Write your name here

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

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Mathematics

Paper 1 (Non-Calculator)

Higher Tier

Thursday 25 May 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
1MA1/1H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.
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 ▶

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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 should be written in the exam.

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

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

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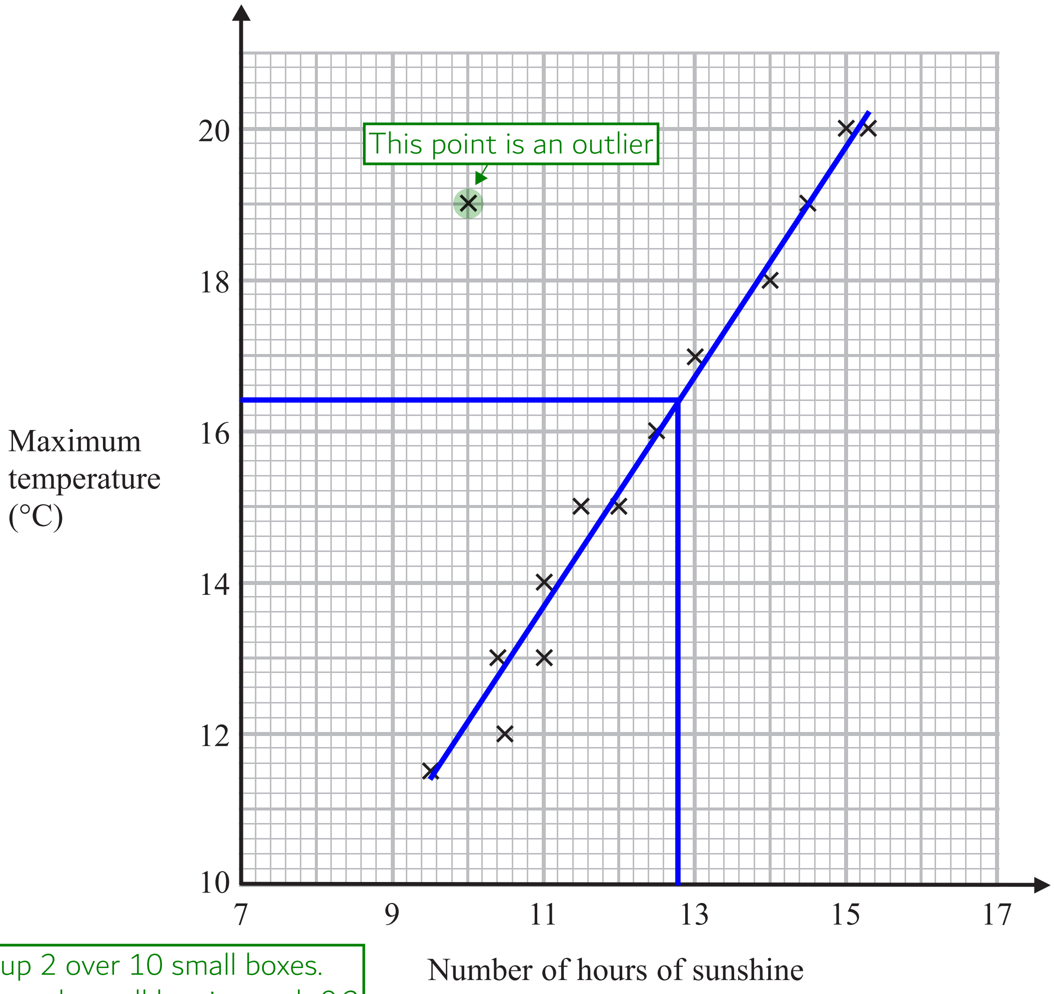
Answer ALL questions.

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.



This point is an outlier

Both scales go up 2 over 10 small boxes.
2 ÷ 10 = 0.2, so each small box is worth 0.2

One of the points is an outlier.

(a) Write down the coordinates of this point.

x-coordinate y-coordinate

(......10...... , ...19......)

(1)

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

......Positive......

(1)

As one variable (number of hours of sunshine) increases, so does the other variable (maximum temperature. This is positive correlation

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.

Drawing a line of best fit. Reading across from 16.4°C to the line then down to the number of hours of sunshine

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)

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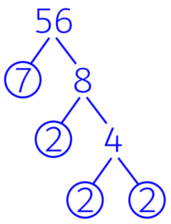
2 Express 56 as the product of its prime factors.



Doing a factor tree. Splitting each number into two factors and stopping at the primes, which are circled

Writing the circled primes multiplied together → $2 \times 2 \times 2 \times 7$

(Total for Question 2 is 2 marks)

3 Work out 54.6 × 4.3

$$\begin{array}{r} 546 \\ \times\ 43 \\ \hline 1638 \\ {\scriptstyle 1\ 1} \\ 21840 \\ {\scriptstyle 1\ 2} \\ \hline 23478 \\ {\scriptstyle 1} \end{array}$$

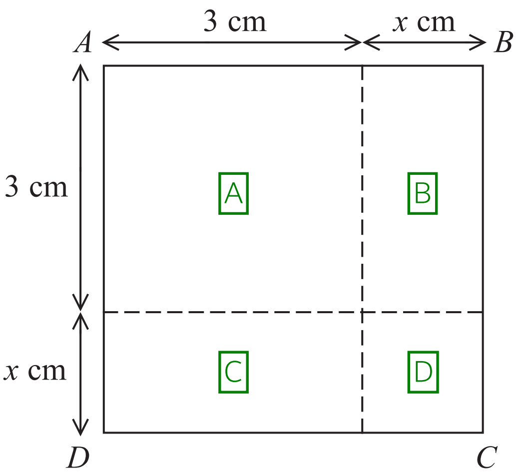
Ignoring the decimal points and doing 546 × 43

There is 1 decimal place in 54.6. There is 1 decimal place in 4.3. There are 2 decimal places in total. So bringing the decimal point to the left 2 times

234.78

(Total for Question 3 is 3 marks)

4



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

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

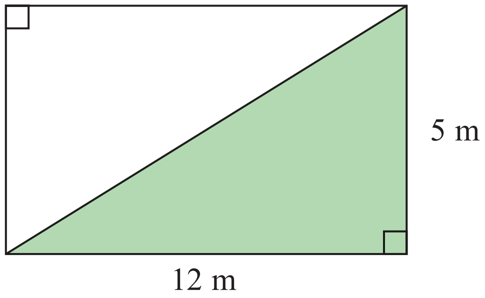
$x^2 + 3x + 3x + 9$ ← Area of rectangle = length × width. So the area of rectangle D is x^2, the area of rectangle C is 3x, the area of rectangle B is 3x and the area of rectangle A is 9. Adding all these areas expresses the area of square ABCD

$x^2 + 6x + 9 = 10$ ← Simplifying the expression of the area of square ABCD. Setting equal to the value of the area, 10

$x^2 + 6x = 1$ ← Subtracting 9 from both sides

(Total for Question 4 is 3 marks)

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



The weight of the metal is 1.5 kg per metre.

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

$12^2 + 5^2$ ← Using Pythagoras' Theorem in the green right-angled triangle to find the missing length going through the middle of the rectangle. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side

$$\begin{array}{r} 144 \\ +\ 25 \\ \hline 169 \end{array}$$

← $12^2 = 144$ and $5^2 = 25$. Then adding these works out that c^2 is 169. 13 is squared to give 169 so the missing length is 13 m

12 + 12 + 5 + 5 + 13 ← Adding all five lengths of metal works out that the total length of metal used is 47 metres

$$\begin{array}{r} 47 \\ \times 15 \\ \hline 2\overset{3}{3}5 \\ 470 \\ \hline \underset{1}{7}05 \end{array}$$

← Multiplying the 47 metres by the 1.5 kg per metre works out the total weight of the metal in the frame. Ignoring the decimal point and doing 47 × 15

There was 1 decimal place in 1.5. So bringing the decimal point to the left 1 time

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.

$3y = 9x - 5$ ← The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. The equation of L_2 needs to be rearranged into this form to work out the gradient. First adding 9x to both sides and subtracting 5 from both sides to get the y term on its own

$y = 3x - \frac{5}{3}$ ← Dividing both sides by 3 gets y on its own and puts it into the form y = mx + c. m is 3 so the gradient is 3

The gradient of both lines is 3 ← Parallel lines have the same gradient

(Total for Question 6 is 2 marks)

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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.

$$\begin{array}{cc} & t \\ m & n \end{array}$$

Mean = total/number, where total is the total of the marks and number is the number of people. Writing this as a formula triangle

$60 \times 30 = 1800$

Covering t in the formula triangle finds that total = mean × number. So multiplying the mean for all the class by the 30 people (10 boys + 20 girls) works out that the total marks for all the class is 1800

$54 \times 20 = 1080$

Covering t in the formula triangle finds that total = mean × number. So multiplying the mean for the girls by the 20 girls works out that the total marks for all the girls is 1080

$$\begin{array}{r} 1\,\overset{7}{\cancel{8}}\,{}^{1}0\,0 \\ -\,1\,0\,8\,0 \\ \hline 7\,2\,0 \end{array} \div 10$$

Subtracting the total for the girls from the total for all the class works out that the total for the boys is 720

Dividing the total for the boys by the 10 boys works out the mean for the boys

72

(Total for Question 7 is 3 marks)

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8 (a) Write 7.97×10^{-6} as an ordinary number.

7.97 divided by ten 6 times. This moves the decimal point 6 times to the left

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.

$$4 \overline{)\,2.{}^{2}5\,{}^{1}2} = 0.63 \times 10^{8}$$

The 2.52 can be divided by the 4 and the 10^5 can be divided by the 10^{-3}. $a^x \div a^y = a^{x-y}$, so $10^5 \div 10^{-3} = 10^{5--3} = 10^{5+3} = 10^8$

The 0.63 must be multiplied by ten 1 time to get 6.3, which is at least 1 and less than 10. So the 10^8 needs to be divided by ten 1 time to keep it equal. $10^8 \div 10^1 = 10^{8-1} = 10^7$

6.3×10^7

(2)

(Total for Question 8 is 3 marks)

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?

$100 + 20$ ← Adding the 20% to 100% works out that it has been increased to 120% of the original price

$600 \div 120$ ← Dividing the £600 by 120 works out that 1% of the original price is £5.
$600 \div 120 = 60 \div 12 = 5$

5×100 ← Multiplying the value of 1% by 100 works out that 100% of the original price is £500

£ ....500............

(Total for Question 9 is 2 marks)

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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.

$x^2 + 2x + x + 2$ ← Expanding the first two brackets

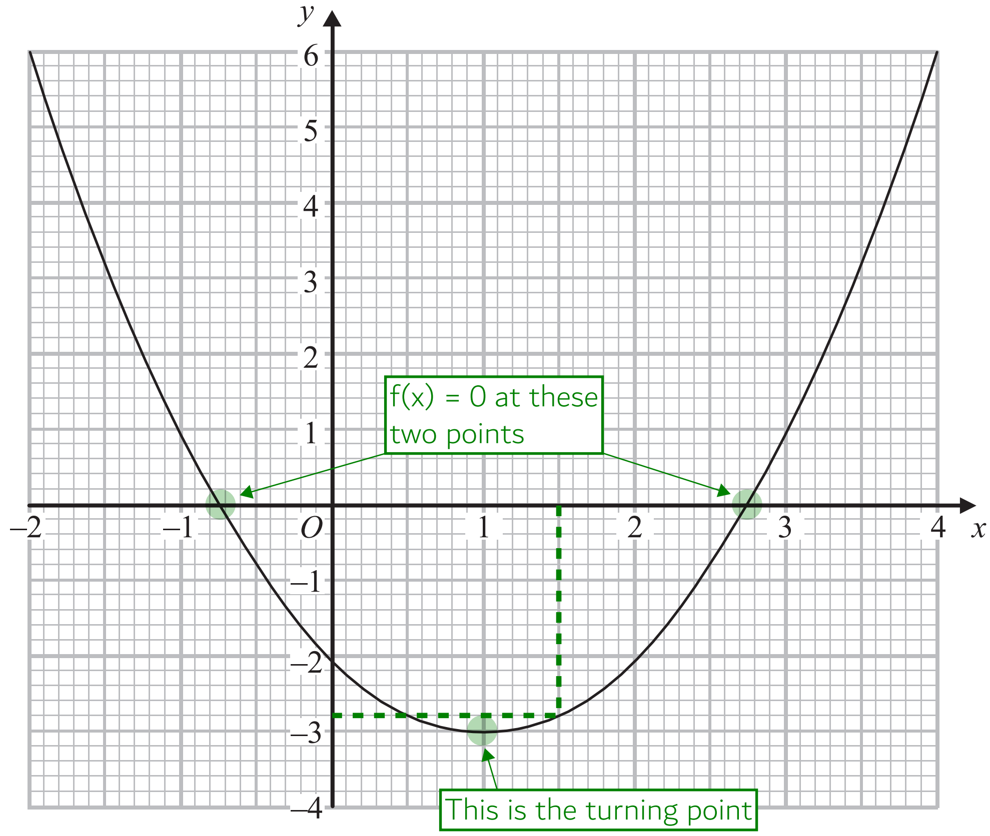
$(x^2 + 3x + 2)(x + 3)$ ← Simplifying by collecting like terms and writing multiplied by the third bracket

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

$x^3 + 6x^2 + 11x + 6$ ← Simplifying by collecting like terms

(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.

x-coordinate y-coordinate

(1 , -3)

(1)

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

-0.75, 2.75

(1)

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

When x = 1.5, y = -2.8

-2.8

(1)

(Total for Question 11 is 3 marks)

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

The power of 1/2 means to square root. $\sqrt{81} = 9$.
Then the negative power means to do the reciprocal

$\frac{1}{9}$ ……………………………………
(2)

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

The 3 as the denominator of the power means to cube root. $\sqrt[3]{64} = 4$ and $\sqrt[3]{125} = 5$. Then the 2 as the numerator of the power means to square. $4^2 = 16$ and $5^2 = 25$

$\frac{16}{25}$ ……………………………………
(2)

(Total for Question 12 is 4 marks)

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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.

$y = \frac{k}{x^2}$ ← Writing the proportion as an equation, where k is a constant which needs to be found

$k = yx^2$ ← Rearranging to make k the subject by multiplying both sides by x^2

$= 9 \times 1^2$ ← Substituting in the first pair of x and y values finds that k = 9

Rewriting the equation with k as 9 → $y = \frac{9}{x^2}$ ……………………………………
(2)

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

$16 = \frac{9}{x^2}$ ← Substituting 16 for y in the equation

$16x^2 = 9$ ← Multiplying both sides by x^2 to eliminate it as a denominator

$x^2 = \frac{9}{16}$ ← Dividing both sides by 16 to get x^2 on its own

$\frac{3}{4}$ ……………………………………
(2)

Square rooting both sides finds the positive value of x

(Total for Question 13 is 4 marks)

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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.

$\frac{4}{9} \times \frac{3}{10}$

4 + 5 = 9 parts in total in the ratio of the white shapes. 4 out of these 9 parts are for white circles so 4/9 of the white shapes are circles. 3 + 7 = 10 parts in total in the ratio of the shapes. 3 out of these 10 parts are for white shapes so 3/10 of the shapes are white. 4/9 of the 3/10 of the shapes are white circles. Of means to multiply

$\frac{2}{3} \times \frac{1}{5}$

Simplifying by cancelling out common factors from the numerators and denominators

$\frac{2}{15}$

To multiply fractions: multiply the numerators and multiply the denominators. So 2/15 of the shapes are white circles

$\frac{2}{7} \times \frac{7}{10}$

2 + 5 = 7 parts in total in the ratio of the black shapes. 2 out of these 7 parts are for black circles so 2/7 of the black shapes are circles. 3 + 7 = 10 parts in total in the ratio of the shapes. 7 out of these 10 parts are for black shapes so 7/10 of the shapes are black. 2/7 of the 7/10 of the shapes are black circles. Of means to multiply

$\frac{1}{1} \times \frac{1}{5}$

Simplifying by cancelling out common factors from the numerators and denominators. To multiply fractions: multiply the numerators and multiply the denominators. So 1/5 of the shapes are black circles

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

Adding the fraction which are white circles and the fraction which are black circles gives the fraction which are circles. Multiplying both the numerator and denominator of 1/5 by 3 to give 3/15 so that both fractions have the same denominator and can be added

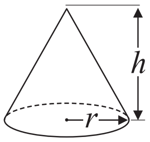
$\frac{5}{15}$

(Total for Question 14 is 4 marks)

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

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

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



$100 = \frac{1}{3} \times 3 \times 5^2 \times h$ ← Substituting 100 for the volume of cone, 3 for π and 5 for r in the formula. Rough numbers can be used as it is an estimate

$100 = 25h$ ← 1/3 × 3 = 1 and 5^2 = 25 then 1 × 25 × h = 25h

Dividing both sides by 25 finds that h = 4 → 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.

More, as the volume of cone was rounded up, π was rounded down and the radius was rounded down

The 25 was too low and the 100 was too high. Dividing the 100 by 25 gives an answer which is too high

(1)

(Total for Question 15 is 4 marks)

---

16 n is an integer greater than 1

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

$n^2 - 2 - (n^2 - 4n + 4)$ ← Expanding the square bracket by squaring the first term, doubling the product of the two terms and squaring the last term

$4n - 6$ ← Subtracting everything in the bracket. Double negative becomes positive

$2(2n - 3)$ ← Bringing 2 out as a factor shows that it is even

(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.

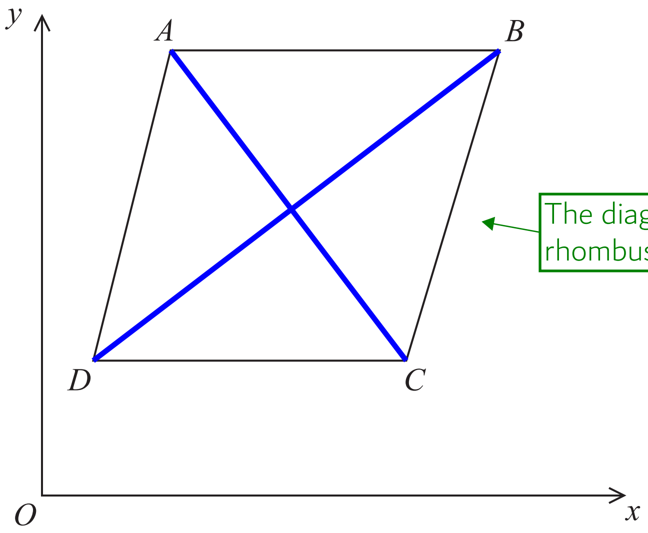
$\frac{7}{9} \times \frac{2}{8} + \frac{2}{9} \times \frac{7}{8}$ ← Green AND blue OR blue AND green. AND means to multiply the probabilities. OR means to add the probabilities. After the first counter is taken there is 1 fewer counter in total

$\frac{14}{72} + \frac{14}{72}$ ← To multiply fractions: multiply the numerators and multiply the denominators

The numerators can be added as the denominators are the same → $\frac{28}{72}$

(Total for Question 17 is 4 marks)

18



The diagonals of a rhombus are perpendicular

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*.

$y = -2x + c$

The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. The gradient of DB is 1/2. The gradient of AC is the negative reciprocal of this as they are perpendicular so is -2

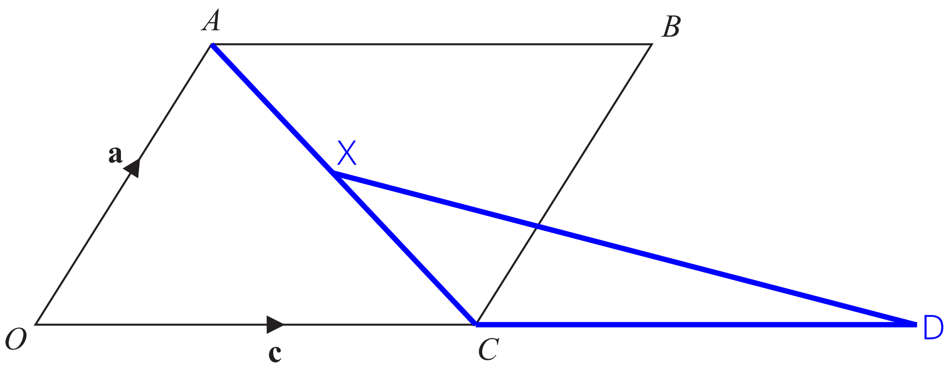
$c = 11 + 2(5)$

Rearranging to make c the subject by adding 2x to both sides and substituting 11 for y and 5 for x. 2(5) = 10 then 11 + 10 = 21

$y = -2x + 21$

(Total for Question 18 is 4 marks)

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*.

$\overrightarrow{CA} = -c + a$ ← $\overrightarrow{CA} = \overrightarrow{CO} + \overrightarrow{OA}$. $\overrightarrow{CO} = -\overrightarrow{OC} = -c$

$\overrightarrow{CD} = -\frac{1}{2}c + \frac{1}{2}a + \frac{6}{2}c - \frac{1}{2}a$ ← $\overrightarrow{CD} = \overrightarrow{CX} + \overrightarrow{XD}$. $\overrightarrow{CX} = 1/2\ \overrightarrow{CA}$. Writing 3c as 6/2 c so that it has the same denominator of 2. So $\overrightarrow{CD} = 5/2$ c

$c : \frac{5}{2}c$ ← Expressing the ratio OC : CD

$1 : \frac{5}{2}$ ← Simplifying by dividing both sides by c

$\frac{2}{5} : 1$ ← Dividing both sides by 5/2 to get 1 on the right. 1 divided by does the reciprocal, so 1 ÷ 5/2 = 2/5

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

(Total for Question 19 is 4 marks)

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20 Solve algebraically the simultaneous equations

$$x^2 + y^2 = 25$$

1st equation

$$y - 3x = 13$$

2nd equation

$y = 3x + 13$

Rearranged the 2nd equation to make y the subject by adding 3x to both sides. This forms the 3rd equation

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

Substituting 3x + 13 for y in the 1st equation. Expanding $(3x + 13)^2$ to get $9x^2 + 78x + 169$ by squaring the first term, doubling the product of the two terms, squaring the last term

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

Collecting like terms and subtracting 25 from both sides to put it into the quadratic form $ax^2 + bx + c = 0$

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

Dividing all terms on both sides by 2 to get smaller whole numbers

$5x^2 + 15x + 24x + 72$

a = 5, b = 39, c = 72. Multiplying a by c gives 360. Two numbers which multiply to this and add to b are 15 and 24. Splitting the middle x term into these numbers of x

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

Factorising the left two terms and the right two terms separately

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

Bringing together the 5x and +24 and writing the (x + 3) once. This is now fully factorised. Putting it back equal to 0. Either 5x + 24 = 0 (so x = -24/5) or x + 3 = 0 (so x = -3)

$y = 3(-3) + 13$

$y = 3(-\frac{24}{5}) + 13$

Substituting the values of x back into the 3rd equation works out the y values

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

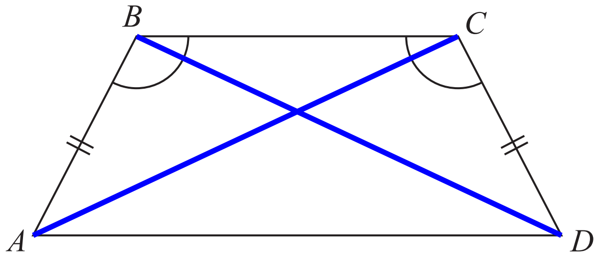
Writing 13 as 65/5 so that it has 5 as the denominator

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

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

(Total for Question 20 is 5 marks)

21 *ABCD* is a quadrilateral.



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

Prove that $AC = BD$.

AB = CD ← This is given

Angle ABC = angle BCD ← This is given

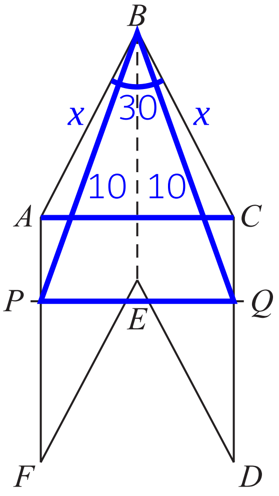
BC is shared ← BC is in both triangle ABC and triangle BCD

SAS, so triangles ABC and BCD are congruent ← Two sides and the angle between them are the same in both triangles so they are congruent (the same shape and size)

So AC = BD ← As they are opposite the same angle in the congruent triangles

(Total for Question 21 is 4 marks)

22 The diagram shows a hexagon *ABCDEF*.



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

$AC^2 = x^2 + x^2 - 2 \times x \times x \times \cos 30$ ← Using the cosine rule in triangle ABC: $a^2 = b^2 + c^2 - 2bc\cos A$

0	30	45	60	90
4	3	2	1	0

← Listing the angles 0, 30, 45, 60, 90 degrees. Listing 4, 3, 2, 1, 0 under these for the cos values. Square rooting them and putting them over 2 works out that $\cos 30 = \sqrt{3}/2$

$AC^2 = 2x^2 - \sqrt{3}x^2$ ← Simplifying

$AC^2 = PQ^2$ ← AF is parallel to CD as they are in the parallelograms. Parallel lines are the same distance away from each other at all points so AC = PQ and $AC^2 = PQ^2$

$PQ^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos PBQ$ ← Using the cosine rule in triangle PBQ: $a^2 = b^2 + c^2 - 2bc\cos A$

$2x^2 - \sqrt{3}x^2 = 200 - 200\cos PBQ$ ← Simplifying and substituting in AC^2 for PQ^2

$\frac{2x^2 - \sqrt{3}x^2 - 200}{-200} = \cos PBQ$ ← Subtracting 200 from both sides then dividing both sides by -200

$\cos PBQ = 1 - \frac{(2 - \sqrt{3})}{200}x^2$ ← -200/-200 = 1. Dividing the rest by -200 makes it negative then can be put over 200. Bringing out x^2 as a factor

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS