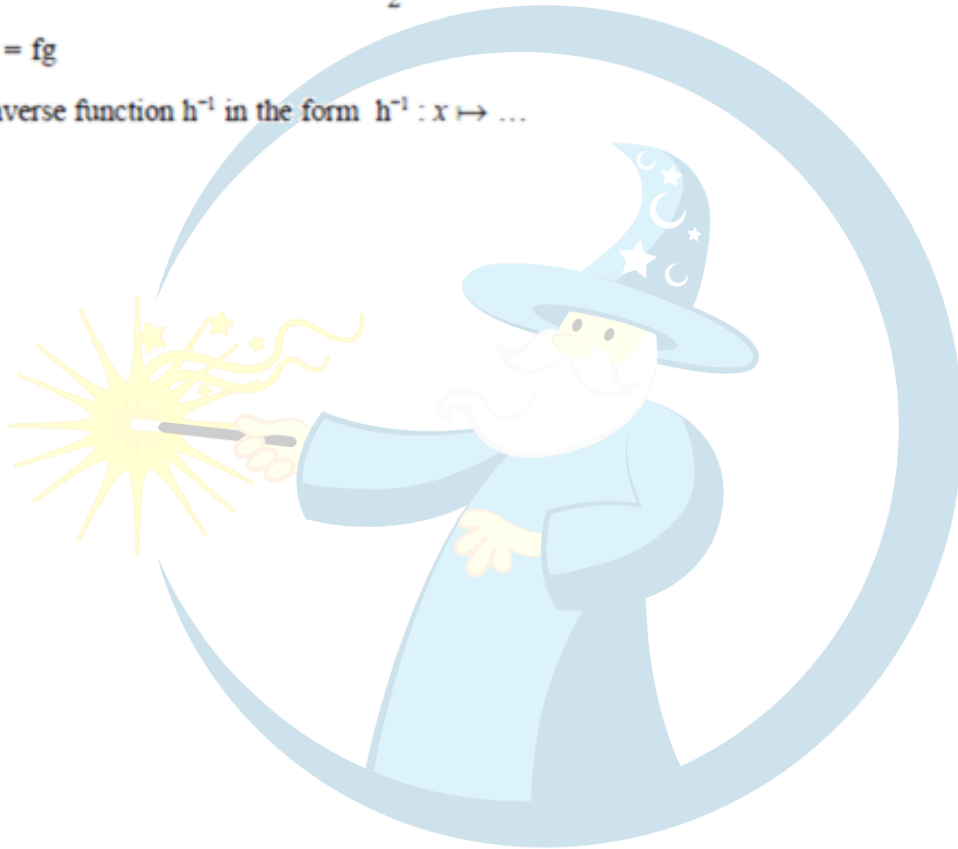
9. Jan 2018 (3H) Q23

f is the function such that $f(x) = \dfrac{3x}{x-2}$ where $x \neq 2$

g is the function such that $g(x) = \dfrac{4x}{5}$

(a) Find gf(−4)

.... (2)

(b) Express the composite function fg in the form fg(x) = ...
Give your answer as a single fraction in its simplest form.

fg(x) = ... (3)

(c) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) = $ .... (3)

(Total for Question 23 is 8 marks)

10. June 2018 3H Q21

f is the function such that $f(x) = 3 - 2x$

(a) Find f(−4)

....

(1)

(b) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) = $ ....

(2)

g is the function such that $g(x) = x^2 - 5$

(c) Solve the equation gf(x) = ff(x)
Show clear algebraic working.

....

(5)
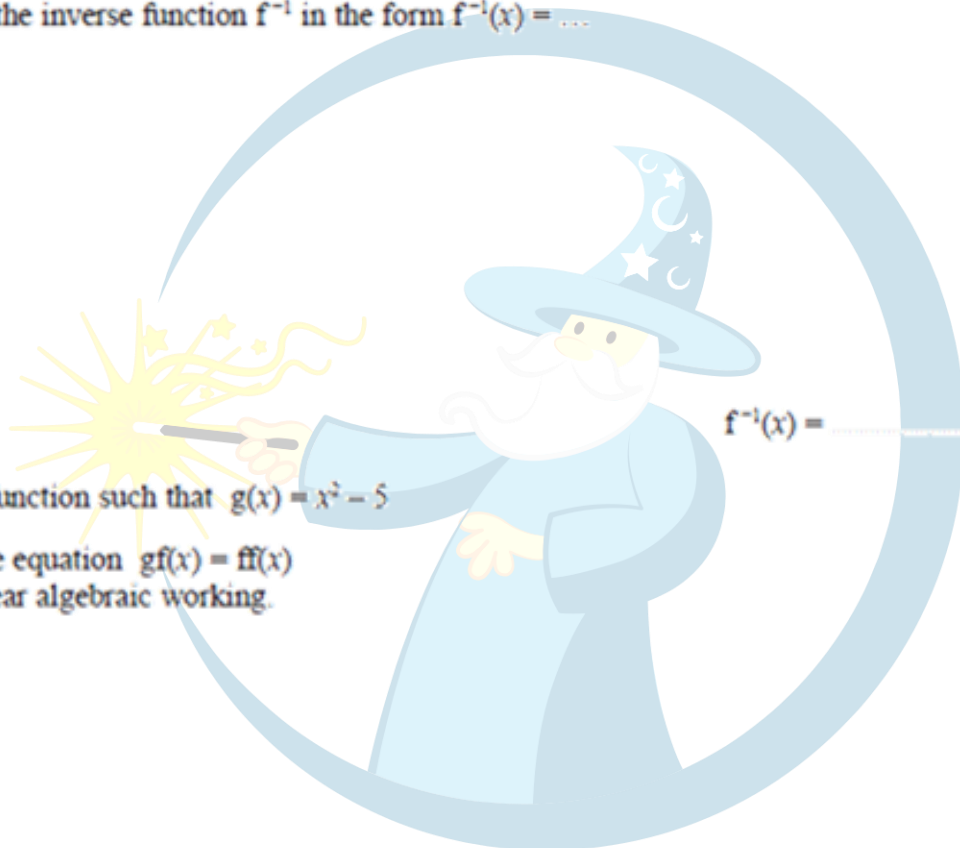
(Total for Question 21 is 8 marks)

11. Jan 2018 (3HR) Q23

f is the function such that $f(x) = (x + 1)^2$ for $x > 0$

(a) Find the value of a for which $f(a) = \dfrac{25}{9}$

Show clear algebraic working.

$a =$ ....
(3)

g is the function such that $g(x) = \dfrac{1}{x}$ for $x > 0$

(b) Show that $x^2 fg(x) = f(x)$ for all $x > 0$

(2)
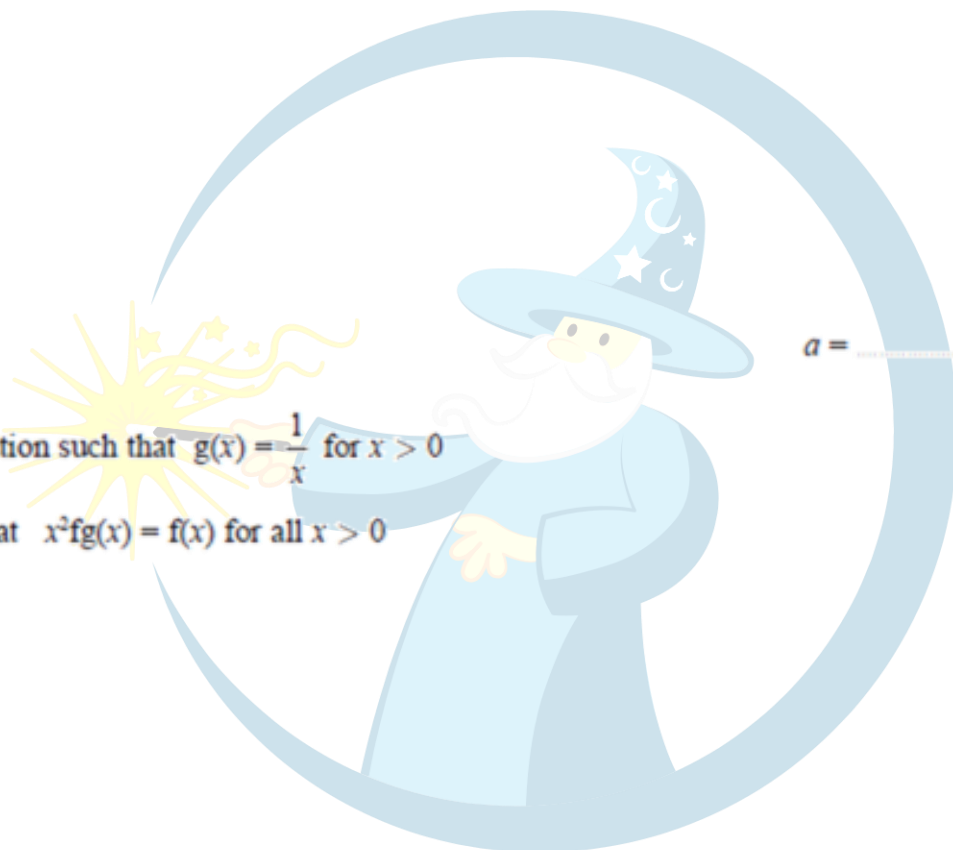
h is the function such that $hf(x) = x$ for all $x > 1$

(c) Find the function h in the form $h(x) = \ldots$

$h(x) =$ ....
(2)

(Total for Question 23 is 7 marks)

12. June 2018 (3HR) Q23

f is the function such that $f(x) = \sqrt{4 - x}$ and $f(x) \geqslant 0$

(a) State which values of x must be excluded from any domain of f

....

(1)

The inverse function f^{-1} has domain $x \geqslant 0$

(b) Find $f^{-1}(x)$

$f^{-1}(x) =$ ....

(2)
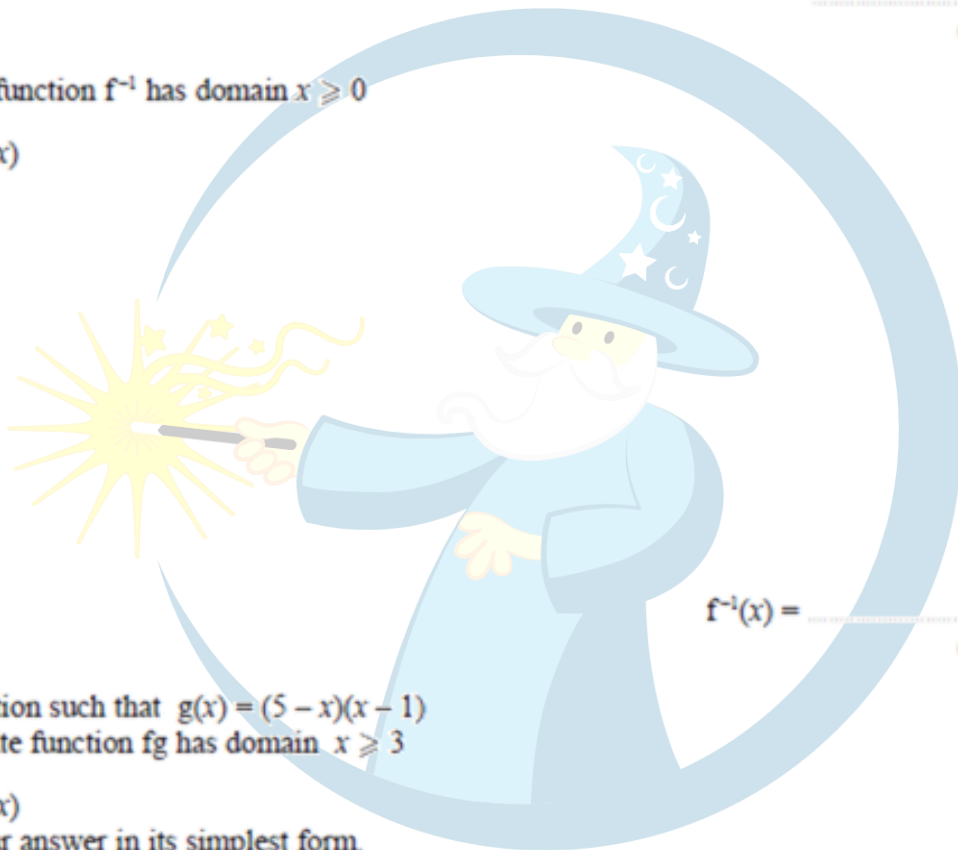
g is the function such that $g(x) = (5 - x)(x - 1)$
The composite function fg has domain $x \geqslant 3$

(c) Find $fg(x)$
   Give your answer in its simplest form.

$fg(x) =$ ....

(4)

(Total for Question 23 is 7 marks)

13. Jan 2019 (1H) Q19

g is the function with domain $x \geqslant -3$ such that $g(x) = x^2 + 6x$

(a) Write down the range of g^{-1}

(1)

(b) Express the inverse function g^{-1} in the form $g^{-1} : x \longmapsto \ldots$
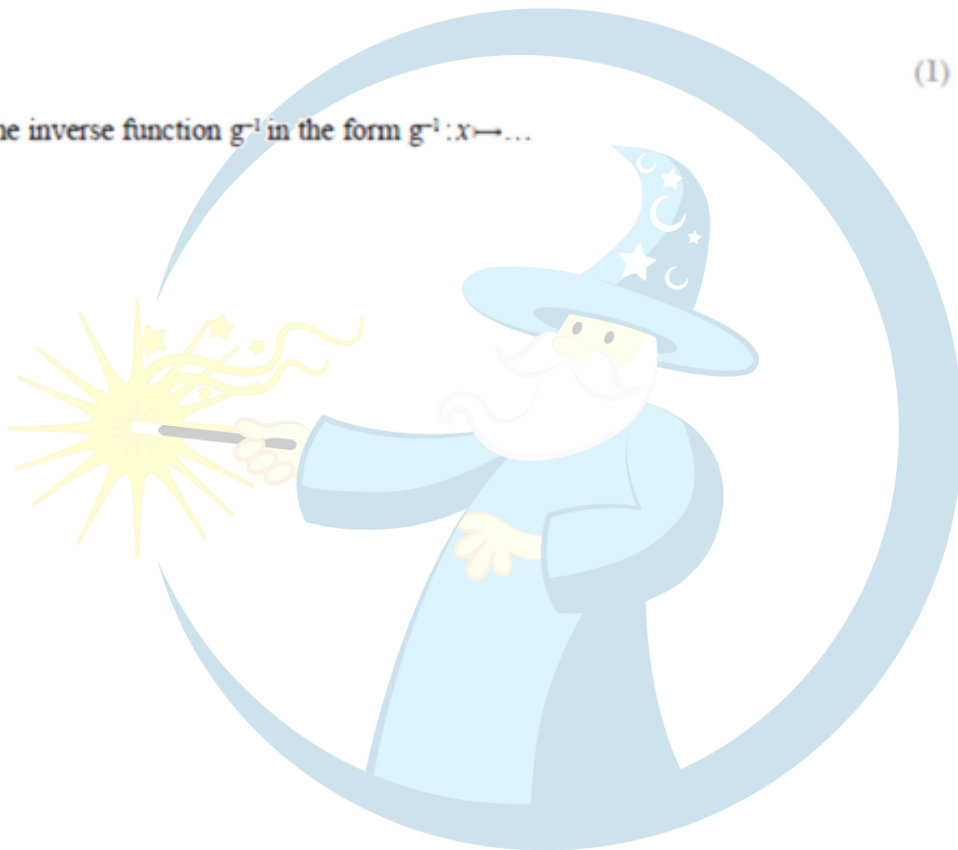
$$g^{-1} : x \longmapsto$$

(4)

(Total for Question 19 is 5 marks)

14. Jan 2019 (1HR) Q23

The function f is defined as $f(x) = \dfrac{\sqrt{x^2 + k^2}}{x}$ for $x > 0$ and where k is a positive number.

(a) Find the value of p for which $f^{-1}(p) = k$

$p =$

(3)
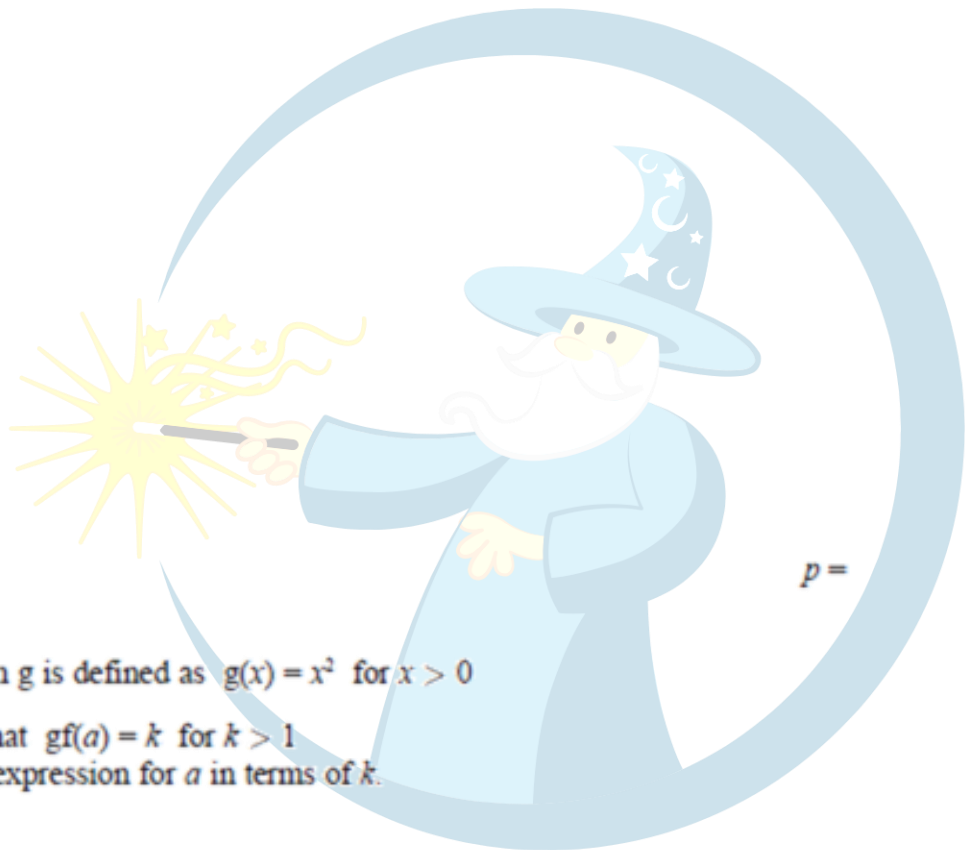
The function g is defined as $g(x) = x^2$ for $x > 0$

(b) Given that $gf(a) = k$ for $k > 1$
find an expression for a in terms of k.

$a =$

(3)

(Total for Question 23 is 6 marks)

15. Jan 2019 (2H) Q17

f is the function such that f(x) = 4 – 3x

(a) Work out f(5)

(1)

g is the function such that $g(x) = \dfrac{1}{1 - 2x}$

(b) Find the value of x that cannot be included in any domain of g

(1)

(c) Work out fg(−1.5)

(2)

(Total for Question 17 is 4 marks)

Variation / Proportion

1. June 2016 (4H) Q13

M is directly proportional to p^3
$M = 128$ when $p = 8$

(a) Find a formula for M in terms of p.

(3)

(b) Find the value of M when $p = 5$

(1)

(Total for Question 13 is 4 marks)
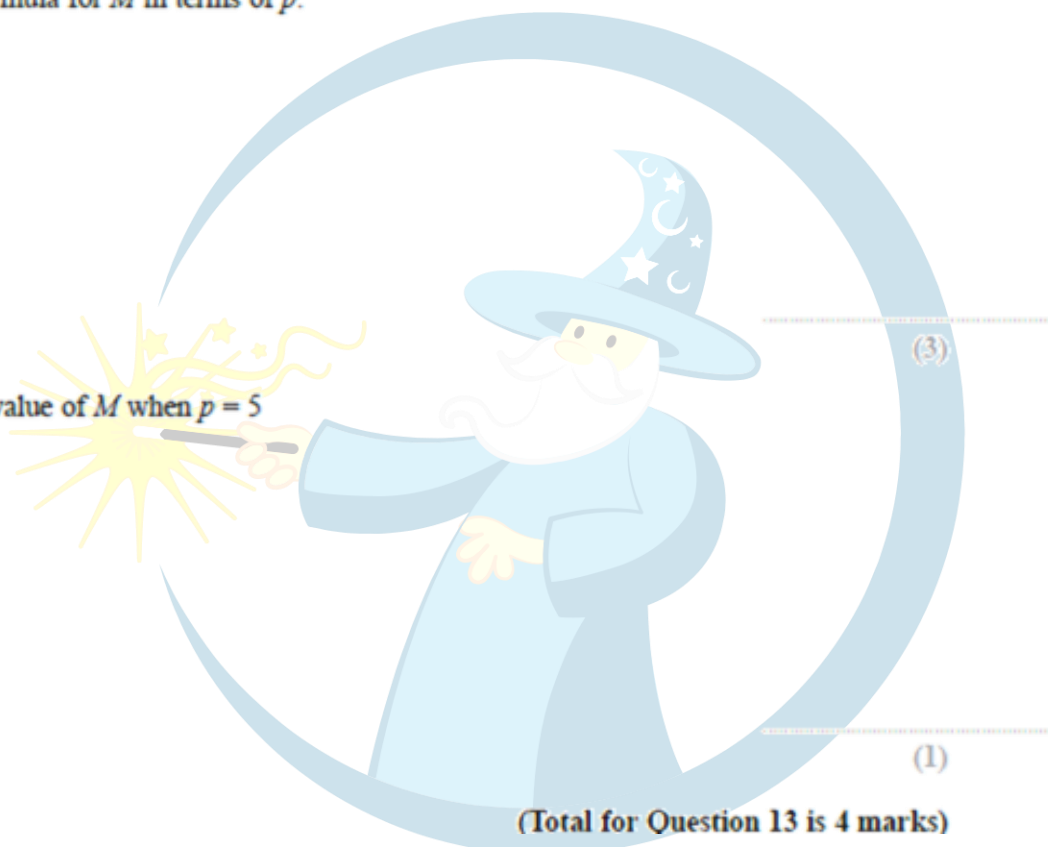
2. June 2017 (3H) Q15

P is directly proportional to r^3
$P = 343$ when $r = 3.5$

Find a formula for P in terms of r.

3. Jan 2017 (3H) Q14

T is directly proportional to $\sqrt{x}$
$T = 400$ when $x = 625$

(a) Find a formula for T in terms of x.

(3)

(b) Calculate the value of T when $x = 56.25$

(1)

(Total for Question 14 is 4 marks)
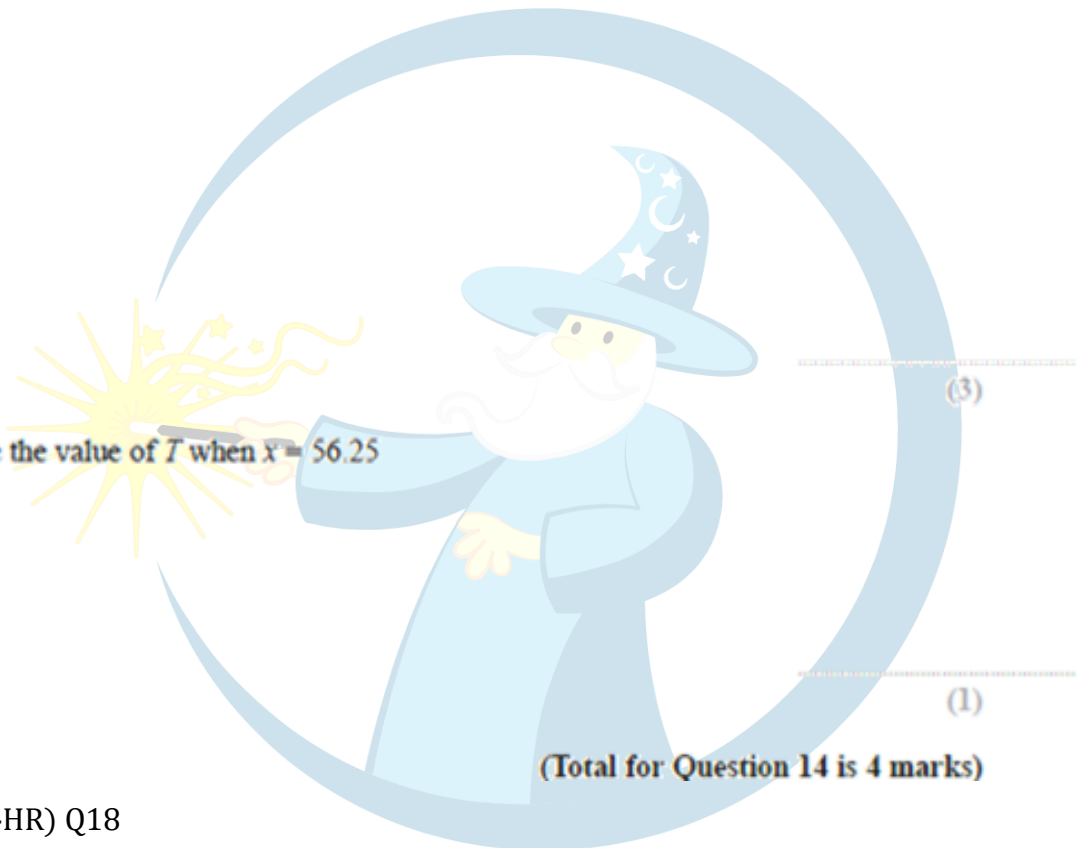
4. June 2017 (4HR) Q18

A is directly proportional to x^2

$A = 480$ when $x = 5$

Find the value of A when $x = 1.5$

5. Jan 2017 (4HR) Q13

P is inversely proportional to the square of q.
When $q = 2$, $P = 12.8$

(a) Find a formula for P in terms of q.

.... (3)

(b) Find the value of P when $q = 8$

.... (1)

(Total for Question 13 is 4 marks)
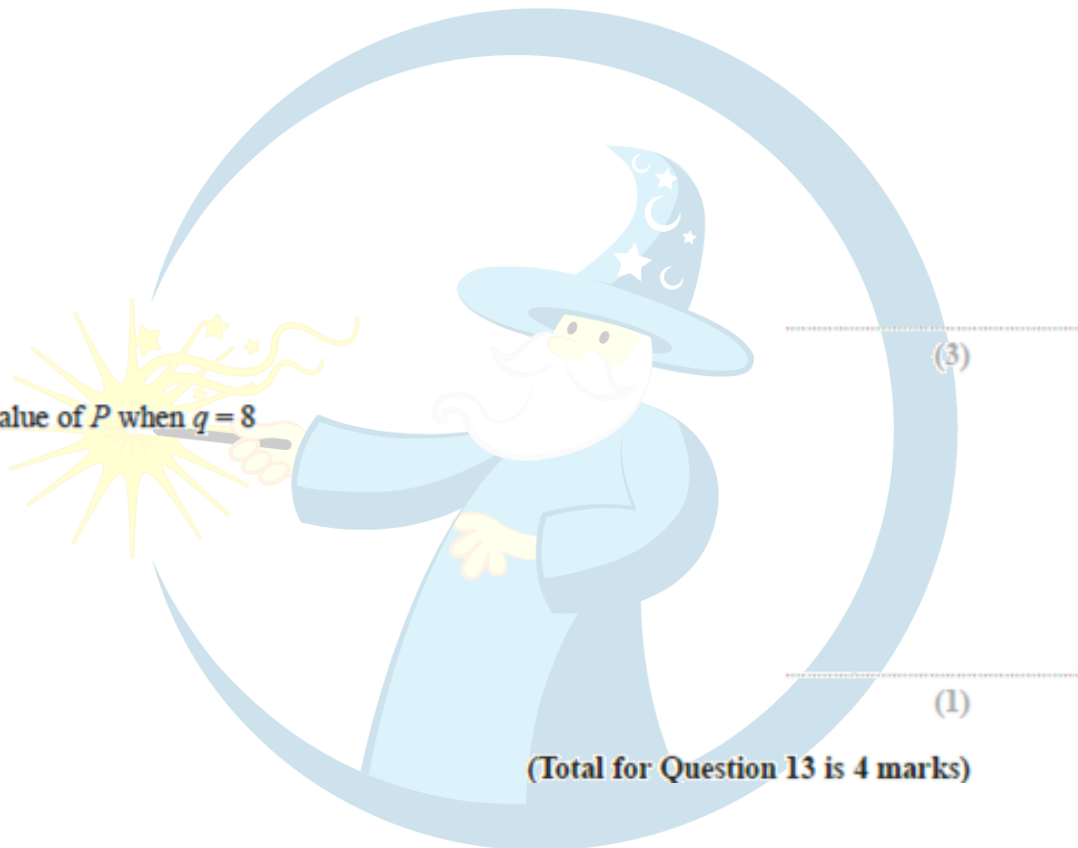
6. June 2018 (2H) Q16

R is proportional to t^2
The graph shows the relationship between R and t for $0 \leqslant t \leqslant 4$
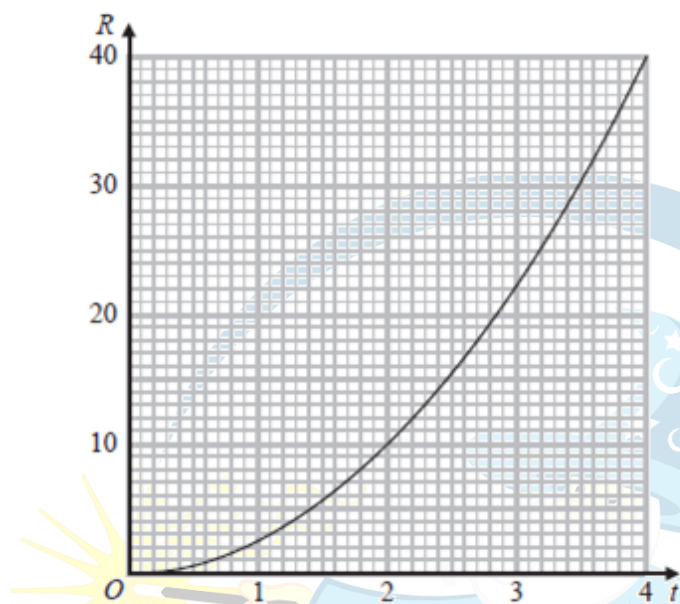
(a) Find a formula for R in terms of t.

(3)

Given also that $R = \dfrac{8}{5x}$

(b) show that t is inversely proportional to $\sqrt{x}$ for $t > 0$

7. Jan 2018 (4H) Q15

P is inversely proportional to the square of d.

$P = 25.6$ when $d = \dfrac{1}{8}$

Find a formula for P in terms of d.
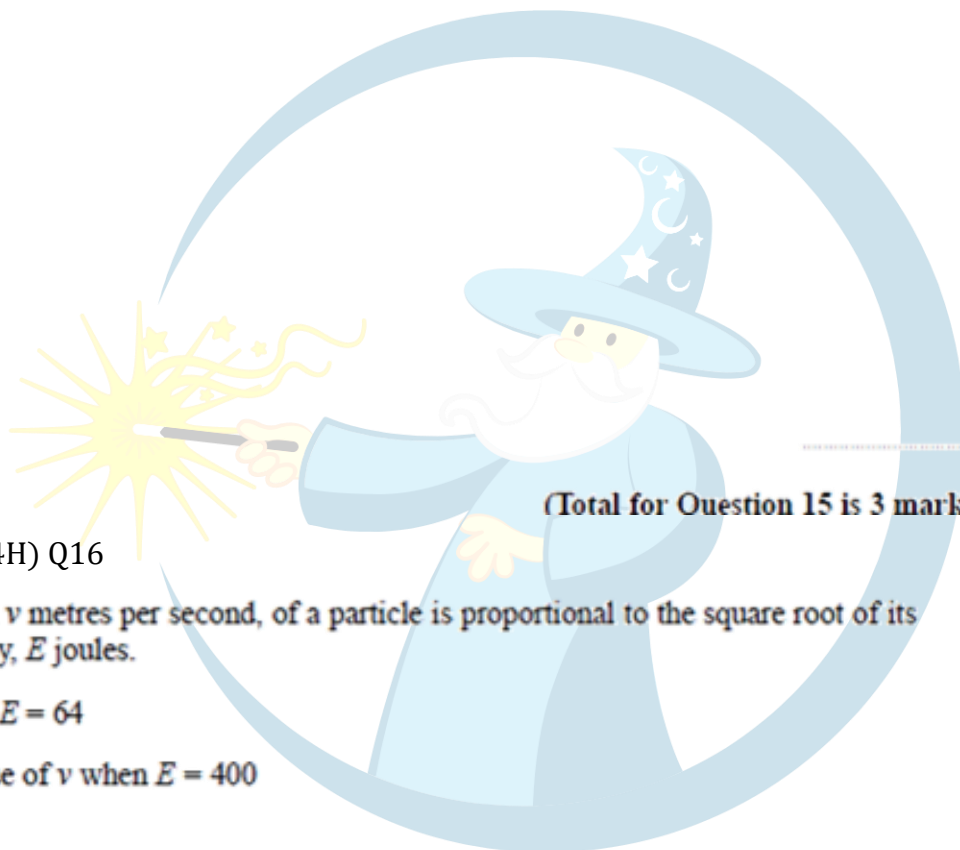
(Total for Question 15 is 3 marks)

8. June 2018 (4H) Q16

The velocity, v metres per second, of a particle is proportional to the square root of its kinetic energy, E joules.

$v = 30$ when $E = 64$

Find the value of v when $E = 400$

(Total for Question 16 is 4 marks)

9. Jan 2018 (4HR) Q14

P is directly proportional to the square of Q.
$P = 180$ when $Q = 12$

(a) Find a formula for P in terms of Q.

.... (3)

(b) Find the value of P when $Q = 30$

$P = $ .... (1)
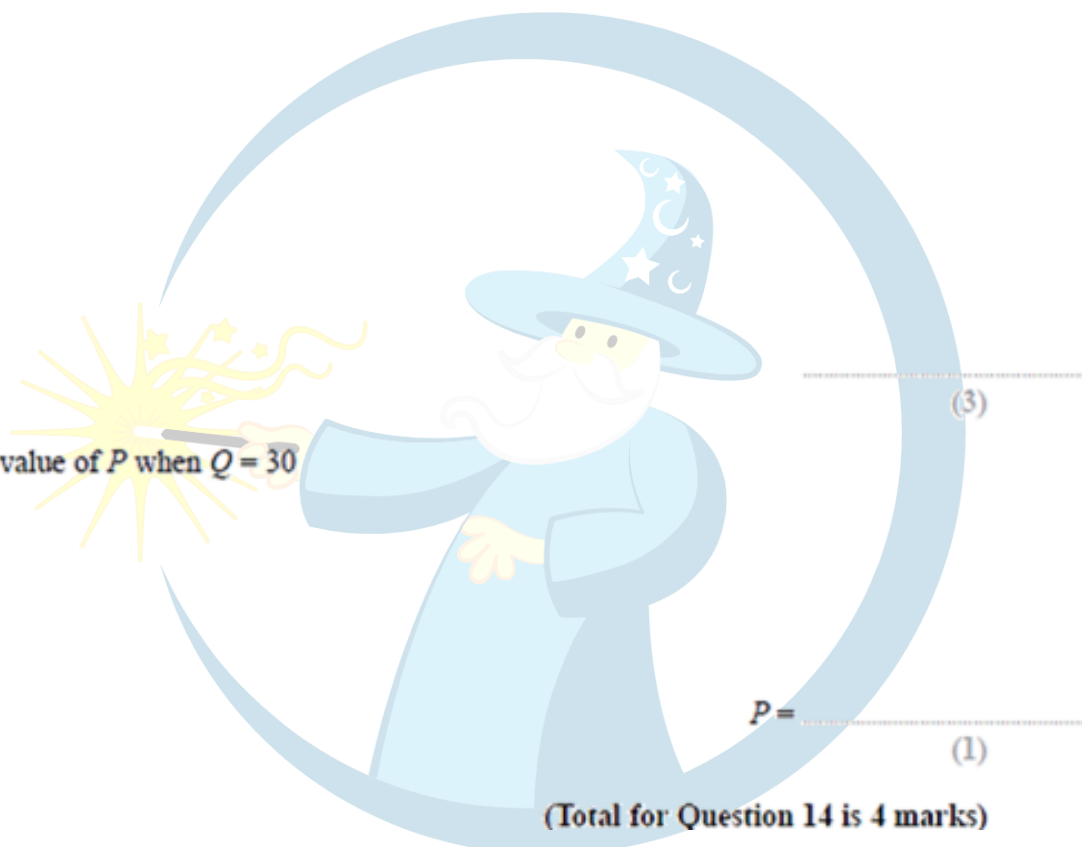
(Total for Question 14 is 4 marks)

10. Jan 2019 (1H) Q14

T is directly proportional to the cube of r

$T = 21.76$ when $r = 4$

(a) Find a formula for T in terms of r

(3)
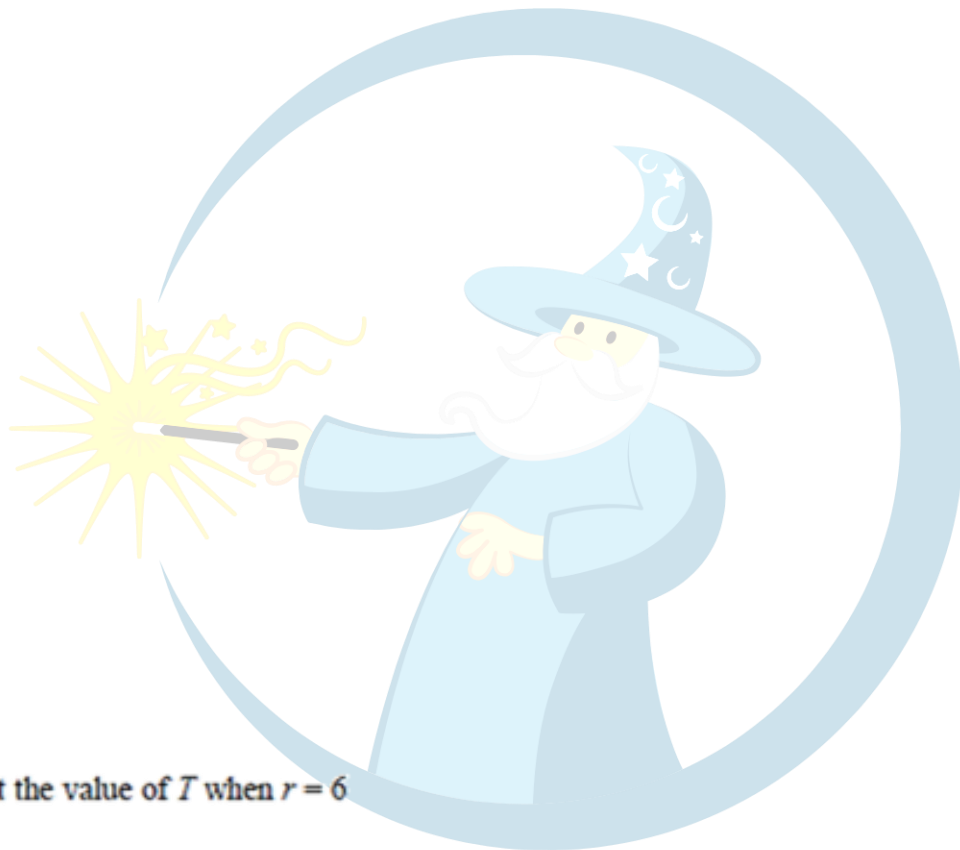
(b) Work out the value of T when $r = 6$

(1)

(Total for Question 14 is 4 marks)

TRIGONOMETRY

Right-angled triangles

1. June 2016 (3H) Q8

Diagram **NOT** accurately drawn

13.4 cm

53°
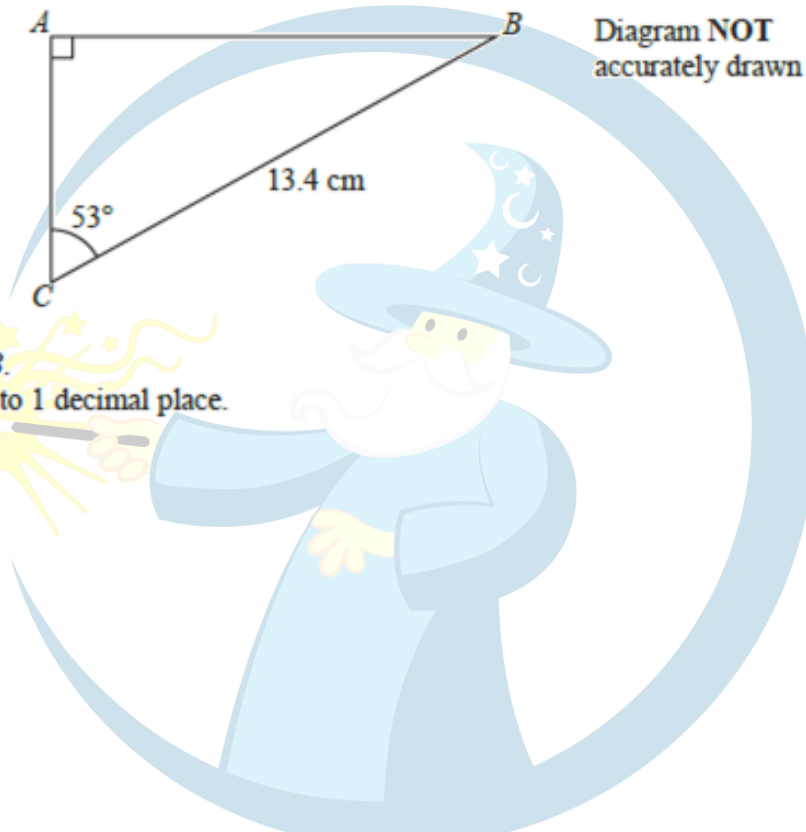
Work out the length of *AB*.
Give your answer correct to 1 decimal place.

2. June 2017 (3H) Q7

14.9 cm

22°
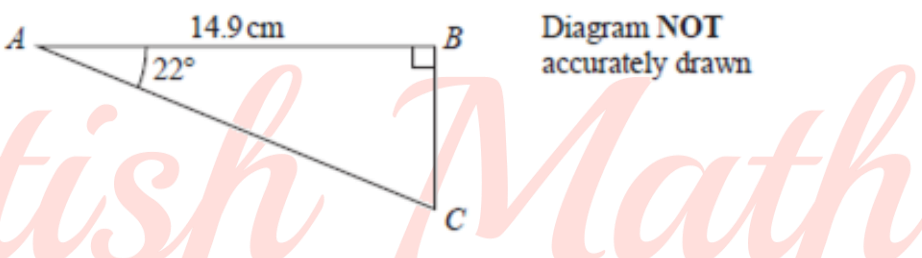
Diagram **NOT** accurately drawn

Calculate the length of *AC*.
Give your answer correct to 3 significant figures.

3. June 2016 (3HR) Q13

Here is the quadrilateral *ABCD*.

9.8 cm

A

B

Diagram **NOT** accurately drawn

3.6 cm

8.4 cm

D

C
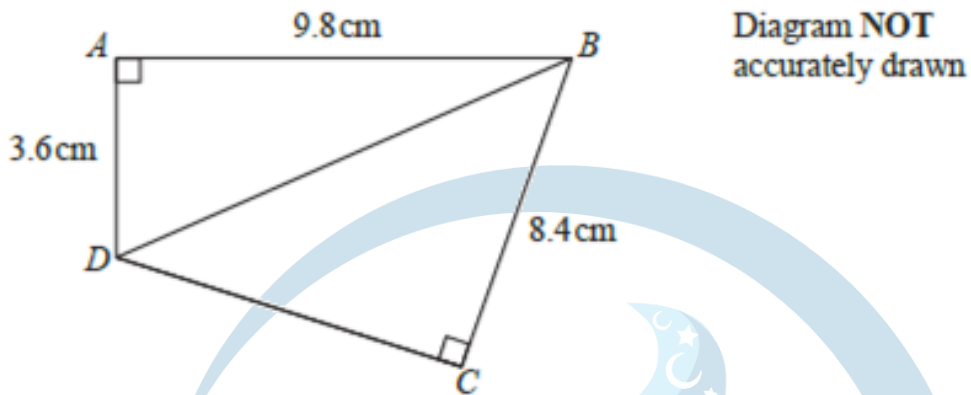
Angle *BAD* = 90° and angle *BCD* = 90°
AB = 9.8 cm
AD = 3.6 cm
BC = 8.4 cm

Calculate the length of *DC*.
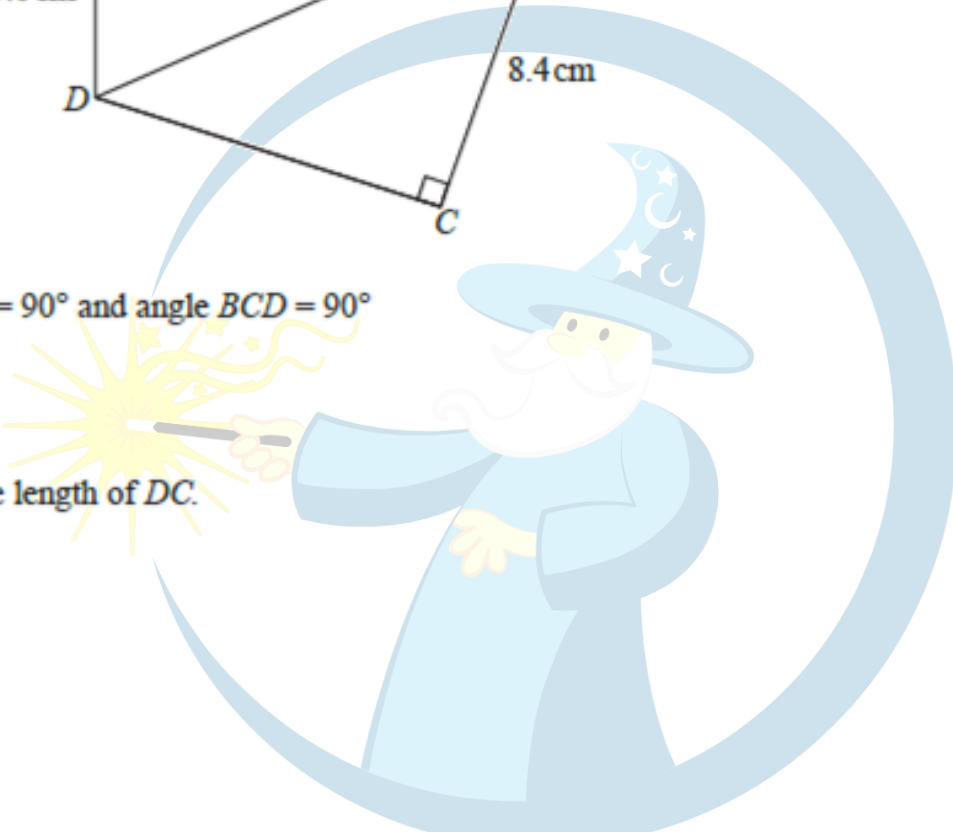
4. Jan 2017 (4HR) Q6
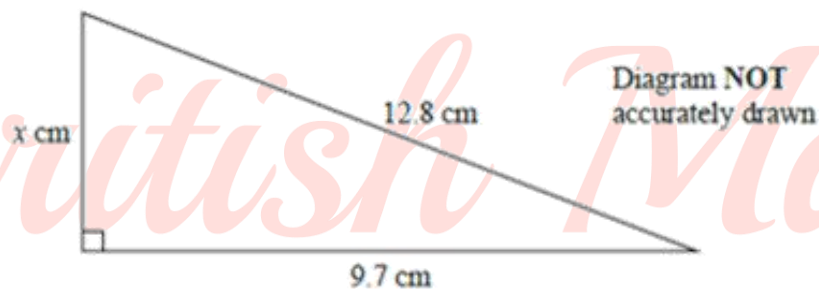
Diagram **NOT** accurately drawn

x cm

12.8 cm

9.7 cm

Work out the value of *x*.
Give your answer correct to 3 significant figures.

5. June 2016 (4HR) Q11

Here is a triangle *QRS*.

Diagram **NOT** accurately drawn
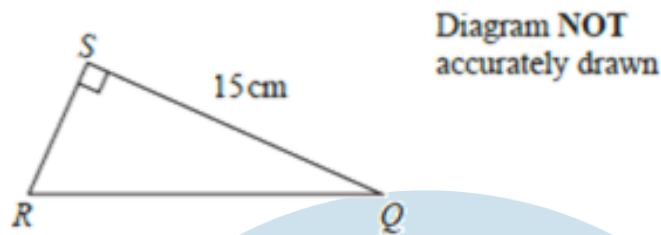
SQ = 15 cm
Angle *RSQ* = 90°
Area of triangle *QRS* = 60 cm²

Work out the size of angle *SQR*.
Give your answer correct to 1 decimal place.
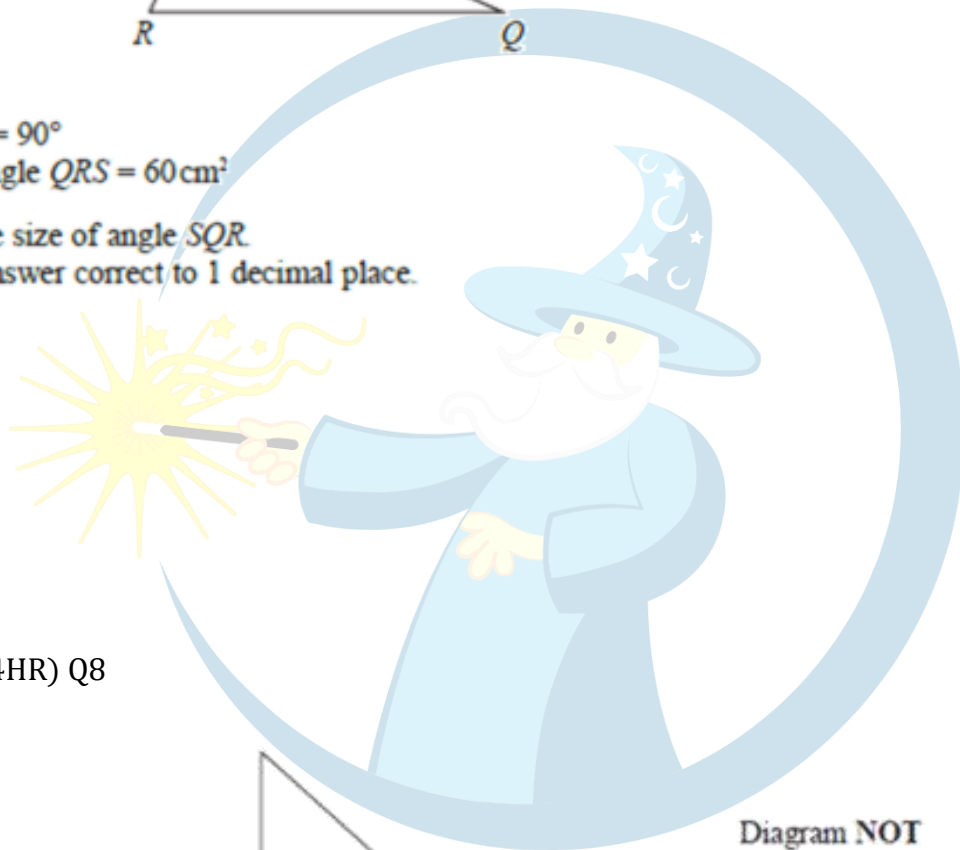
6. June 2017 (4HR) Q8
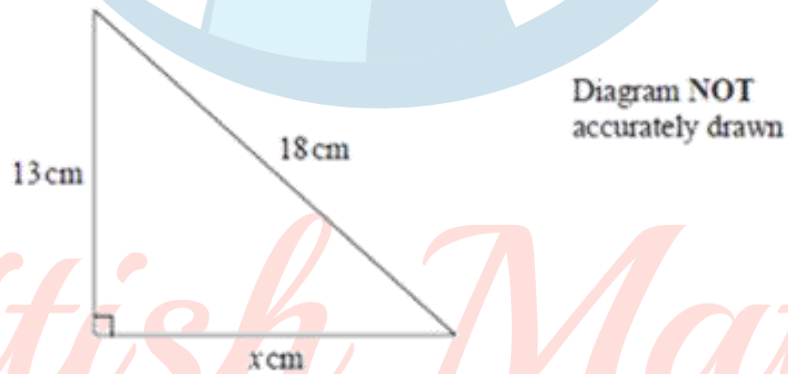
Diagram **NOT** accurately drawn

Work out the value of *x*.
Give your answer correct to 3 significant figures.

7. Jan 2017 (4H) Q9

The diagram shows a ladder, *EF*, leaning against a vertical wall.
The foot, *E*, of the ladder is on horizontal ground.
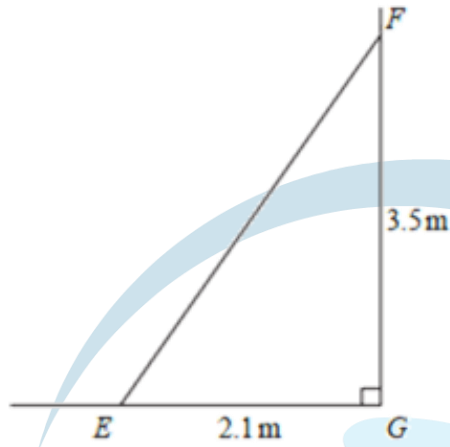
Diagram **NOT**
accurately drawn

$EG = 2.1\,\text{m}$ $FG = 3.5\,\text{m}$ angle $EGF = 90°$

(a) Work out the length of the ladder.
   Give your answer correct to 1 decimal place.

.... m

(3)
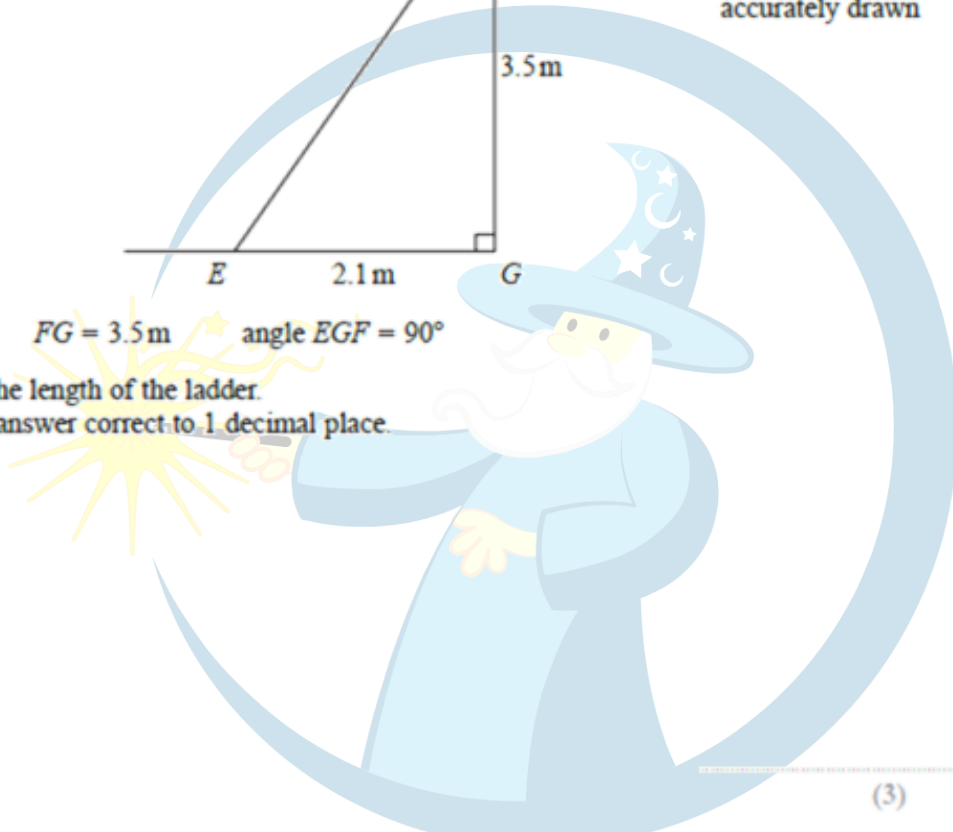
(b) Work out the size of angle *EFG*.
   Give your answer correct to the nearest degree.

.... °

(3)

(Total for Question 9 is 6 marks)

8. June 2017 (4HR) Q13

The diagram shows triangle *ABC*.

Diagram **NOT** accurately drawn
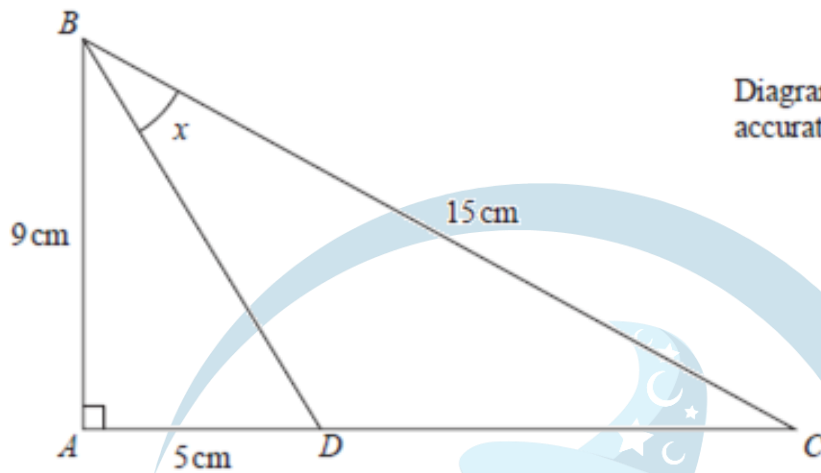
$AB = 9\,cm \quad BC = 15\,cm$
D is the point on *AC* such that $AD = 5\,cm$.
Angle $BAC = 90°$

Calculate the size of angle *x*.
Give your answer to the nearest degree.

9. June 2018 (1H) Q6
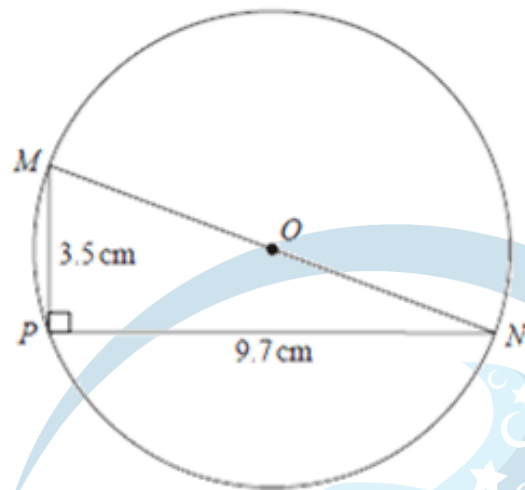
Diagram **NOT** accurately drawn

M, N and P are points on a circle, centre O.
MON is a diameter of the circle.

$MP = 3.5$ cm
$PN = 9.7$ cm

Angle $MPN = 90°$

Work out the circumference of the circle.
Give your answer correct to 3 significant figures.

10. June 2018 (1H) Q9

The diagram shows a right-angled triangle.

72°

12.8 cm
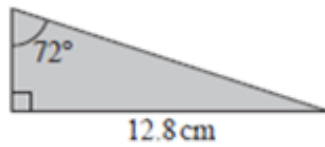
Diagram **NOT**
accurately drawn

Five of these triangles are put together to make a shape.
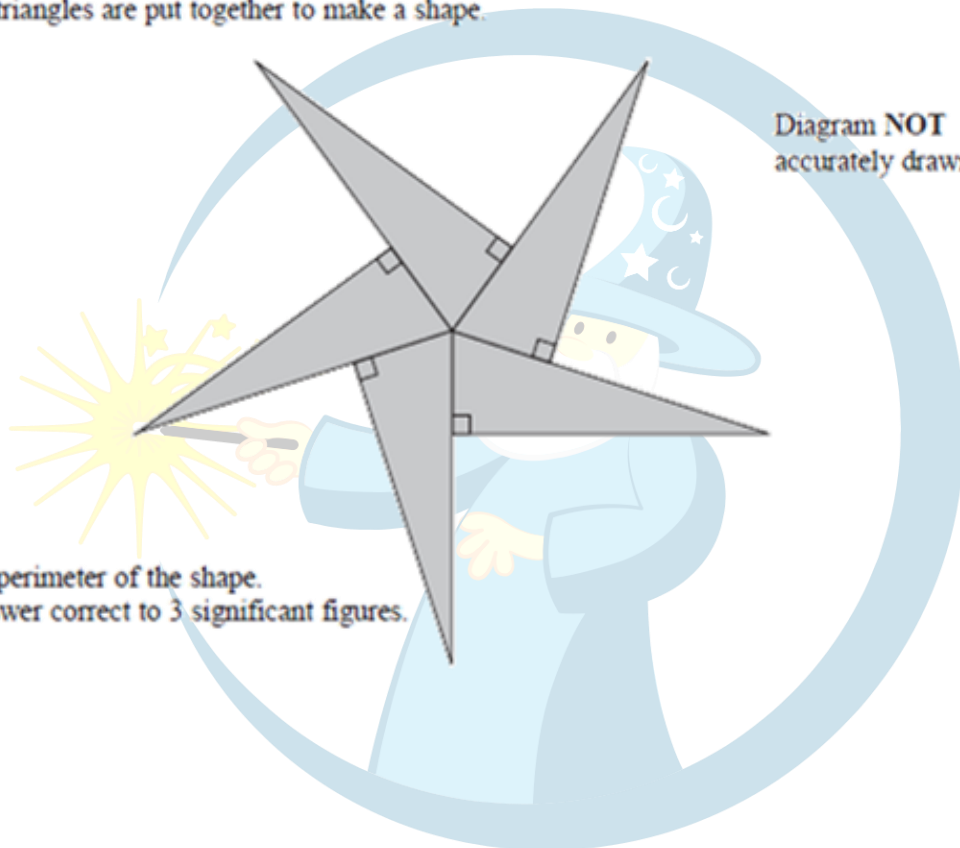
Diagram **NOT**
accurately drawn

Calculate the perimeter of the shape.
Give your answer correct to 3 significant figures.
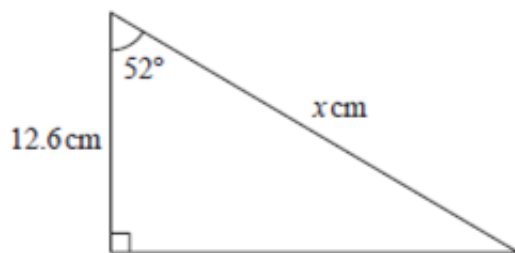
11. June 2018 (2H) Q8

Diagram **NOT** accurately drawn

Work out the value of x.
Give your answer correct to 3 significant figures.

$x =$ ....
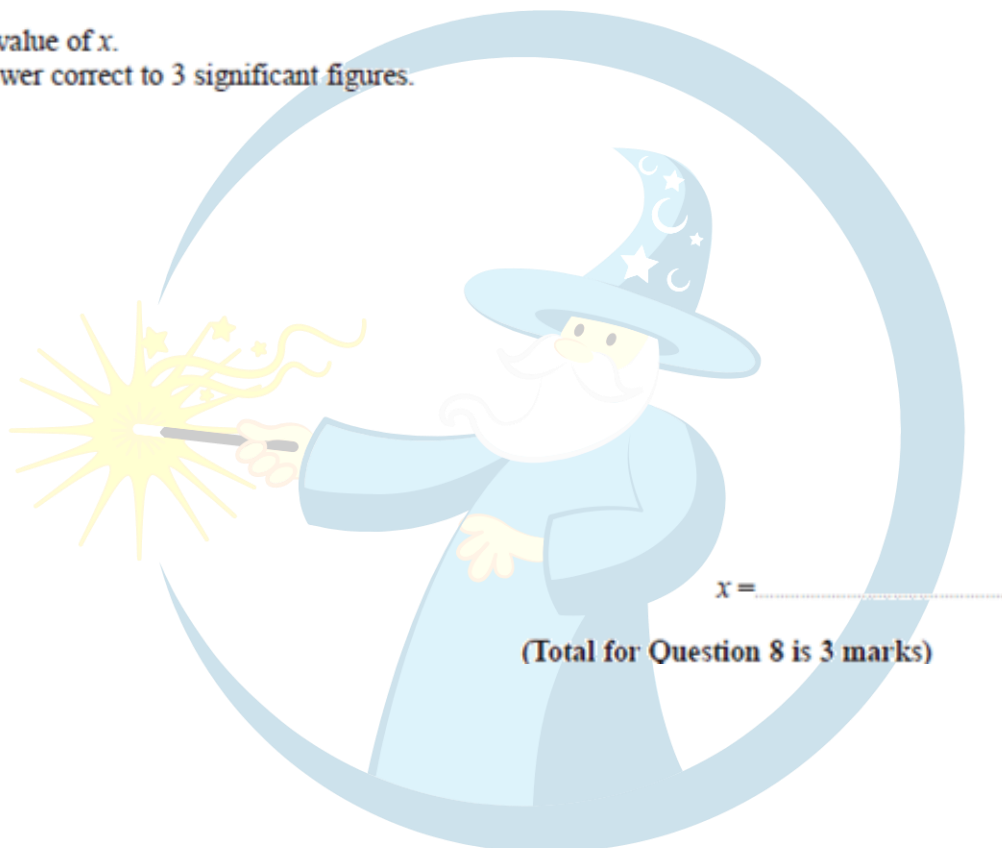
(Total for Question 8 is 3 marks)

12. June 2018 (2HR) Q8

From point *A*, Stanley walks 200 m due east to point *B*.
From *B*, he then walks 160 m due south to point *C*.

Work out the length of *AC*.
Give your answer correct to 3 significant figures.

.... metres

(Total for Question 8 is 3 marks)

13. June 2018 (2HR) Q10

ABCD is a trapezium.
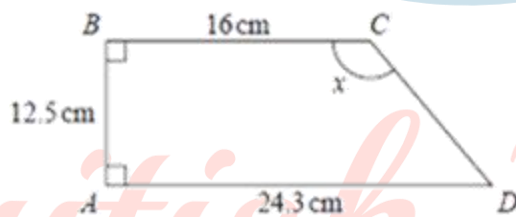
B ————16 cm———— C   Diagram **NOT**
                    x   accurately drawn
12.5 cm

A ———24.3 cm——— D

Work out the size of angle *x*.
Give your answer correct to 1 decimal place.

14. June 2018 (3H) Q7

11.8 cm

K   H

Diagram **NOT**
accurately drawn

16.2 cm

J
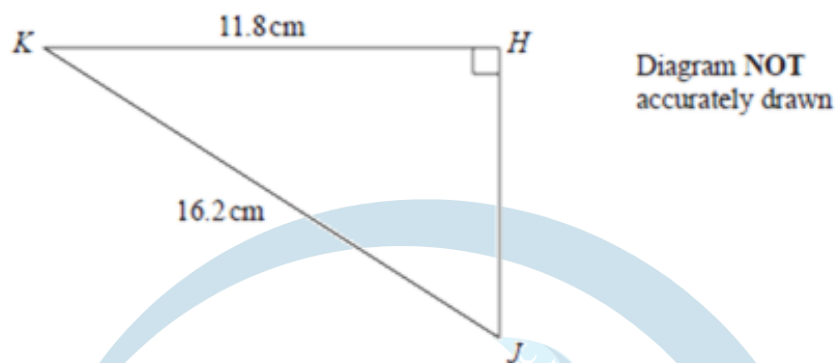
Calculate the length of *HJ*.
Give your answer correct to 3 significant figures.

15. June 2018 (3H) Q6

Diagram **NOT** accurately drawn
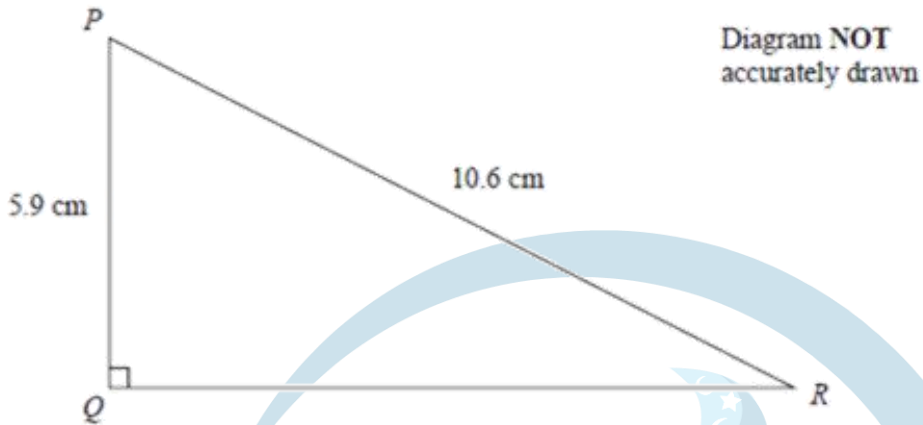
(a) Work out the length of *QR*.
Give your answer correct to 3 significant figures.

.... cm
(3)

(b) Work out the size of angle *PRQ*.
Give your answer correct to 1 decimal place.

.... °
(3)

16. Jan 2018 (3HR) Q11

Here is a right-angled triangle *ABC*.

Diagram **NOT** accurately drawn
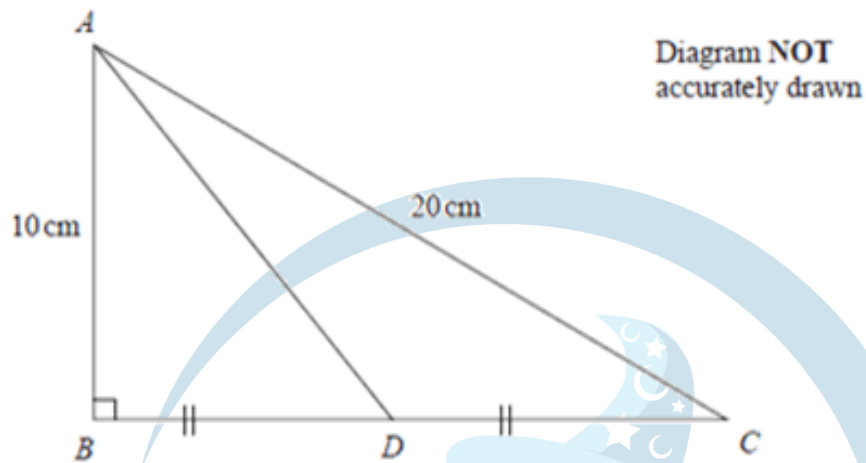
Angle *ABC* = 90°
AC = 20 cm
AB = 10 cm

D is the midpoint of *BC*.

Work out the length of *AD*.
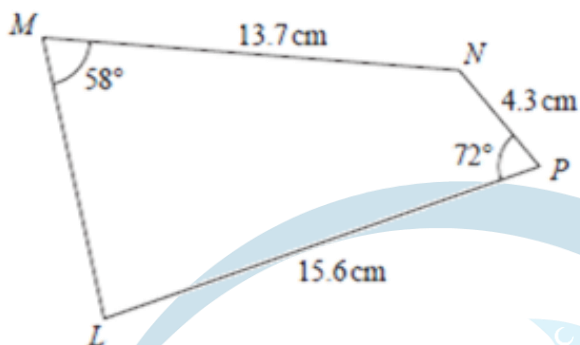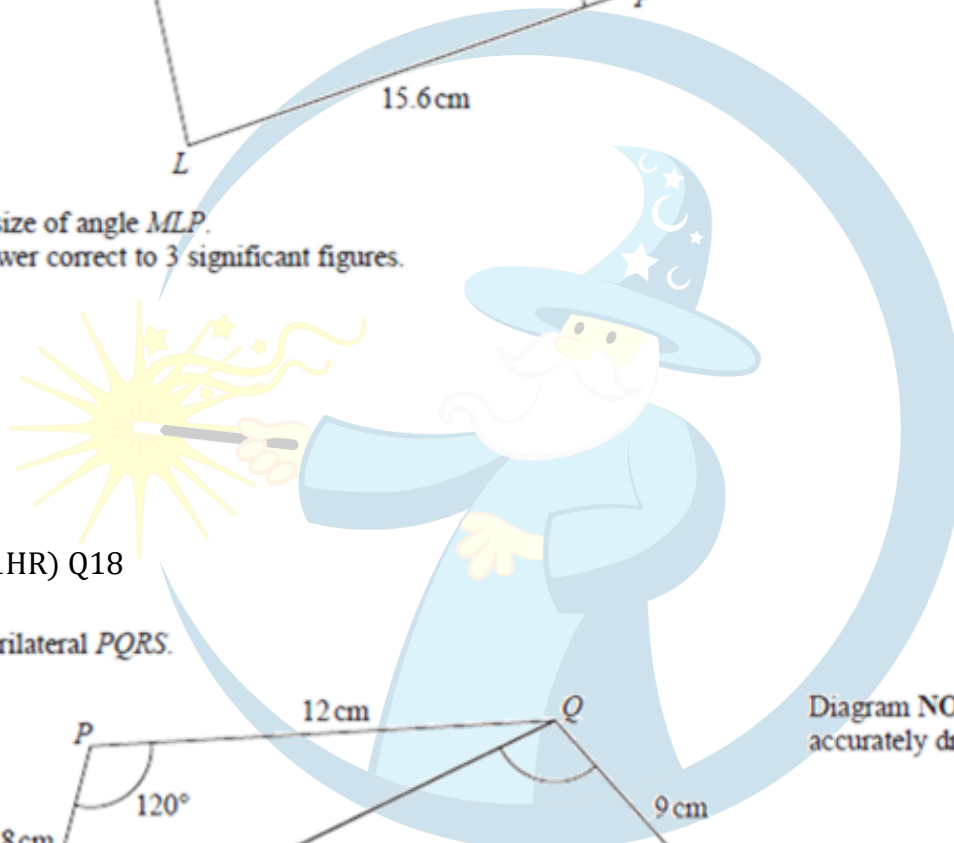Give your answer correct to 1 decimal place.

17. June 2018 (3HR) Q10

Diagram **NOT** accurately drawn
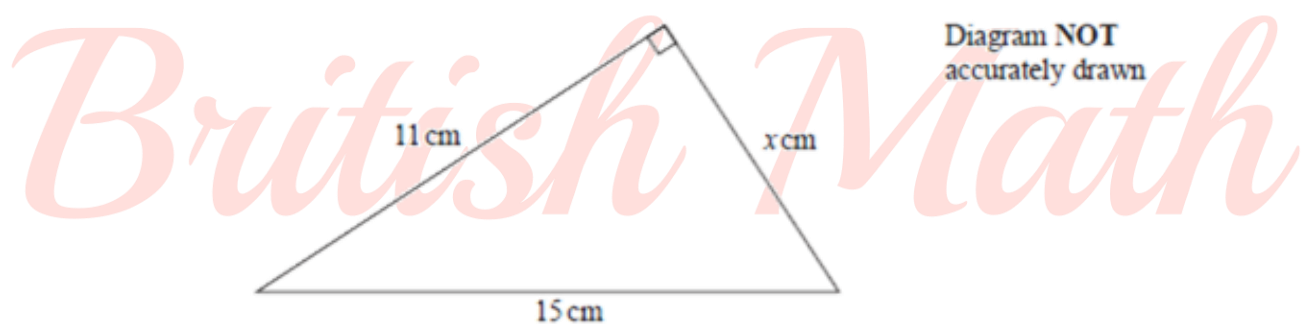
Work out the value of *x*.
Give your answer correct to 3 significant figures.

18. Jan 2018 (4HR) Q8

Here is a right-angled triangle.

Diagram **NOT** accurately drawn

8.4cm

20°

B

A

C
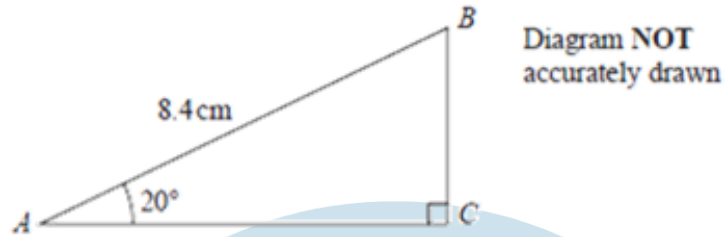
Calculate the length of *BC*.
Give your answer correct to 3 significant figures.

.... cm

(Total for Question 8 is 3 marks)
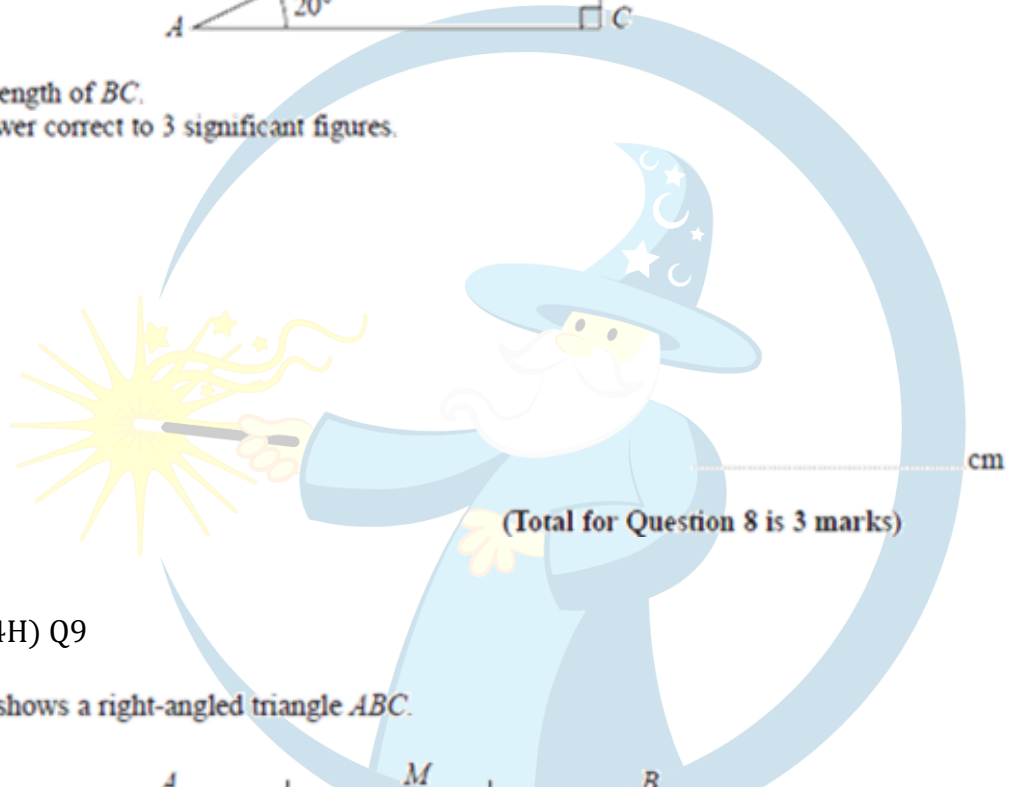
19. June 2018 (4H) Q9

The diagram shows a right-angled triangle *ABC*.

A   *M*   *B*

30°

10cm

C

Diagram **NOT** accurately drawn
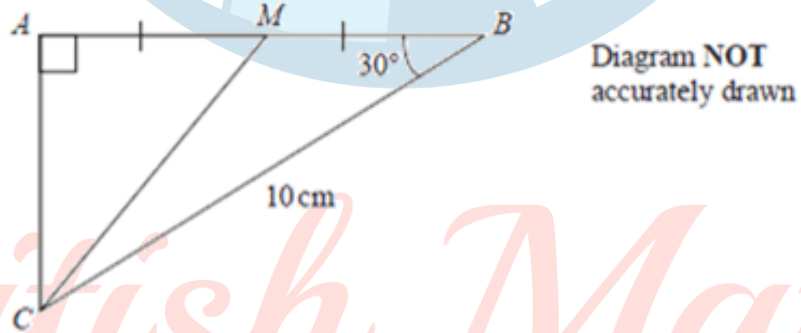
BC = 10 cm.
Angle *CAB* = 90°
Angle *ABC* = 30°
M is the midpoint of *AB*.

Work out the size of angle *AMC*.
Give your answer correct to 1 decimal place.

20. Jan 2019 (1H) Q8

The diagram shows an isosceles triangle.

Diagram **NOT** accurately drawn

x cm x cm

5 cm
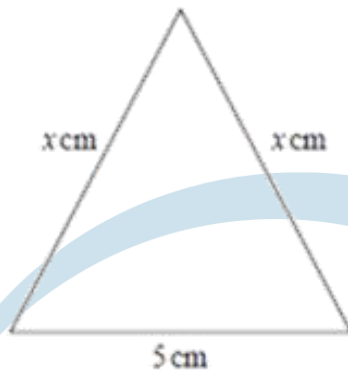
The area of the triangle is 12 cm²

Work out the perimeter of the triangle.
Give your answer correct to 3 significant figures.
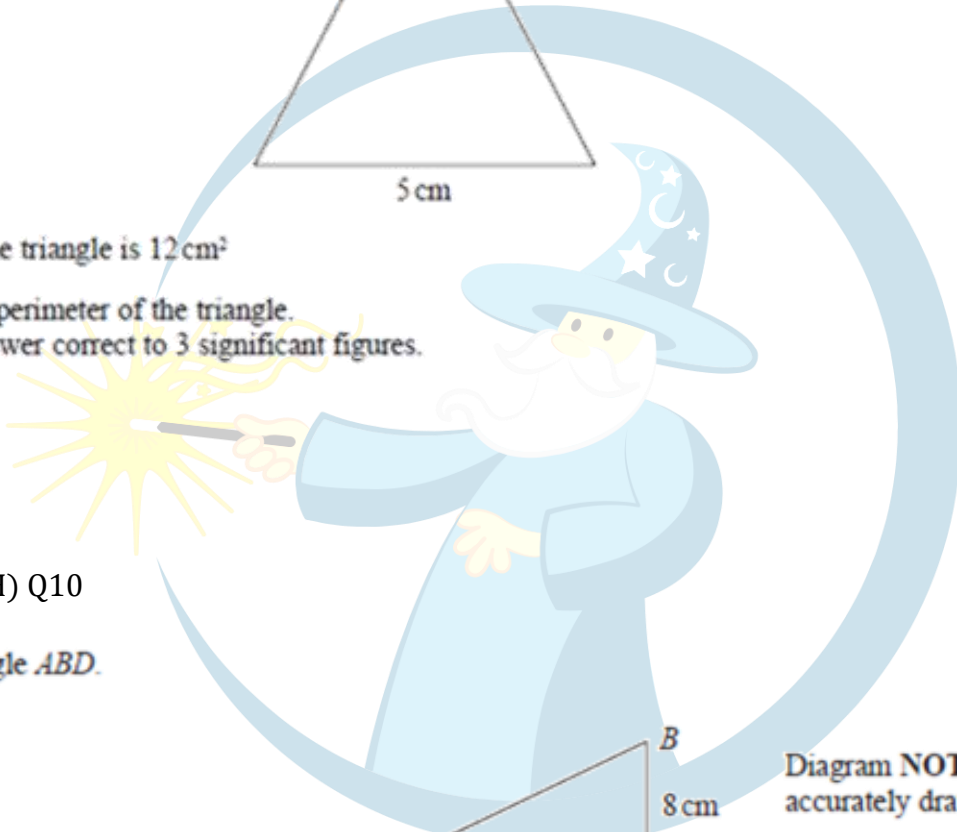
21. Jan 2019 (1H) Q10

Here is triangle ABD.

Diagram **NOT** accurately drawn

B

8 cm

C

20°

A D
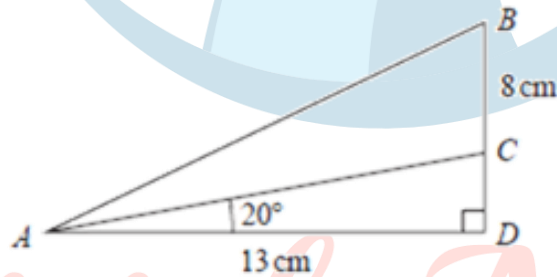
13 cm

The point C lies on BD.

$AD = 13$ cm $BC = 8$ cm   angle $ADB = 90°$ angle $CAD = 20°$

Calculate the size of angle BAC.
Give your answer correct to 1 decimal place.

22. Jan 2019 (1HR) Q3

Diagram **NOT** accurately drawn
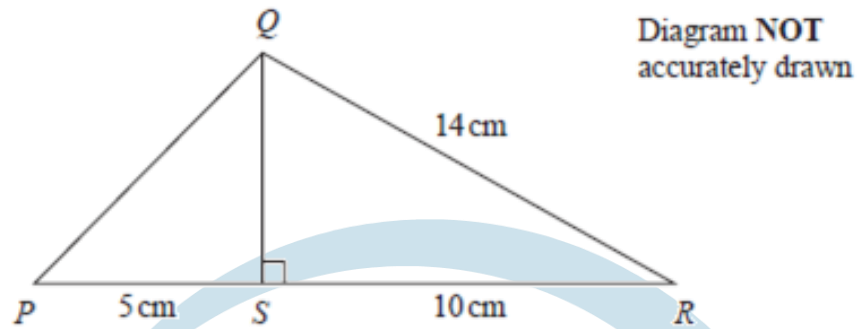
In triangle *PQR*,

S is the point on *PR* such that angle *RSQ* = 90°
RQ = 14 cm
RS = 10 cm
SP = 5 cm

Work out the length of *PQ*.

23. Jan 2019 (2HR) Q7

The diagram shows a trapezium.

Diagram **NOT** accurately drawn
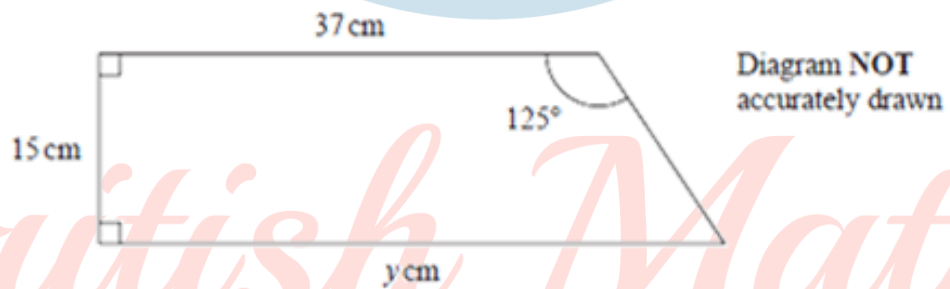
Work out the value of *y*.
Give your answer correct to 1 decimal place.

24. June 2019 (2H) Q12

ABCD is a trapezium.

B   21.2 cm   C

Diagram **NOT** accurately drawn

16.7 cm

43°

A   D
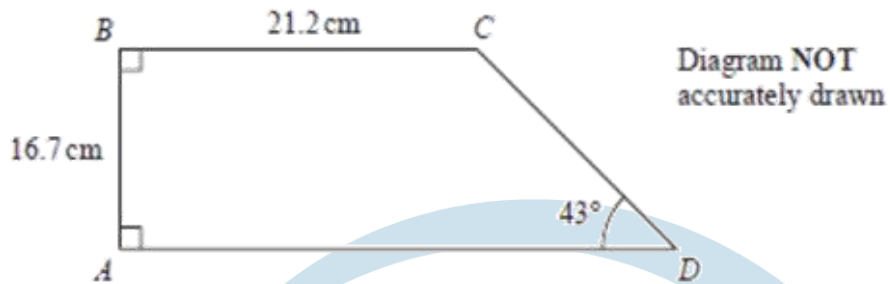
Calculate the perimeter of the trapezium.
Give your answer correct to 3 significant figures.

.... cm
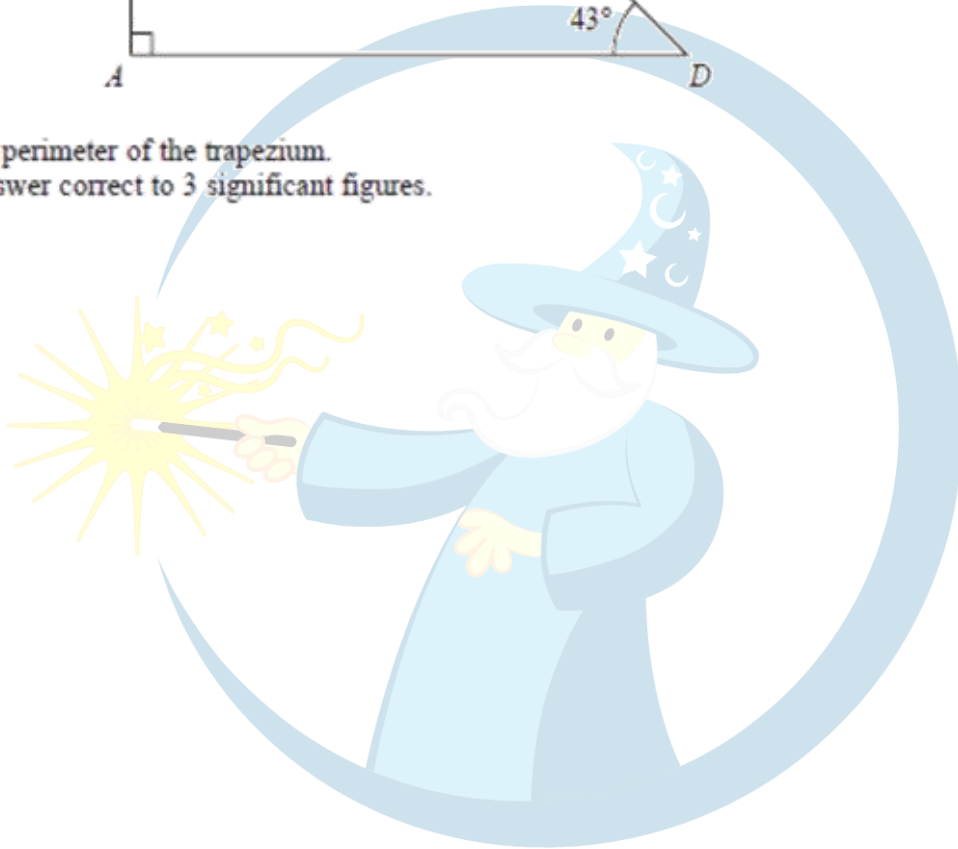
(Total for Question 12 is 4 marks)

Non-right-angled triangles

1. June 2016 (3H) Q22

The diagram shows a pentagon.

Diagram **NOT** accurately drawn

12 cm   12 cm

105°   105°

8 cm   8 cm

13 cm
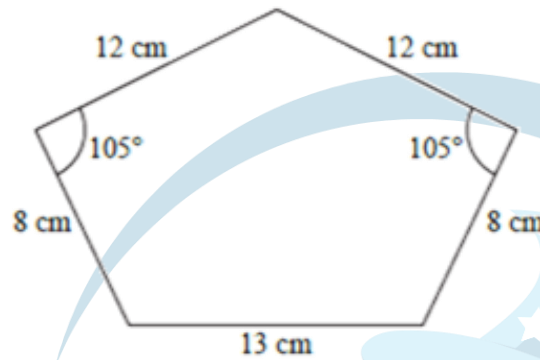
Work out the area of the pentagon.
Give your answer correct to 3 significant figures.

2. Jan 2017 (3H) Q15
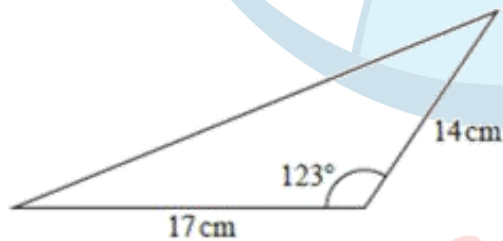
Diagram **NOT** accurately drawn

14 cm

123°

17 cm

Calculate the perimeter of the triangle.
Give your answer correct to 1 decimal place.

3. June 2018 (2H) Q18

A triangle has sides of length 8 cm, 10 cm and 14 cm.

Work out the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.

4. Jan 2017 (3HR) Q21

The shape *OABC* is made from a triangle and a sector of a circle.

Diagram **NOT** accurately drawn
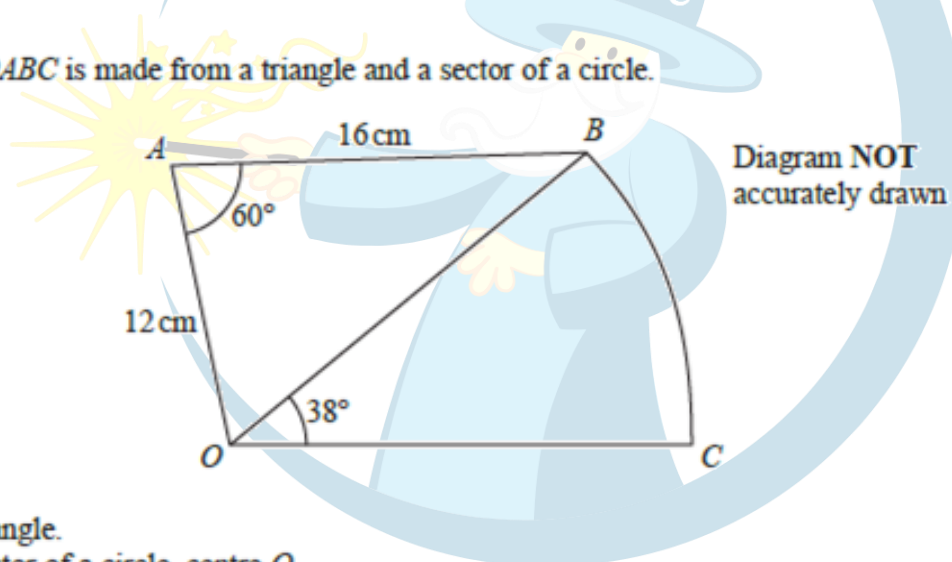
OAB is a triangle.
OBC is a sector of a circle, centre *O*.

OA = 12 cm
AB = 16 cm
Angle *OAB* = 60°
Angle *BOC* = 38°

Work out the area of *OABC*.
Give your answer correct to 3 significant figures.

5. June 2017 (3HR) Q14

ABCDE is a regular pentagon with sides of length 10 cm.
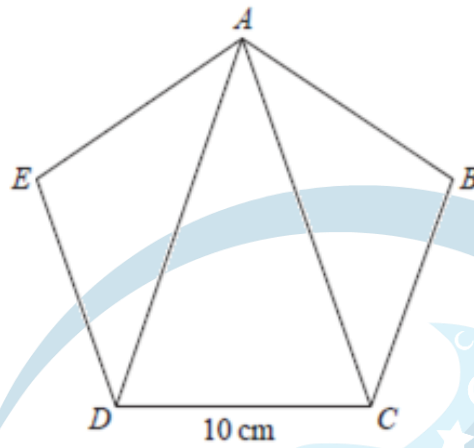
Diagram **NOT** accurately drawn

Calculate the area of triangle *ACD*.
Give your answer correct to 3 significant figures.
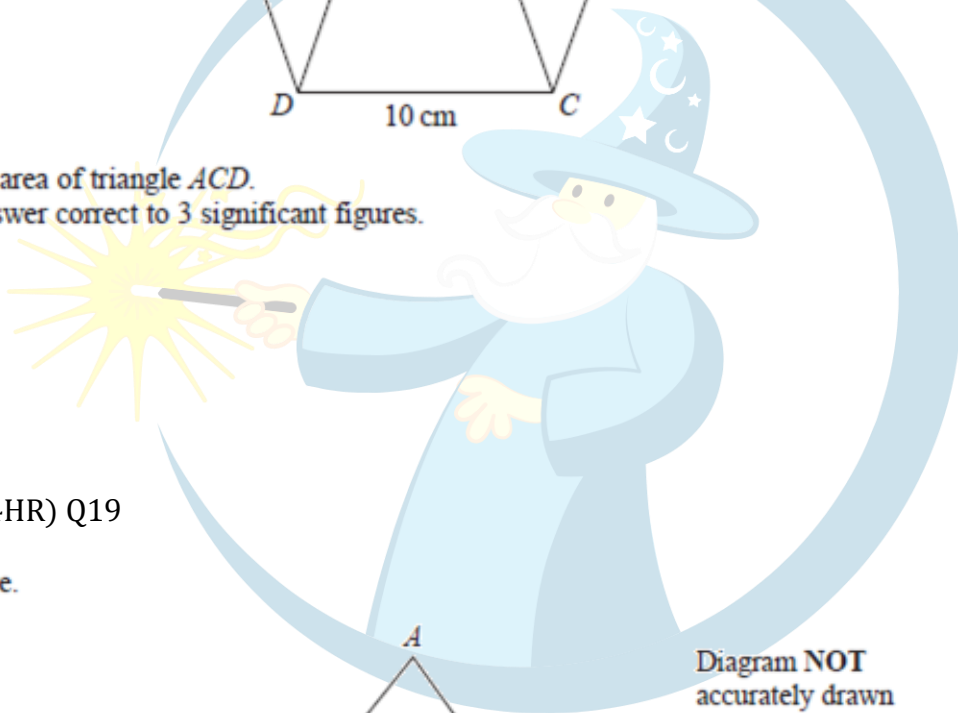
6. June 2017 (4HR) Q19

ABCD is a kite.
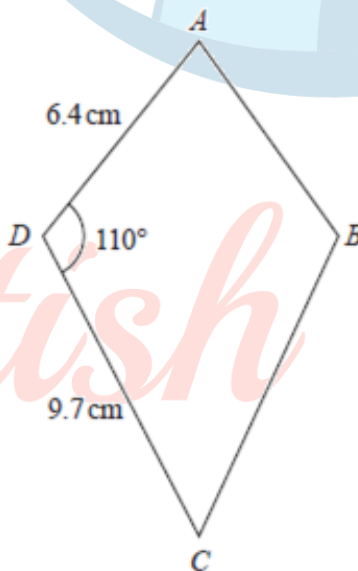
Diagram **NOT** accurately drawn

Work out the area of the kite.
Give your answer correct to 3 significant figures.

7. June 2017 (4H) Q21

LMNP is a quadrilateral.

M ———— 13.7 cm ———— N

58°

72° P

4.3 cm

15.6 cm

L

Diagram **NOT** accurately drawn

Work out the size of angle *MLP*.
Give your answer correct to 3 significant figures.

8. June 2018 (1HR) Q18

Here is a quadrilateral *PQRS*.

P —— 12 cm —— Q

120°

8 cm

9 cm

27°

S

R
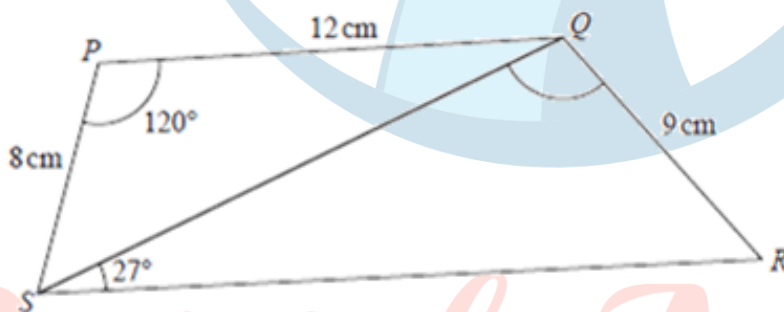
Diagram **NOT** accurately drawn

Angle *SRQ* is acute.

Work out the size of angle *SQR*.
Give your answer correct to 1 decimal place.

9. June 2018 (3H) Q16

12.7 cm

P
78°

Q

Diagram **NOT**
accurately drawn

18.5 cm

R
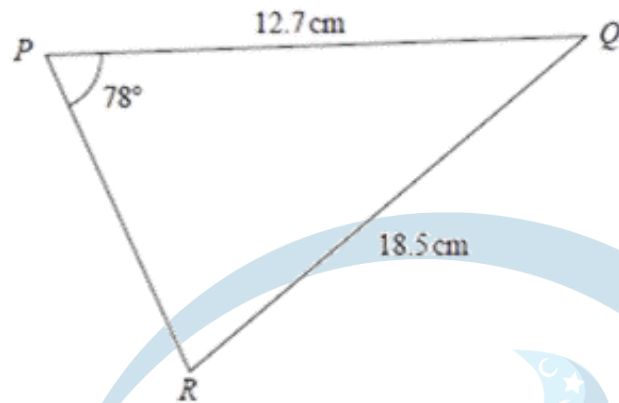
Work out the area of triangle *PQR*.
Give your answer correct to 3 significant figures.

10. June 2018 (3HR) Q21

C

105°

7 cm   10 cm

A   B
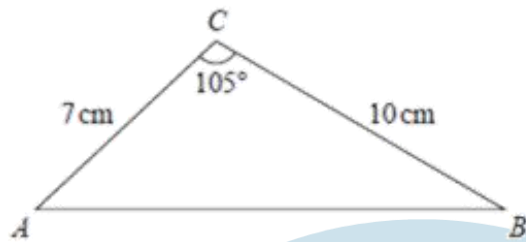
Diagram **NOT**
accurately drawn

(a) Work out the area of triangle *ABC*.
Give your answer correct to 3 significant figures.

.... cm²

(2)
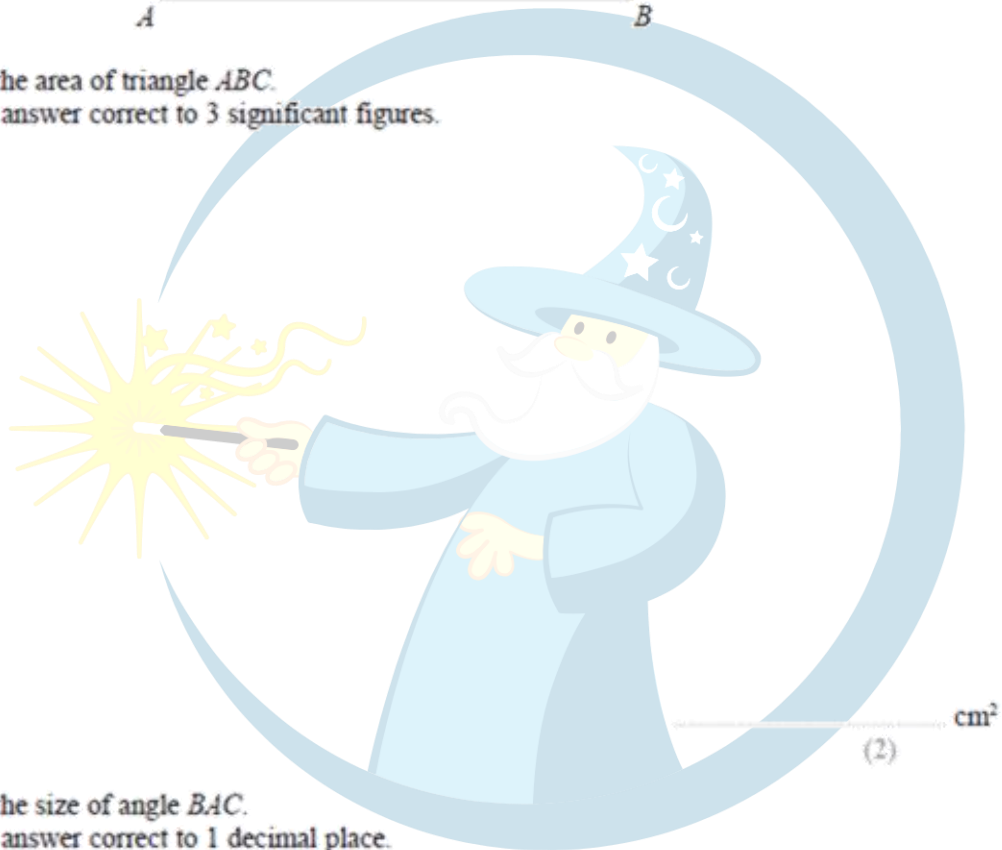
(b) Work out the size of angle *BAC*.
Give your answer correct to 1 decimal place.

11. Jan 2018 (4H) Q16

17.6 cm

J

109°

10.5 cm

L

K
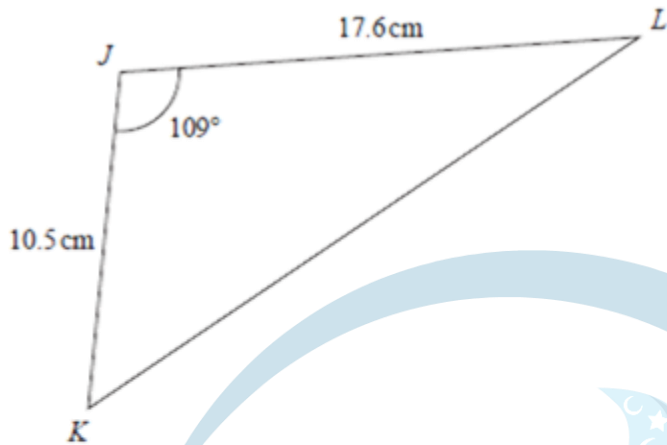
Diagram **NOT** accurately drawn

(a) Work out the area of triangle *JKL*.
   Give your answer correct to 3 significant figures.
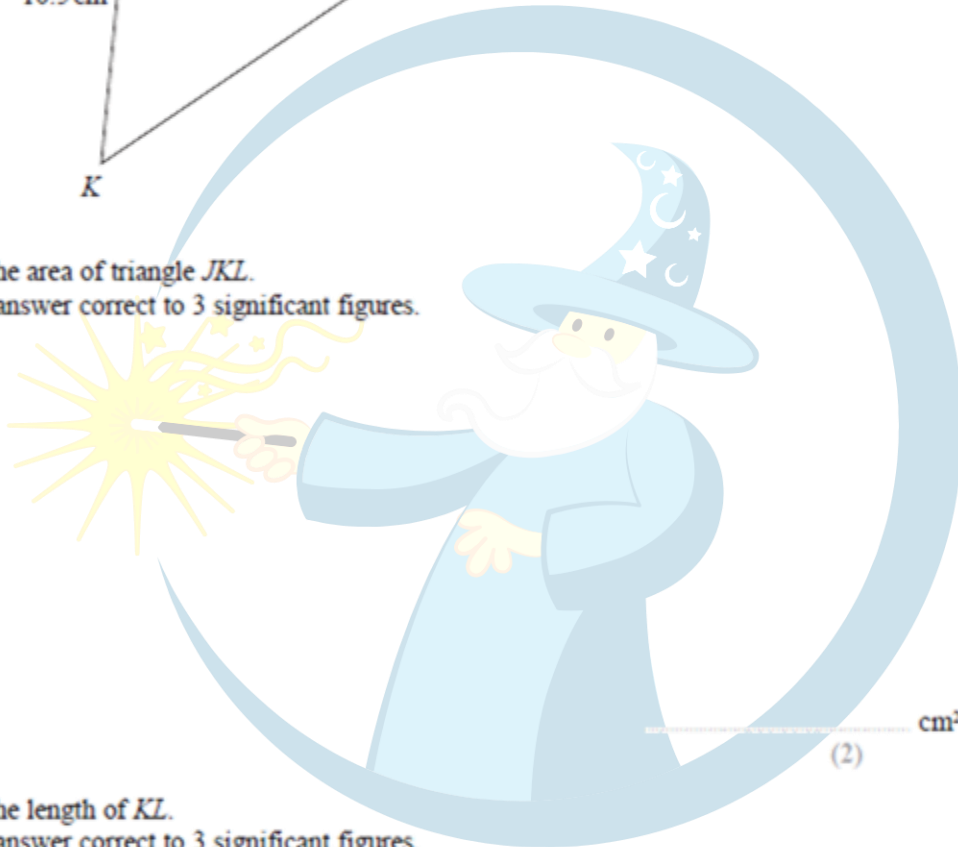
.... cm²

(2)

(b) Work out the length of *KL*.
   Give your answer correct to 3 significant figures.

.... cm

(3)

(Total for Question 16 is 5 marks)

12. Jan 2019 (1H) Q17

Here is triangle *ABC*.

5.3 cm

B

Diagram **NOT** accurately drawn

110°

4.1 cm

x°

A

C
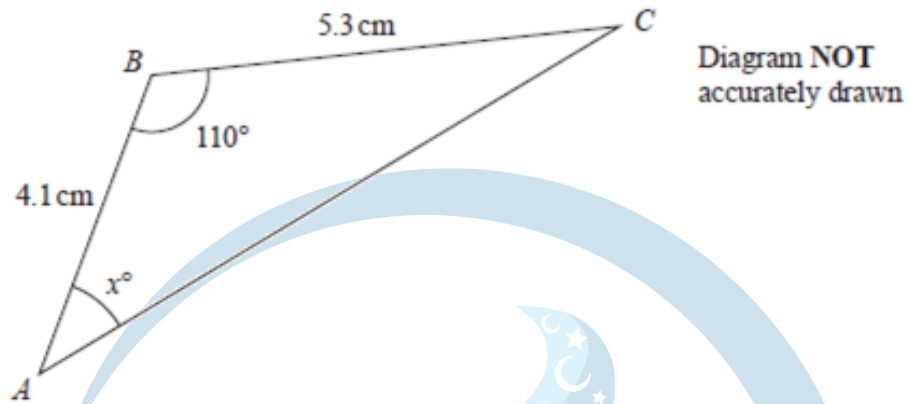
Calculate the value of *x*.
Give your answer correct to 3 significant figures.
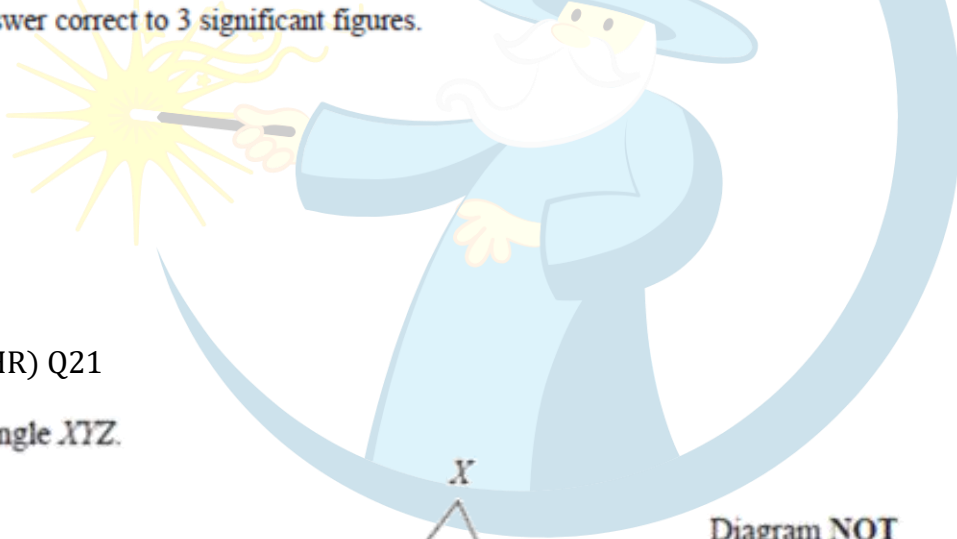
13. Jan 2019 (1HR) Q21

Here is a triangle *XYZ*.

X

Diagram **NOT** accurately drawn

5 cm

60°

y cm

Y

x cm

Z
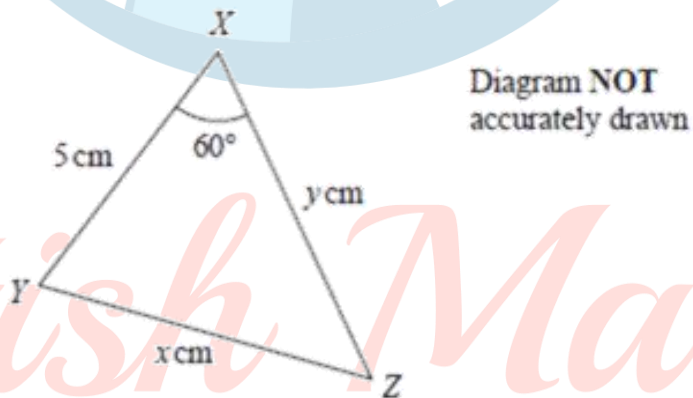
The perimeter of the triangle is *k* cm.

Given that $x = y - 1$
find the value of *k*.
Show your working clearly.

14. Jan 2019 (2HR) Q19

ABCD is a quadrilateral.

9.3 cm   *A*   97°

D

58°   *B*

47°

11.2 cm

C

Diagram **NOT** accurately drawn
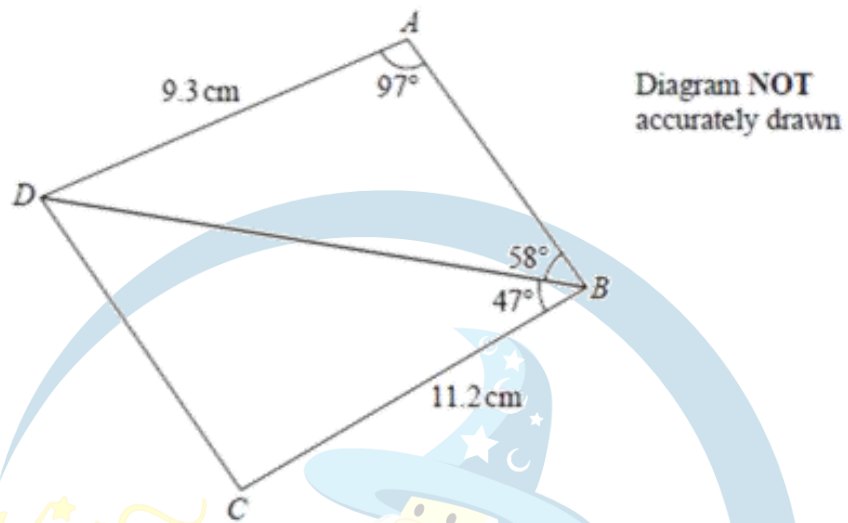
Find the area of quadrilateral *ABCD*.
Give your answer correct to 3 significant figures.

15. May 2019 (1H) Q18

The diagram shows triangle *PQR*.

Diagram **NOT**
accurately drawn

P

17.8 cm

36°

R   Q

26.3 cm
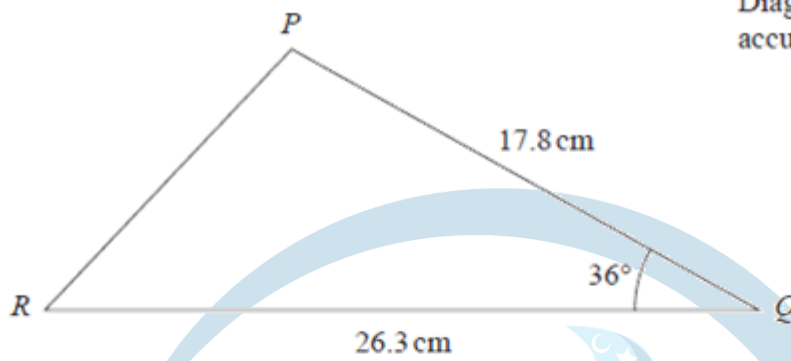
Calculate the length of *PR*.
Give your answer correct to 3 significant figures.

.... cm
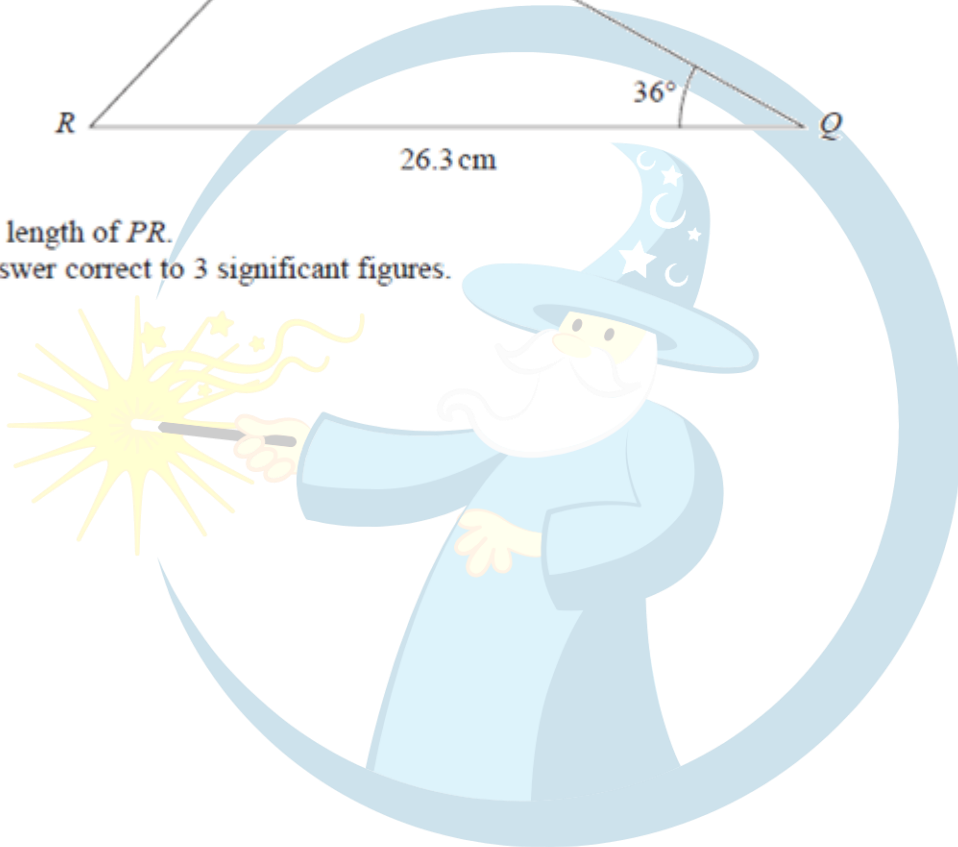
(Total for Question 18 is 3 marks)

Advanced Trigonometry

1. June 2016 (3H) Q16

ABCDEFGH is a cuboid.
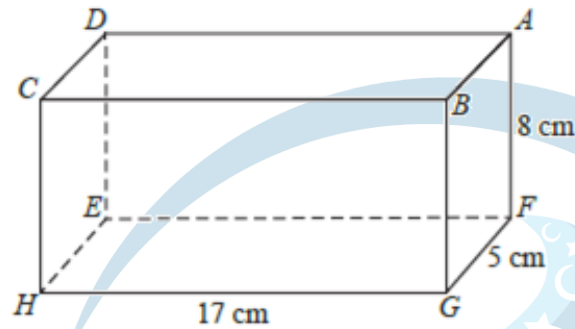
Diagram **NOT** accurately drawn

The cuboid has

    length 17 cm
    width 5 cm
    height 8 cm

Work out the size of the angle that *AH* makes with the plane *EFGH*.
Give your answer correct to 1 decimal place.

2. June 2016 (4HR) Q17

The diagram shows a prism.

Diagram **NOT** accurately drawn
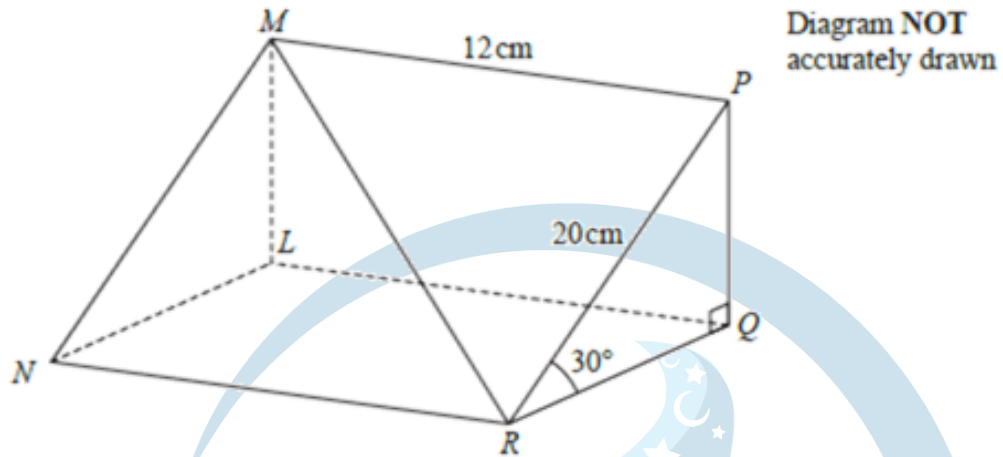
Triangle *PQR* is a cross section of the prism.

PR = 20 cm
MP = 12 cm
Angle *PRQ* = 30°
Angle *PQR* = 90°

Calculate the size of the angle that the line *MR* makes with the plane *RQLN*.
Give your answer correct to 1 decimal place.

3. Jan 2017 (4H) Q21

The diagram shows a cuboid *ABCDEFGH*.

Diagram **NOT**
accurately drawn

9 cm
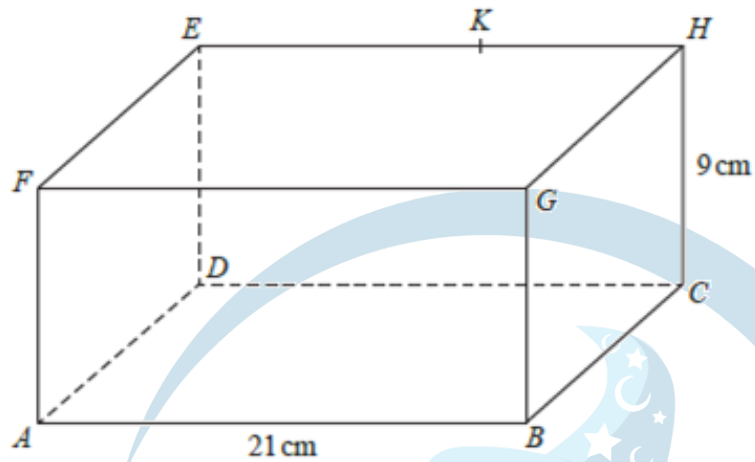
21 cm

AB = 21 cm and *CH* = 9 cm.
K is the point on *EH* such that angle *AKB* = 68° and *BK* = 16.5 cm.

(a) Calculate the size of angle *BAK*.
   Give your answer correct to 1 decimal place.

(b) Calculate the size of the angle between the line *BK* and the plane *ABCD*.
   Give your answer correct to 1 decimal place.

4. June 2017 (3H) Q21

The diagram shows a triangular prism with a horizontal base *ABCD*.

Diagram **NOT** accurately drawn
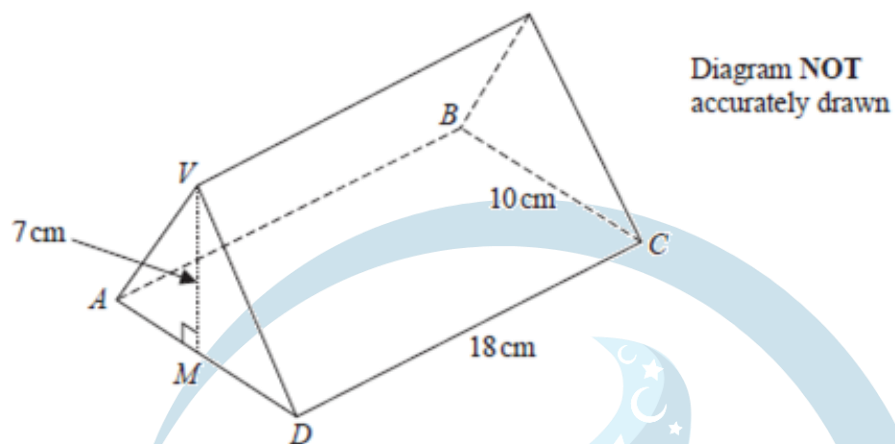
M is the midpoint of *AD*.
The vertex *V* is vertically above *M*.

$DC = 18\,cm$, $BC = 10\,cm$, $MV = 7\,cm$.

Calculate the size of the angle between *VC* and the plane *ABCD*.
Give your answer correct to 3 significant figures.

5. June 2017 (3HR) Q21

Here is a shape *ABCDE*.
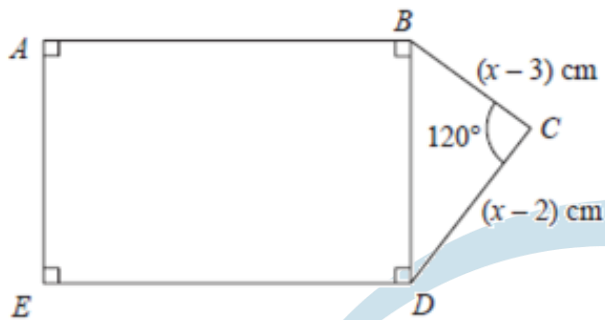
Diagram **NOT** accurately drawn

ABDE is a rectangle in which *AB* = 2*BD*
BCD is a triangle in which angle *BCD* = 120°

BC = (*x* − 3) cm   *CD* = (*x* − 2) cm

The area of the rectangle *ABDE* is *S* cm²

Show that *S* can be expressed in the form $S = ax^2 + bx + c$
where *a*, *b* and *c* are integers to be found.
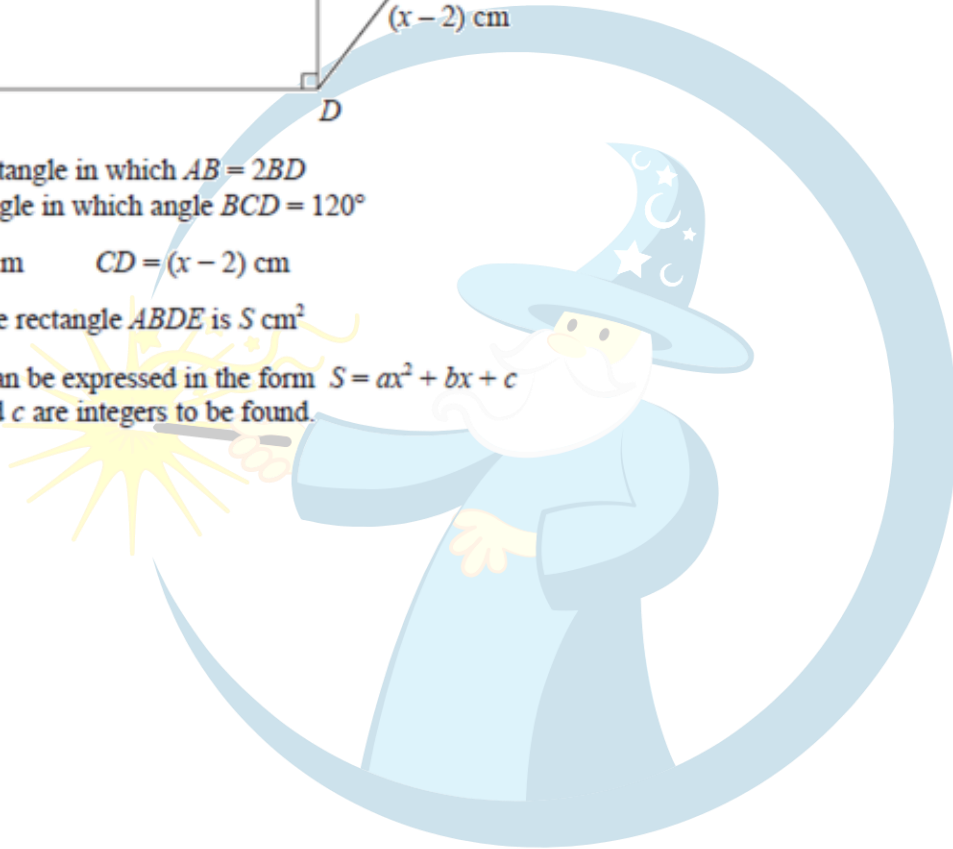
6. June 2017 (4HR) Q22

ABCDEFGH is a cuboid.

A   16 cm   B   Diagram **NOT** accurately drawn

D   C

F   G

15 cm

E   M   H
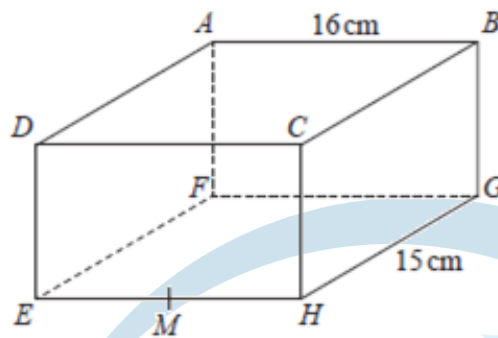
AB = 16 cm and *HG* = 15 cm.
M is the midpoint of *EH*.

BM makes an angle of 24° with the base *EFGH*.

Calculate the height, *BG*, of the cuboid.
Give your answer correct to 3 significant figures.
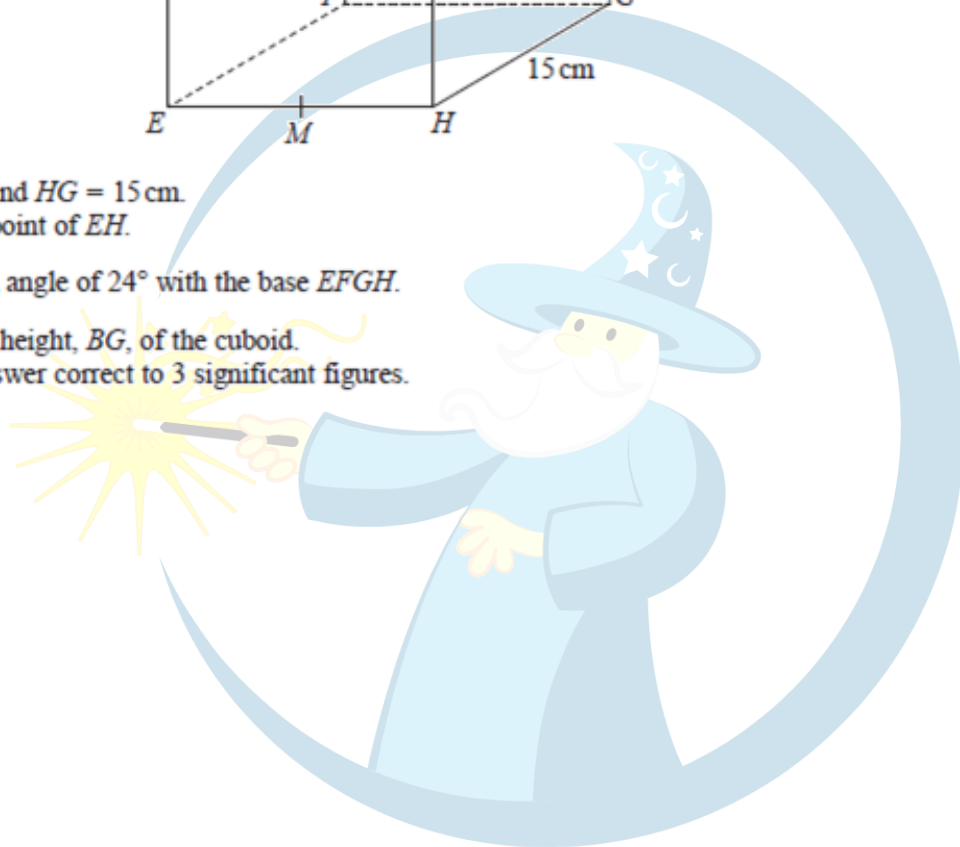
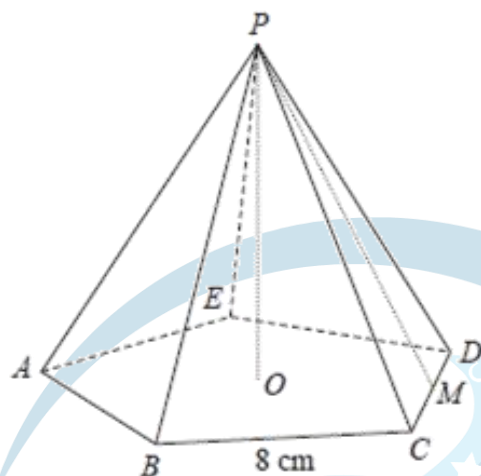**7.** June 2018 (2H) Q19

The diagram shows a triangular prism.
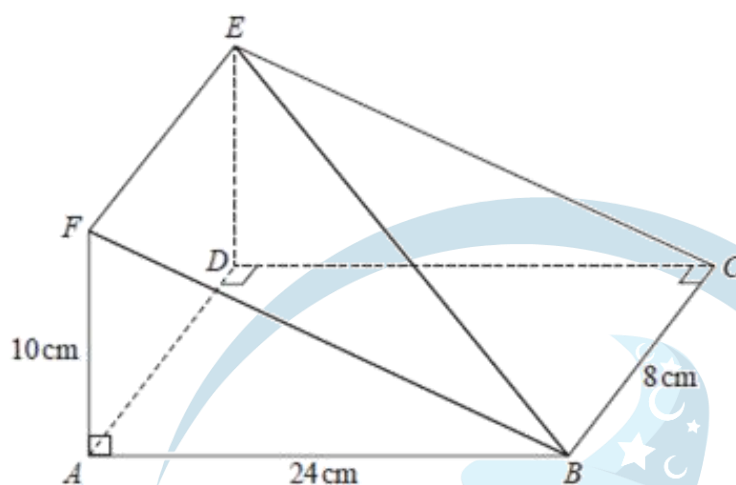
Diagram **NOT** accurately drawn

$AF = 10$ cm, $AB = 24$ cm and $BC = 8$ cm.
Angle FAB = angle ADC = angle $BCD = 90°$

Work out the size of the angle between the line BE and the plane $ABCD$.
Give your answer correct to 1 decimal place.
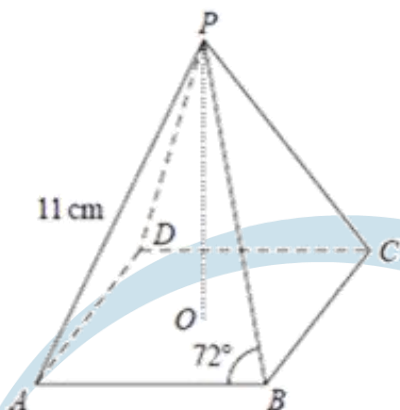
8. Jan 2018 (3H) Q25

Diagram **NOT** accurately drawn

The diagram shows a pyramid with horizontal base *ABCDE*. *ABCDE* is a regular pentagon, centre *O* and side 8 cm.

The vertex *P* is vertically above *O*.
M is the midpoint of *CD*.
OP = 10 cm.

Calculate the size of angle *APM*.
Give your answer correct to 1 decimal place.

9. June 2018 (4HR) Q23

Diagram **NOT** accurately drawn

11 cm

72°

The diagram shows a pyramid with a horizontal square base.
The vertex, *P*, of the pyramid is vertically above the centre, *O*, of the base.
The triangular faces of the pyramid are congruent isosceles triangles.

In triangle *ABP*
PA = *PB* = 11 cm and angle *PBA* = 72°

Work out the height, *OP*, of the pyramid.
Give your answer correct to 3 significant figures.

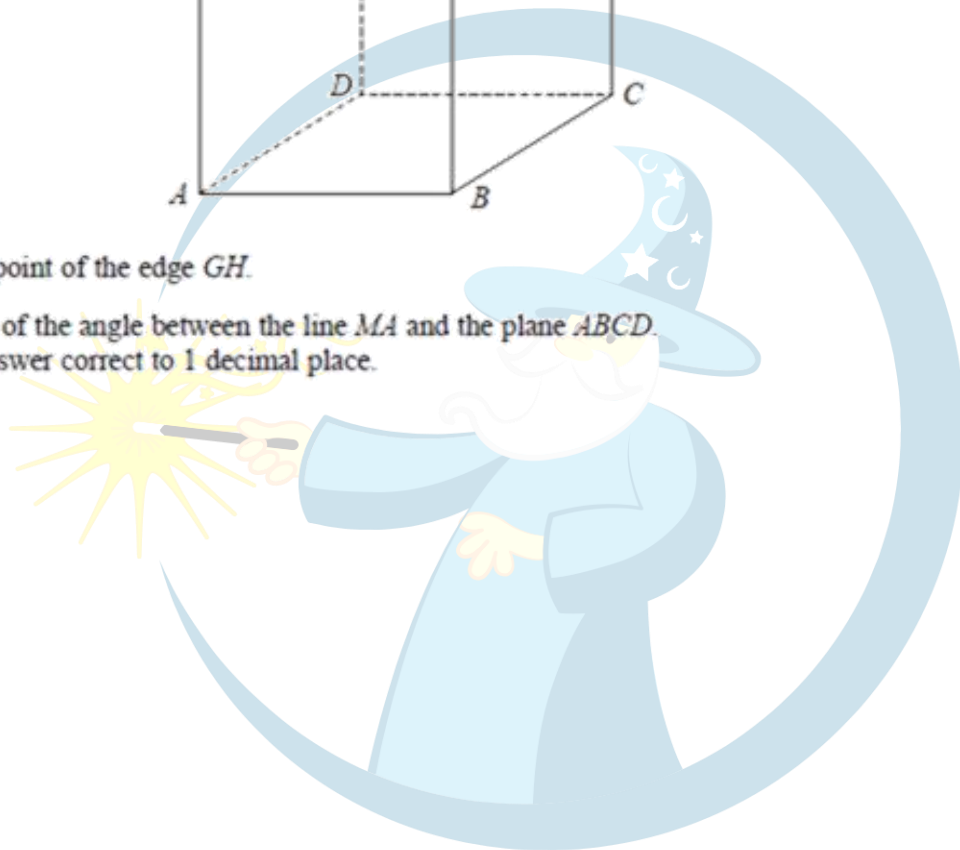**10.** Jan 2019 (1HR) Q20

Here is a cube *ABCDEFGH*.
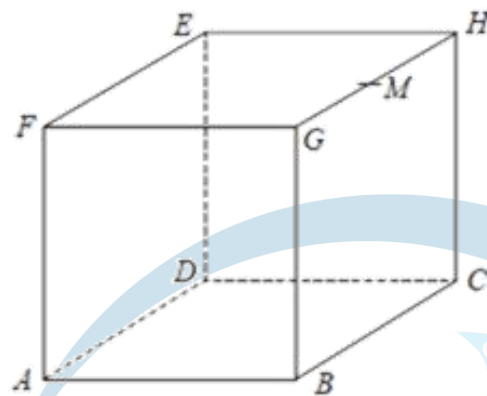
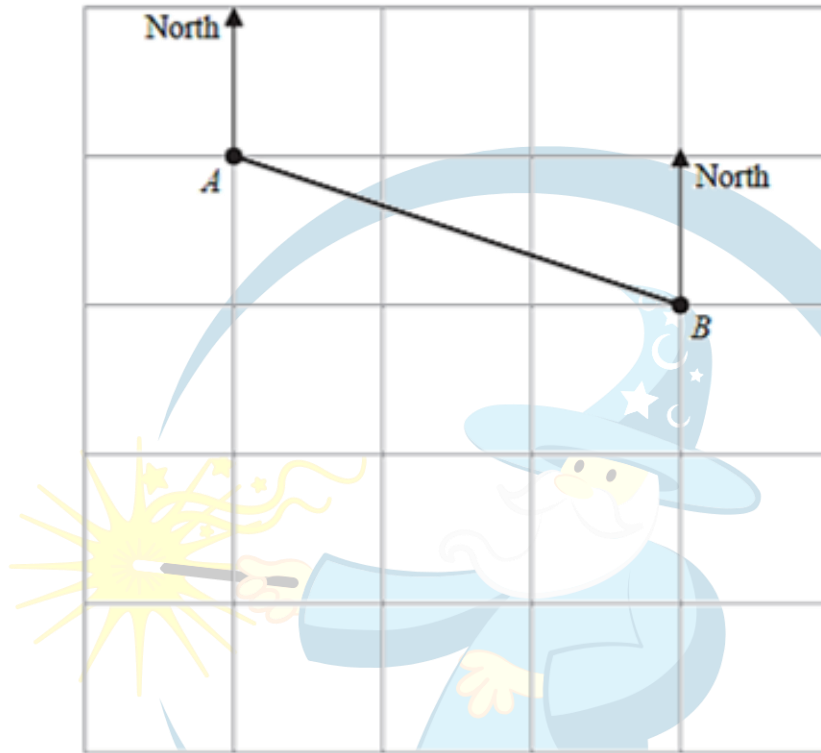Diagram **NOT** accurately drawn

M is the midpoint of the edge *GH*.

Find the size of the angle between the line *MA* and the plane *ABCD*.
Give your answer correct to 1 decimal place.

BEARING

1. Jan 2017 (4H) Q8

The diagram shows point A and point B on a map.
The point C is due south of A
The bearing of C from B is 235°

(a) Mark the point C on the map.

(2)

The bearing of a point D from B is 168°

(b) Find the bearing of B from D

(2)

2. Jan 2017 (4HR) Q9

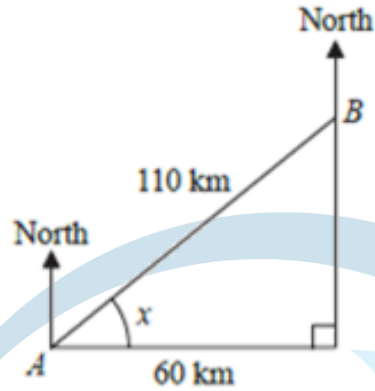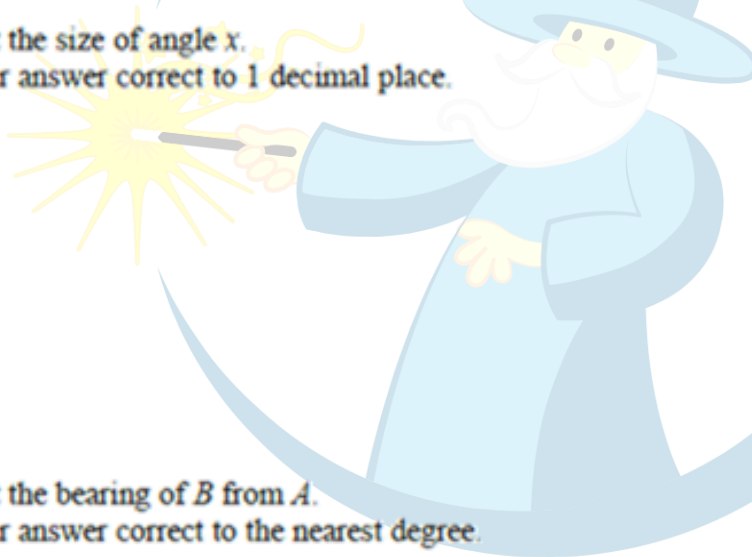The diagram shows the positions of two towns, *A* and *B*.

North

B

Diagram **NOT** accurately drawn

110 km

North

x

A   60 km

The distance from *A* to *B* is 110 km.
B is 60 km east of *A*.

(a) Work out the size of angle *x*.
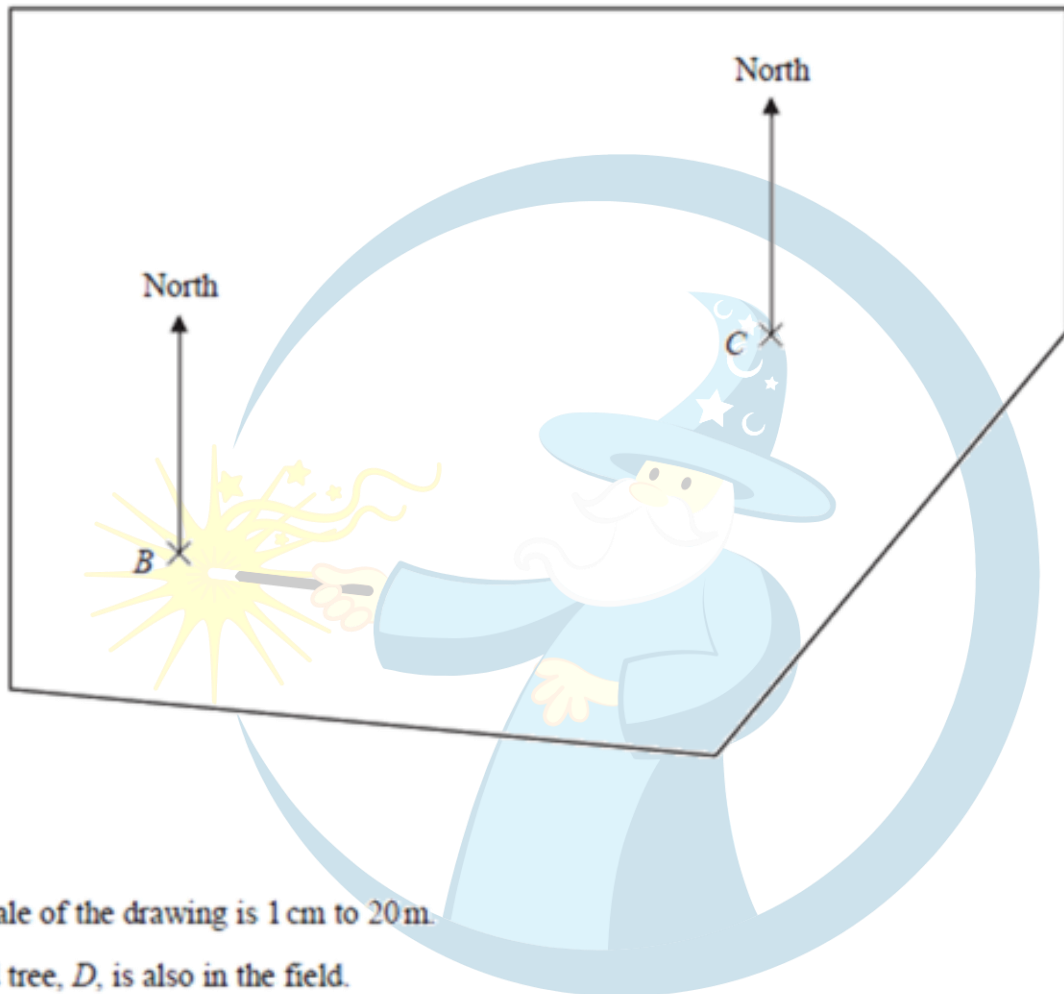   Give your answer correct to 1 decimal place.

....°

(3)

(b) Work out the bearing of *B* from *A*.
    Give your answer correct to the nearest degree.

....°

(2)

3. Jan 2018 (4H) Q4

The accurate scale drawing shows the positions of two trees, *B* and *C*, in a field.

The scale of the drawing is 1 cm to 20 m.

A third tree, *D*, is also in the field.
D is 110 m from *B* and on a bearing of 220° from *C*.

Find the position of *D*.
Mark this point with a cross (×) and label it *D*.

(Total for Question 4 is 3 marks)

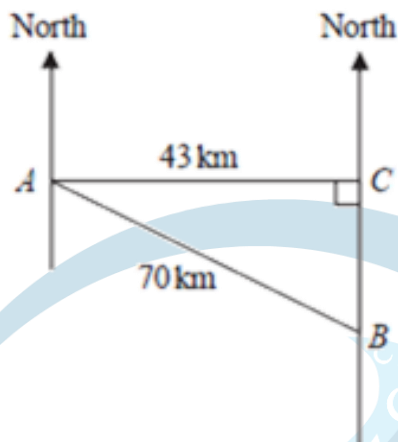**4.** June 2018 (4HR) Q8

A, *B* and *C* are three cities.

North   North

Diagram **NOT** accurately drawn

43 km

A   *C*

70 km

B

City *C* is due east of city *A* and due north of city *B*.
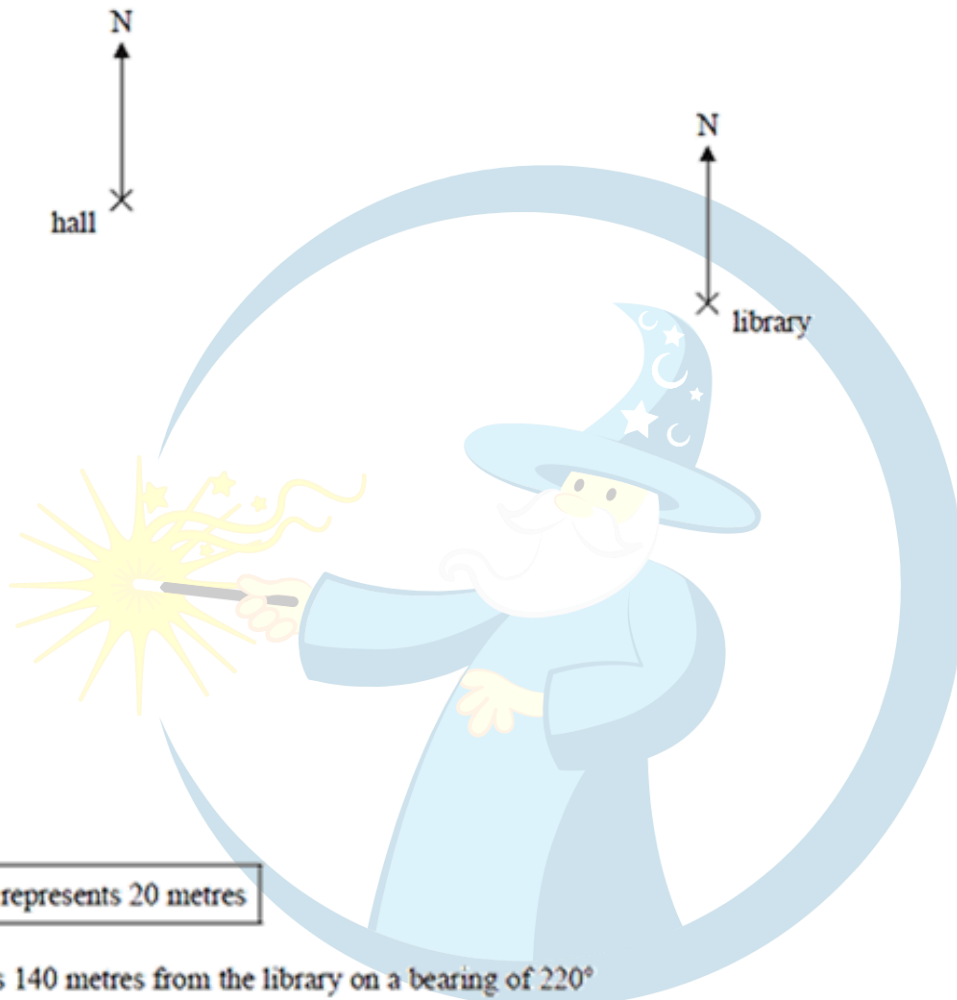City *A* is 43 km from city *C* and 70 km from city *B*.

Work out the bearing of city *B* from city *A*.
Give your answer correct to the nearest degree.

5. Jan 2019 (2HR) Q5

The scale drawing shows the position of a hall and the position of a library.

N

hall ×

N

× library

Scale: 1 cm represents 20 metres

A post box is 140 metres from the library on a bearing of 220°

(a) Show the position of the post box on the scale drawing.
Mark the position with a cross (×) and label it *P*.

(2)

(b) Use your scale drawing to find

(i) the real distance, in metres, of the hall from the post box,

.... m

(ii) the bearing of the hall from the post box.

.... °

(2)

(Total for Question 5 is 4 marks)

British Maths

SCAN ME

"There are no secrets to success.

 It is the result of **preparation, hard work,** and **learning from failure**."

— *General Colin Powell*