Write your name here

| Surname | Other names |
|---|---|
| | |

Pearson Edexcel
Level 1 / Level 2
GCSE (9–1)

| Centre Number | Candidate Number |
|---|---|
| | |

# Mathematics

## Paper 1 (Non-Calculator)

**Higher Tier**

| Thursday 25 May 2017 – Morning<br>**Time: 1 hour 30 minutes** | Paper Reference<br>**1MA1/1H** |
|---|---|

| **You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.<br>Tracing paper may be used. | Total Marks |
|---|---|

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may not be used.**

## Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶



6/6/6/6/6/7/7/



Pearson

**Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.**

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

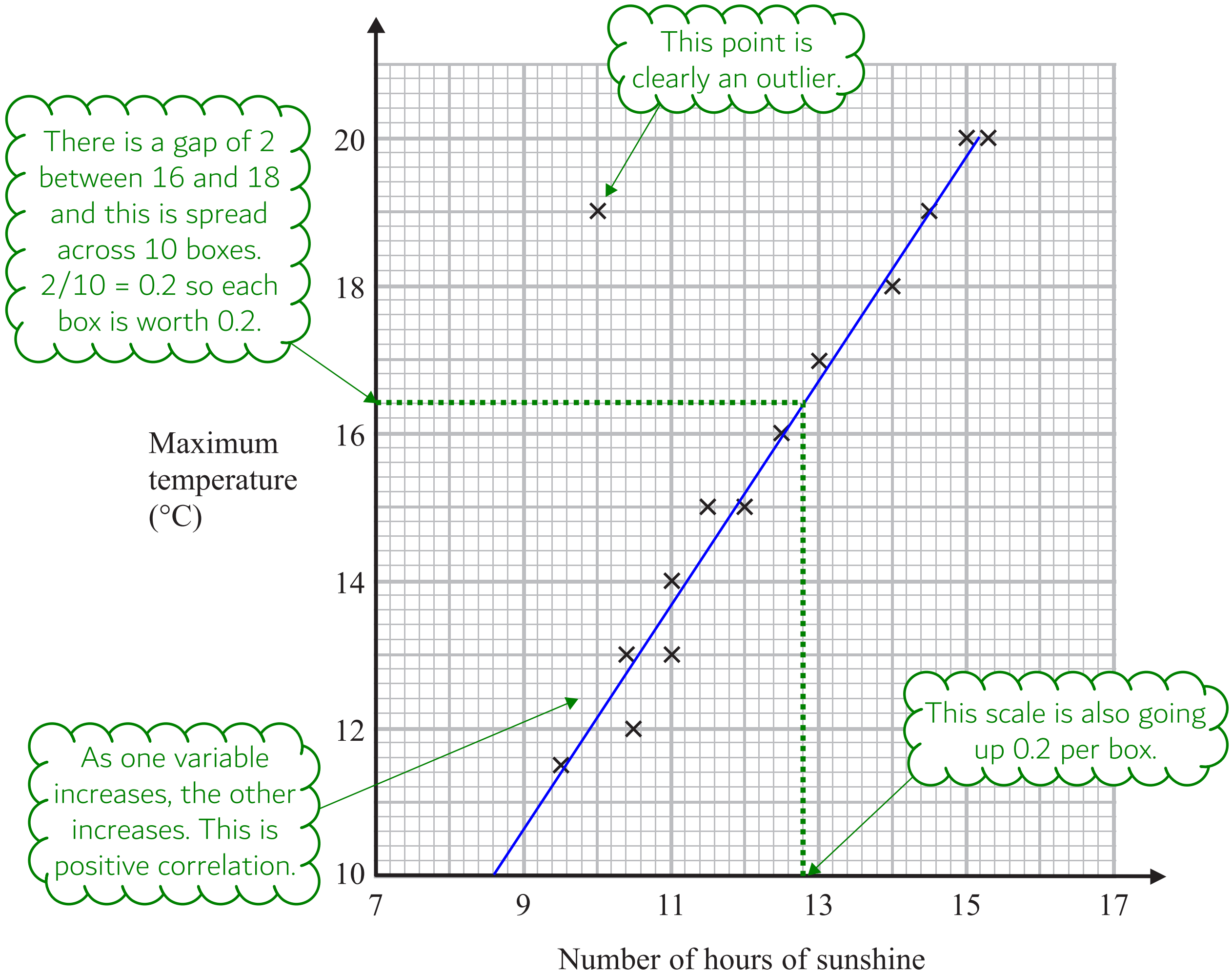
**.CG Maths.**

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1** The scatter graph shows the maximum temperature and the number of hours of sunshine in fourteen British towns on one day.




One of the points is an outlier.

(a) Write down the coordinates of this point.

( 10 , 19 )

**(1)**

(b) For all the other points write down the type of correlation.

Positive

**(1)**

https://youtu.be/lep4WjALdBA

DO NOT WRITE IN THIS AREA

On the same day, in another British town, the maximum temperature was 16.4 °C.

(c) Estimate the number of hours of sunshine in this town on this day.

12.8 hours

**(2)**

A weatherman says,

"Temperatures are higher on days when there is more sunshine."

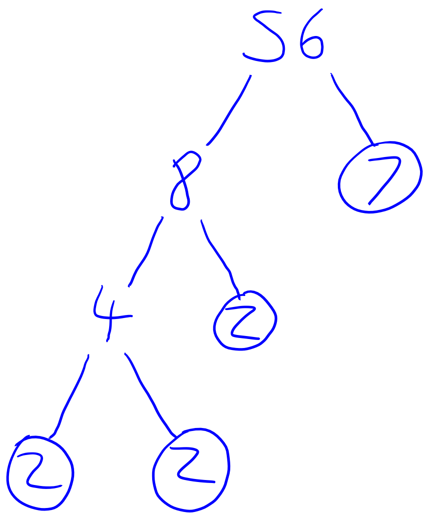
(d) Does the scatter graph support what the weatherman says?
Give a reason for your answer.

Yes, as there is positive correlation.

**(1)**

**(Total for Question 1 is 5 marks)**

**2** Express 56 as the product of its prime factors.




56 = 8 x 7
7 is prime.
8 = 4 x 2
2 is prime.
4 = 2 x 2
2 is prime.

Check: $2^3 \times 7 = 8 \times 7 = 56$

$2^3 \times 7$

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

https://youtu.be/txucZDTT6mU

**3** Work out $54.6 \times 4.3$

$$
\begin{array}{r}
54.6 \\
\times \quad 4.3 \\
\hline
1638 \\
21840 \\
\hline
234.78
\end{array}
$$

There is 1 decimal place in 54.6. There is 1 decimal place in 4.3. There are 2 decimal places in total so there must be 2 decimal places in the answer

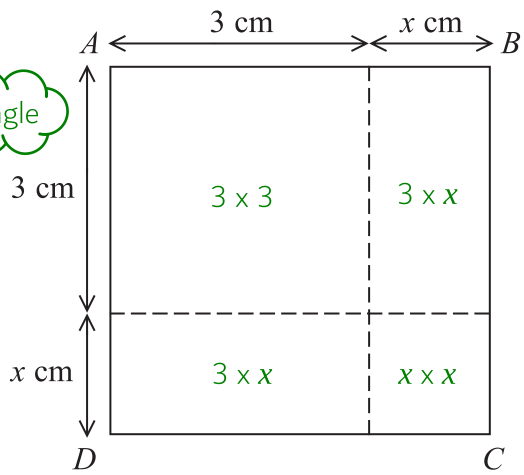
234.78

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

https://youtu.be/7ickKjCNoro

**4**

Length x width = area of rectangle




The area of square $ABCD$ is 10 cm$^2$.

Show that $x^2 + 6x = 1$

Adding up all the individual areas gives the total area of 10

$$3^2 + 3x + 3x + x^2 = 10$$

$$x^2 + 6x + 9 = 10$$

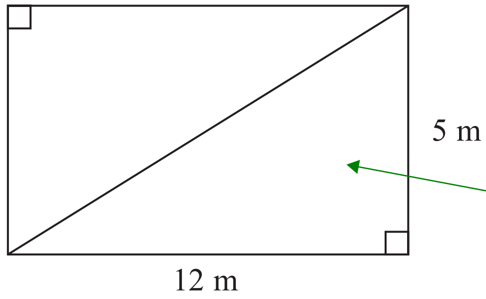
$$x^2 + 6x = 1$$

Simplifying gets us closer to the desired result.

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

https://youtu.be/2y9d5R7F1Bw

**5** This rectangular frame is made from 5 straight pieces of metal.




This is a right-angled triangle so Pythagoras finds the missing side.
$a^2 + b^2 = c^2$
$c = \sqrt{a^2 + b^2}$

The weight of the metal is 1.5 kg per metre.

Work out the total weight of the metal in the frame.

$1.5 \times (12 + 5 + 12 + 5 + \sqrt{12^2 + 5^2})$

$1.5 \times (34 + \sqrt{169})$

$1.5 \times 47$

Adding together all the lengths and multiplying it by the weight per metre gives the total weight.

https://youtu.be/pNclOfdZi9Y

70.5 kg

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

**6** The equation of the line $L_1$ is $y = 3x - 2$
The equation of the line $L_2$ is $3y - 9x + 5 = 0$

Show that these two lines are parallel.

$3y = 9x - 5$

$y = 3x - \frac{5}{3}$

$y = mx + c$ is the general equation for a straight line. $m$ is the gradient so $L_1$ must have a gradient of 3. Rearranging the second equation can put it into the desired form and we can work out the gradient.

Both lines have a gradient of 3

$\therefore$ they are parallel

**(Total for Question 6 is 2 marks)**

https://youtu.be/VQEGJpsbVzw

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**7** There are 10 boys and 20 girls in a class.
The class has a test.

The mean mark for all the class is 60
The mean mark for the girls is 54

Work out the mean mark for the boys.

Mean for boys = total for boys/number of boys
Total for boys = total for class - total for girls
total = mean x number

$$\frac{30 \times 60 - 20 \times 54}{10}$$

(30 x 60)/10 - (20 x 54)/10
3 x 60 - 2 x 54

$$180 - 108$$

https://youtu.be/wBqGoKZQ9KA

72

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

**8** (a) Write $7.97 \times 10^{-6}$ as an ordinary number.

x $10^{-6}$ is dividing by ten six times. This moves the decimal place to the left six times, essentially adding six zeros.

0.00000797

**(1)**

(b) Work out the value of $(2.52 \times 10^{5}) \div (4 \times 10^{-3})$
Give your answer in standard form.

$$\frac{2.52}{4} \times \frac{10^5}{10^{-3}} = 0.63 \times 10^8$$

$a^x/a^y = a^{x-y}$
$10^5/10^{-3} = 10^{5--3}$

$$4\overline{)2.52} = 0.63$$

Standard form: $a \times 10^n$, $1 \leq a < 10$, $n$ is integer.
Multiplying 0.63 by ten gives a suitable number but we need to divide by ten to balance this change so 1 is taken off the power of 10.

$6.3 \times 10^7$

**(2)**

https://youtu.be/YuiOxgLhoCo

**(Total for Question 8 is 3 marks)**

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**9** Jules buys a washing machine.

20% VAT is added to the price of the washing machine.
Jules then has to pay a total of £600

What is the price of the washing machine with **no** VAT added?

$x$ is the original price. Multiplying it by 1.2 increases it by 20% and this gives 600.

$$x \times 1.2 = 600$$

$$x = \frac{600}{1.2}$$

https://youtu.be/qAoDOs522qw

£ 500

**(Total for Question 9 is 2 marks)**

**10** Show that $(x + 1)(x + 2)(x + 3)$ can be written in the form $ax^3 + bx^2 + cx + d$ where $a$, $b$, $c$ and $d$ are positive integers.

The brackets can be expanded two at a time. Expanding the first two gives this.

$$(x^2 + 3x + 2)(x + 3)$$

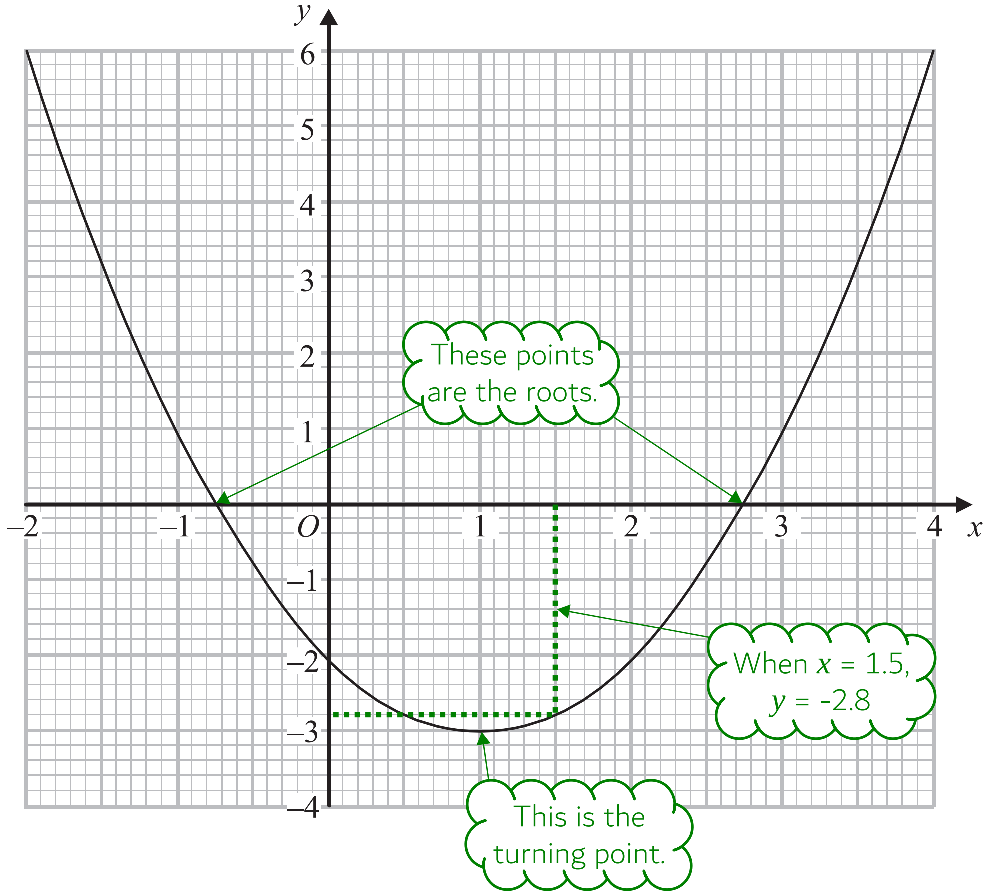
$$x^3 + 3x^2 + 3x^2 + 9x + 2x + 6$$

$$x^3 + 6x^2 + 11x + 6$$

https://youtu.be/hQ_snQWp0-k

**(Total for Question 10 is 3 marks)**

**11** The graph of $y = f(x)$ is drawn on the grid.




(a) Write down the coordinates of the turning point of the graph.

( 1 , -3 )

**(1)**

(b) Write down estimates for the roots of $f(x) = 0$

2.75, -0.75

**(1)**

(c) Use the graph to find an estimate for $f(1.5)$

-2.8

**(1)**

**(Total for Question 11 is 3 marks)**

https://youtu.be/i4FwCahCJFE

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**12** (a) Find the value of $81^{-\frac{1}{2}}$

$a^{x/y} = \sqrt[y]{a^x} = (\sqrt[y]{a})^x \qquad a^{-x} = 1/a^x$

$\frac{1}{\sqrt{81}}$

$\frac{1}{9}$

**(2)**

(b) Find the value of $\left(\frac{64}{125}\right)^{\frac{2}{3}}$

$a^{x/y} = \sqrt[y]{a^x} = (\sqrt[y]{a})^x$

$\sqrt{a}/\sqrt{b} = \sqrt{a/b}$

$\left(\sqrt[3]{\frac{64}{125}}\right)^2 = \frac{4^2}{5^2}$

$\frac{16}{25}$

**(2)**

https://youtu.be/KM1y3s64HYY

**(Total for Question 12 is 4 marks)**

**13** The table shows a set of values for $x$ and $y$.

| | | | | |
|---|---|---|---|---|
| $x$ | 1 | 2 | 3 | 4 |
| $y$ | 9 | $2\frac{1}{4}$ | 1 | $\frac{9}{16}$ |

$y$ is inversely proportional to the square of $x$.

(a) Find an equation for $y$ in terms of $x$.

$y = \frac{k}{x^2} \qquad k = 9 \times 1^2$

Rearranging to find $k$ and substituting values of $x$ and $y$ which are given in the table. These must satisfy the equation.

$y = \frac{9}{x^2}$

**(2)**

(b) Find the positive value of $x$ when $y = 16$

$x = \sqrt{\frac{9}{y}} = \frac{\sqrt{9}}{\sqrt{16}}$

Rearranged the equation to make $x$ the subject then substituted in $y = 16$

$\frac{3}{4}$

**(2)**

https://youtu.be/QoLOv5QCZO0

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

**14** White shapes and black shapes are used in a game.
Some of the shapes are circles.
All the other shapes are squares.

The ratio of the number of white shapes to the number of black shapes is 3 : 7

The ratio of the number of white circles to the number of white squares is 4 : 5

The ratio of the number of black circles to the number of black squares is 2 : 5

Work out what fraction of all the shapes are circles.

$$\frac{4}{9} \times \frac{3}{10} + \frac{2}{7} \times \frac{7}{10}$$

4/9 is the fraction of the white shapes which are circles. 3/10 is the fraction of the shapes which are white. Multiplying these fractions gives the fraction of shapes which are white circles.

2/7 is the fraction of the black shapes which are circles. 7/10 is the fraction of the shapes which are black. Multiplying these fractions gives the fraction of the shapes which are black circles.

Adding the fraction of shapes which are white circles to the fraction of the shapes which are black circles gives the fraction of the shapes which are circles.

$$\frac{12}{90} + \frac{14}{70}$$

$$\frac{12}{90} = \frac{6}{45} = \frac{2}{15}$$

$$\frac{14}{70} = \frac{7}{35} = \frac{1}{5} = \frac{3}{15}$$

The fractions are simplified so that they have the same denominator so that they can be added.

$$\frac{2}{15} + \frac{3}{15} = \frac{5}{15}$$

$\frac{1}{3}$

**(Total for Question 14 is 4 marks)**

https://youtu.be/FoN0Q7LNBCo

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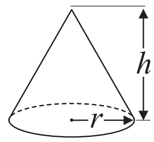
**15** A cone has a volume of 98 $cm^3$.
The radius of the cone is 5.13 cm.

Volume of cone $= \frac{1}{3}\pi r^2 h$




(a) Work out an estimate for the height of the cone.

$$h = \frac{3V}{\pi r^2} = \frac{3 \times 100}{3 \times 5^2} = \frac{100}{25}$$

Rearranging the formula to make the height the subject.

We are only doing an estimate so we can use rough values to one significant figure.

4 .......................................... cm
**(3)**

John uses a calculator to work out the height of the cone to 2 decimal places.

(b) Will your estimate be more than John's answer or less than John's answer?
Give reasons for your answer.

V was increased, π was decreased, r was decreased. These all increase the value of the estimate so it will be more than John's.

**(1)**

https://youtu.be/rs88_nNiGv8

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

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**16** $n$ is an integer greater than 1

Prove algebraically that $n^2 - 2 - (n - 2)^2$ is always an even number.

$n^2 - 2 - (n^2 - 4n + 4)$

$4n - 6$

$2(2n - 3)$

$\therefore$ must be even

https://youtu.be/OPqjZA0W33Y

**(Total for Question 16 is 4 marks)**

**17** There are 9 counters in a bag.

7 of the counters are green.
2 of the counters are blue.

Ria takes at random two counters from the bag.

Work out the probability that Ria takes one counter of each colour.
You must show your working.

Green AND blue OR blue AND green. 'AND' means to multiply the probabilities and 'OR' means to add the probabilities. The fraction of the counters in the bag which are of a certain colour is the probability of getting that colour. After the first counter is taken there is 1 fewer counter in total.

$$\frac{7}{9} \times \frac{2}{8} + \frac{2}{9} \times \frac{7}{8}$$

$$\frac{14}{72} + \frac{14}{72}$$

https://youtu.be/F053cZv2FI0

$\frac{28}{72}$

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

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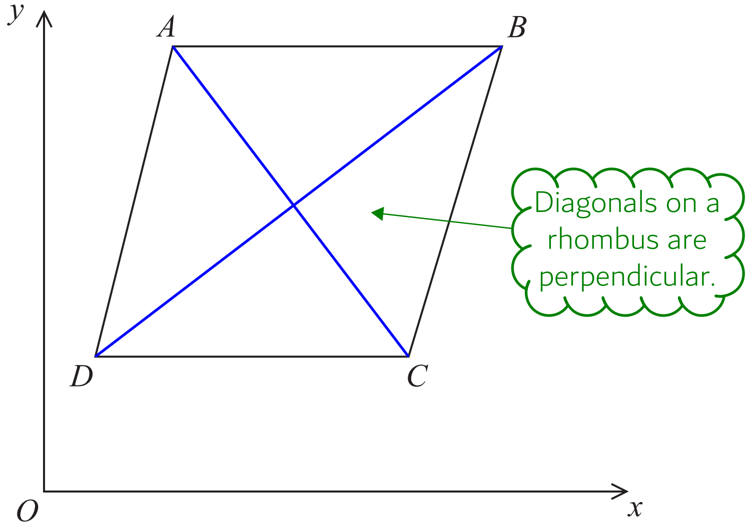
**18**




*ABCD* is a rhombus.
The coordinates of *A* are $(5, 11)$
The equation of the diagonal *DB* is $y = \frac{1}{2}x + 6$

Find an equation of the diagonal *AC*.

$y = mx + c$
$m$ is gradient
$c$ is $y$-intercept

The gradient of DB is 1/2. Perpendicular gradient is the negative reciprocal.

$y = -2x + c$

$c = y + 2x = 11 + 2 \times 5 = 21$

Rearranged to find $c$ then substituting the $x$ and $y$ value from point A as this must satisfy the equation.

$y = -2x + 21$

**(Total for Question 18 is 4 marks)**

https://youtu.be/QrbR17Kl1DE

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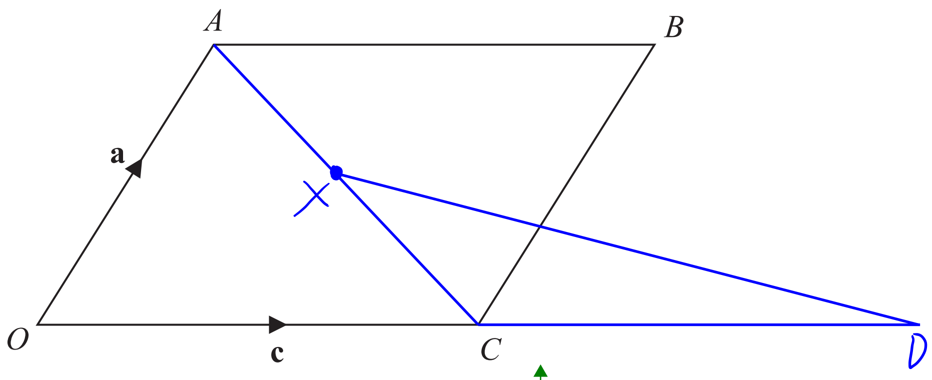
**19**




A rough sketch of the information we are given.

*OABC* is a parallelogram.

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$

*X* is the midpoint of the line *AC*.
*OCD* is a straight line so that $OC : CD = k : 1$

Given that $\overrightarrow{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a}$

find the value of *k*.

This is half of vector $\overrightarrow{CA}$, which is $\overrightarrow{CO} + \overrightarrow{OA}$.

$$\overrightarrow{CD} = \overrightarrow{CX} + \overrightarrow{XD}$$
$$= \frac{1}{2}(-c + a) + 3c - \frac{1}{2}a$$
$$= 2.5c$$

$$c : 2.5c$$

Expressing the ratio of OC : CD.

$$\frac{c}{2.5c} : 1$$

Simplifying the ratio into the form k : 1 by dividing both sides of the ratio by 2.5c

$$\frac{1}{2.5} : 1$$

$k = \frac{2}{5}$

https://youtu.be/7ZpGKMObghw

**(Total for Question 19 is 4 marks)**

**20** Solve algebraically the simultaneous equations

$$x^2 + y^2 = 25$$
$$y - 3x = 13$$

$y = 3x + 13$

Rearrange the second equation to make $y$ the subject then substitute $y$ in the second equation to eliminate $y$ as a variable.

$x^2 + (3x+13)^2 = 25$

Expand the bracket and construct a quadratic which can be solved by factorisation.

$x^2 + 9x^2 + 78x + 169 - 25 = 0$

$10x^2 + 78x + 144 = 0$

Both sides can be divided by 2 as all of the terms are even. This makes it easier to factorise as 5 is prime and there is only one possibility for the $x$-terms in the brackets.

$5x^2 + 39x + 72 = 0$

$(5x+24)(x+3) = 0$

1 , 72
2 , 36
3 , 24

List factor pairs of 72 and trial them in the brackets as we go until we get a pair which when put into the brackets would expand to give the original equation.

$x = \frac{-24}{5}$ or $x = -3$

$y = \frac{-7}{5}$ $\quad$ $y = 4$

Either $x + 3 = 0$ or $5x + 24 = 0$. Rearranging these gives the solutions for $x$. We can then substitute the values into $y = 3x + 13$ to find the corresponding $y$ values. 3 x -3 + 13 = 4

$3 \times \frac{-24}{5} + 13$

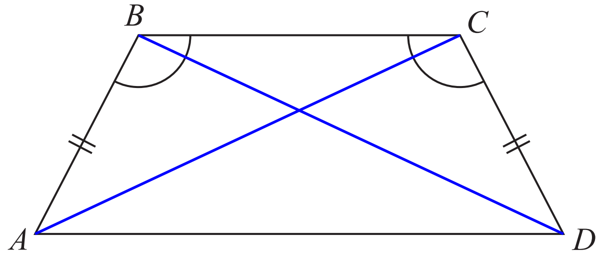
$\frac{-72}{5} + \frac{65}{5}$

Substituting $x$ = -24/5 into the equation $y$ = 3$x$ + 13 to solve $y$.

https://youtu.be/oWKPhBtDD6g

**(Total for Question 20 is 5 marks)**

**21** *ABCD* is a quadrilateral.




$AB = CD$.
Angle $ABC$ = angle $BCD$.

Prove that $AC = BD$.

AB = CD
ABC = BCD
BC is shared
∴ triangles ABC and BCD are congruent
as SAS so AC = BD

https://youtu.be/Wz3kpUoM3aY

**(Total for Question 21 is 4 marks)**

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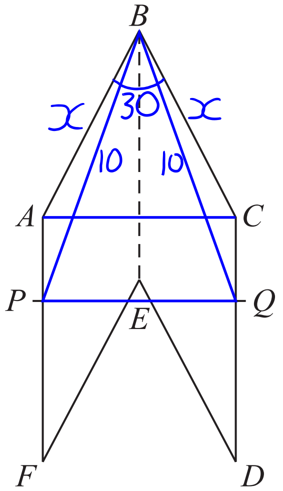
**22** The diagram shows a hexagon *ABCDEF*.

https://youtu.be/mlZAPgemvZI




With harder geometry questions, it is always worth sketching what you are given onto a diagram so you can start to make a plan of what to do.

*ABEF* and *CBED* are congruent parallelograms where $AB = BC = x$ cm.
*P* is the point on *AF* and *Q* is the point on *CD* such that $BP = BQ = 10$ cm.

Given that angle $ABC = 30°$,

prove that $\cos PBQ = 1 - \frac{(2-\sqrt{3})}{200}x^2$

We don't have right-angled triangles so we either have to use the sine or cosine rule. We are trying to find an angle and don't have opposite pairs of angles and sides so likely have to use the cosine rule.

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Rearranging the cosine rule to make cosA the subject and substituting what we are given into the equation. We realise we need to find PQ.

$$\cos PBQ = \frac{PQ^2 - 10^2 - 10^2}{-2 \times 10 \times 10}$$

$$PQ = AC = \sqrt{x^2 + x^2 - 2 \times x \times x \times \cos 30}$$

Rearranging the cosine rule to make *a* the subject and substituting what we are given into the equation.

$$\cos PBQ = \frac{2x^2 - 2x^2 \times \frac{\sqrt{3}}{2} - 200}{-200}$$

Substituting PQ back into the original equation. Square root and square operations cancel out. cos30 = √3/2.

$$= \frac{-200}{-200} + \frac{x^2(2-\sqrt{3})}{-200} = 1 - \frac{(2-\sqrt{3})}{200}x^2$$

The fraction can be split into two and $x^2$ is taken out as a factor. $-2 \times \sqrt{3}/2 = -\sqrt{3}$

**(Total for Question 22 is 5 marks)**

**TOTAL FOR PAPER IS 80 MARKS**