Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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

Time 1 hour 30 minutes

Paper reference **1MA1/1H**

Mathematics

PAPER 1 (Non-Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, Formulae Sheet (enclosed). 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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B:1/1/1/1/

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

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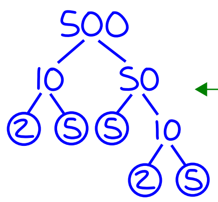
Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Write 500 as a product of powers of its prime factors.



Doing a factor tree for 500. Splitting each number into two factors which multiply to give it. circling any primes and not going any further than these

Multiplying the primes which are circled gives a product of prime factors as 2 x 2 x 5 x 5 x 5. Writing this using powers. 2 x 2 = 2^2 and 5 x 5 x 5 = 5^3

$2^2 \times 5^3$

(Total for Question 1 is 3 marks)

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2 (a) Work out $1\frac{3}{5} + 2\frac{1}{4}$

Give your answer as a mixed number.

$\frac{3}{5} + \frac{1}{4}$ ← First adding the fraction parts of the mixed numbers

$\frac{12}{20} + \frac{5}{20} = \frac{17}{20}$ ← Making the denominators the same so that they can be added. 20 is a common multiple of 5 and 4 so multiplying the numerator and denominator of the first fraction by 4 and the second fraction by 5 to get 20 as the denominators. Then the numerators can be added and the denominators stay the same

$1 + 2 = 3$ ← Adding the whole numbers

Combining the result of the fractions added and the whole numbers added to get a mixed number → $3\frac{17}{20}$

(2)

(b) Show that $2\frac{2}{3} \div 6 = \frac{4}{9}$

$\frac{8}{3} \div \frac{6}{1}$ ← Converted $2^2/_3$ into 8/3 by multiplying the whole number by the denominator and adding the result to the numerator. Writing 6 as a fraction

$\frac{8}{3} \times \frac{1}{6}$ ← To divide by a fraction: keep the first fraction, change the division to a multiplication, flip the second fraction

$\frac{8}{18}$ ← To multiply fractions: multiply the numerators and multiply the denominators. 8 x 1 = 8 and 3 x 6 = 18

$\frac{4}{9}$ ← Simplify the fraction to 4/9 by dividing both the numerator and denominator by 2

(2)

(Total for Question 2 is 4 marks)

3 Simplify $(2^{-5} \times 2^{8})^2$

Give your answer as a power of 2

$(2^3)^2$ ← $a^x \times a^y = a^{x+y}$. $-5 + 8 = 3$

$(a^x)^y = a^{xy}$. $3 \times 2 = 6$

2^6

(Total for Question 3 is 2 marks)

---

4 Work out 0.004×0.32

32
× 4
128

← Ignoring the decimals and dealing just with the significant figures

There are 3 decimal places in 0.004 and 2 decimal places in 0.32. There are 5 decimal places in total so moving the decimal point 5 times to the left

0.00128

(Total for Question 4 is 2 marks)

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5 A car factory is going to make four different car models **A**, **B**, **C** and **D**.

80 people are asked which of the four models they would be most likely to buy.

The table shows information about the results.

Car model	**Number of people**
A	23
B	15
C	30
D	12

The factory is going to make 40 000 cars next year.

Work out how many model **B** cars the factory should make next year.

00500
80 | 40000

Working out that the 40000 cars is 500 times greater than the sample of 80

15
×500
7500

So there needs to be 500 times more of car B than in the sample

7500

(Total for Question 5 is 2 marks)

6 Rizwan writes down three numbers a, b and c

$$a : b = 1 : 3$$
$$b : c = 6 : 5$$

(a) (i) Find $a : b : c$

a | b | c
1 | 3 |
  | 6 | 5
2 | 6 | 5

Writing both of the ratios then combining them by getting the same number of parts for b in both ratios as b is in both ratios. 6 is a common multiple of 3 and 6 so multiplying both sides of the first ratio by 2 to get 6 parts for b. Then a : b = 2 : 6 and b : c is still 6 : 5. They can be written as a : b : c as there is the same number of parts for b meaning 1 part in the first ratio is worth the same as 1 part in the second ratio

2:6:5

(2)

(ii) Express a as a fraction of the total of the three numbers a, b and c

2+6+5

Working out that there are 13 parts in total in the combined ratio which must represent the total of the three numbers a, b and c

2 out of the 13 parts are for a. So a must be 2/13 of the total

$\frac{2}{13}$

(2)

Emma writes down three numbers m, n and p

$$n = 2m$$
$$p = 5n$$

(b) Find $m : p$

$p = 5(2m)$

Substituting n for 2m in p = 5n, as n is the same as 2m. This gets an equation just in terms of m and p

$= 10m$

5 x 2m = 10m

In the equation p = 10m, m could be 1 and p could be 10 as 10 = 10 x 1

1:10

(2)

(Total for Question 6 is 6 marks)

7

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

A storage tank exerts a force of 10 000 newtons on the ground.

The base of the tank in contact with the ground is a 4 m by 2 m rectangle.

Work out the pressure on the ground due to the tank.

4×2 ← Area of rectangle = length x width, so the area in contact with the ground is $8m^2$

$8 \overline{)10000} = 01250$ ← Dividing the force in newtons by the area in m^2 gives the pressure in newtons/m^2

1250 newtons/m^2

(Total for Question 7 is 2 marks)

8 Two numbers m and n are such that

m is a multiple of 5
n is an even number
the highest common factor (HCF) of m and n is 7

Write down a possible value for m and a possible value for n.

As 7 is a factor of both numbers, they must both be multiples of 7. m needs to be a multiple of both 5 and 7. n needs to be an even multiple of 7

$m =$ 35

$n =$ 14

(Total for Question 8 is 2 marks)

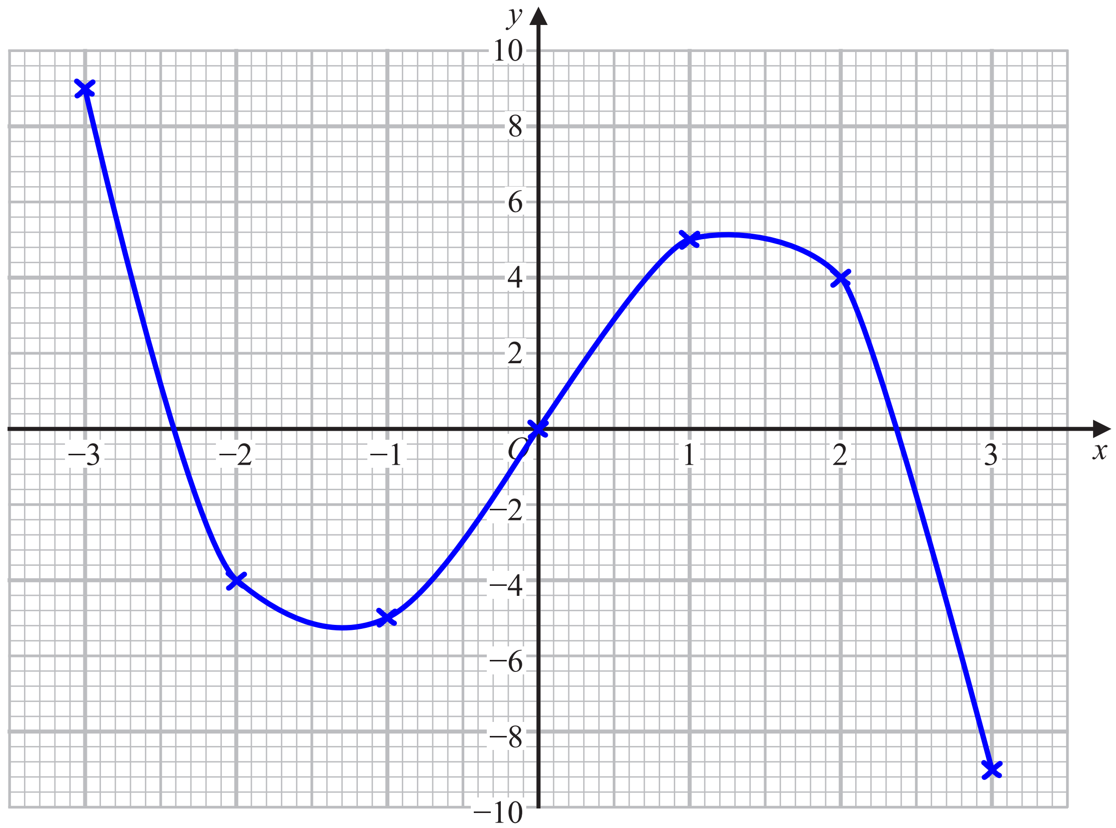
9 (a) Complete the table of values for $y = 6x - x^3$

Using table mode. f(x) = 6x - x³. Start: -3. End: 3. Step: 1

x	−3	−2	−1	0	1	2	3
y	9	−4	−5	0	5	4	−9

(2)

(b) On the grid, draw the graph of $y = 6x - x^3$ for values of x from −3 to 3

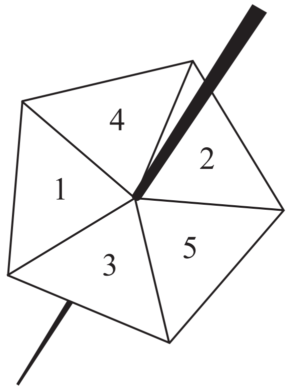


(2)

(Total for Question 9 is 4 marks)

Plotting the points then joining them up with a curve

10 Lina spins a biased 5-sided spinner 40 times.



Here are her results.

Score	1	2	3	4	5
Frequency	6	8	9	7	10

Lina is now going to spin the spinner another two times.

(a) Work out an estimate for the probability that she gets a score of 5 both times.

$\frac{10}{40}$ ← 10 out the 40 times were a 5

$\frac{1}{4} \times \frac{1}{4}$ ← Dividing both the numerator and denominator by 10 simplifies the probability of getting a score of 5 to 1/4. 5 AND 5, AND means to multiply the probabilities

To multiply fractions, multiply the numerators and multiply the denominators → $\frac{1}{16}$

(2)

Derek is going to spin the spinner a large number of times.

(b) Work out an estimate for the percentage of times Derek can expect to get a score of 1

$\frac{6}{40}$ ← 6 out the 40 times were a 1

$\frac{3}{20}$ ← Simplifying the fraction by dividing both the numerator and denominator by 2

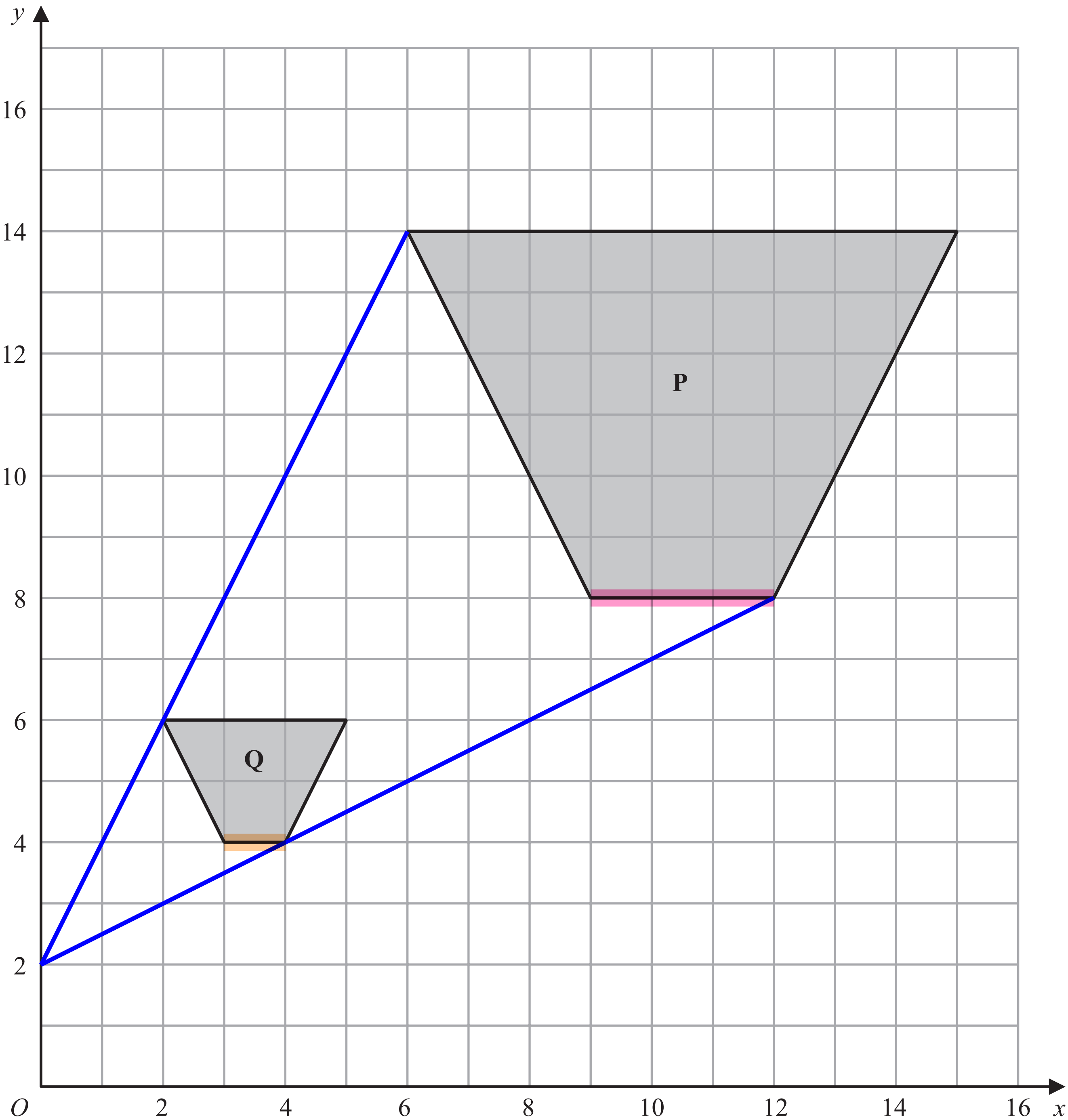
$\frac{15}{100}$ ← Multiplying the numerator and denominator by 5 to get 100 as the denominator as percentage is out of 100. So it must be 15%

15 %

(2)

(Total for Question 10 is 4 marks)

11



Describe fully the single transformation that maps shape **P** onto shape **Q**.

Enlargement, scale factor 1/3, centre (0 , 2)

It must be enlargement as it has changed size. The scale factor is 1/3 as the side in orange is 1/3 of the size of the side in pink. The centre is (0 , 2) as this is where the lines going through the same corners meet

(Total for Question 11 is 2 marks)

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12 Solve the simultaneous equations

$$5x + 2y = 11$$ ← The first equation
$$4x + 3y = 6$$ ← The second equation

$15x+6y=33$
$8x+6y=12$ ← Multiplying all terms in the first equation by 3 and all terms in the second equation by 2 to get the same number of y

$7x=21$ ← Subtracting the two new equations from each other cancels out the y terms and gets an equation just in terms of x

$x=3$ ← Dividing both sides by 7 gets x on its own

$15+2y=11$ ← Substituting 3 for x in the first equation. 5 x 3 = 15

$2y=-4$ ← Subtracting 15 from both sides get the y term on its own

Dividing both sides by 2 gets y on its own

$x =$ 3

$y =$ -2

(Total for Question 12 is 4 marks)

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13 *p* is inversely proportional to *t*

Complete the table of values.

÷ 4 ÷ 5 ÷ 50

t	100	25	20	2
p	1	4	5	50

x 4 x 5 x 50

Inversely proportional means that whatever t is multiplied or divided by, the opposite happens to p, and whatever p is multiplied or divided by, the opposite happens to t. 100 is divided by 4 to get 25 so 1 must be multiplied by 4 to get 4. 1 was multiplied by 5 to get 5 so 100 must be divided by 5 to get 20. 100 was divided by 50 to get 2 so 1 must be multiplied by 50 to get 50

(Total for Question 13 is 3 marks)

14 The table shows information about the weights, in grams, of some potatoes.

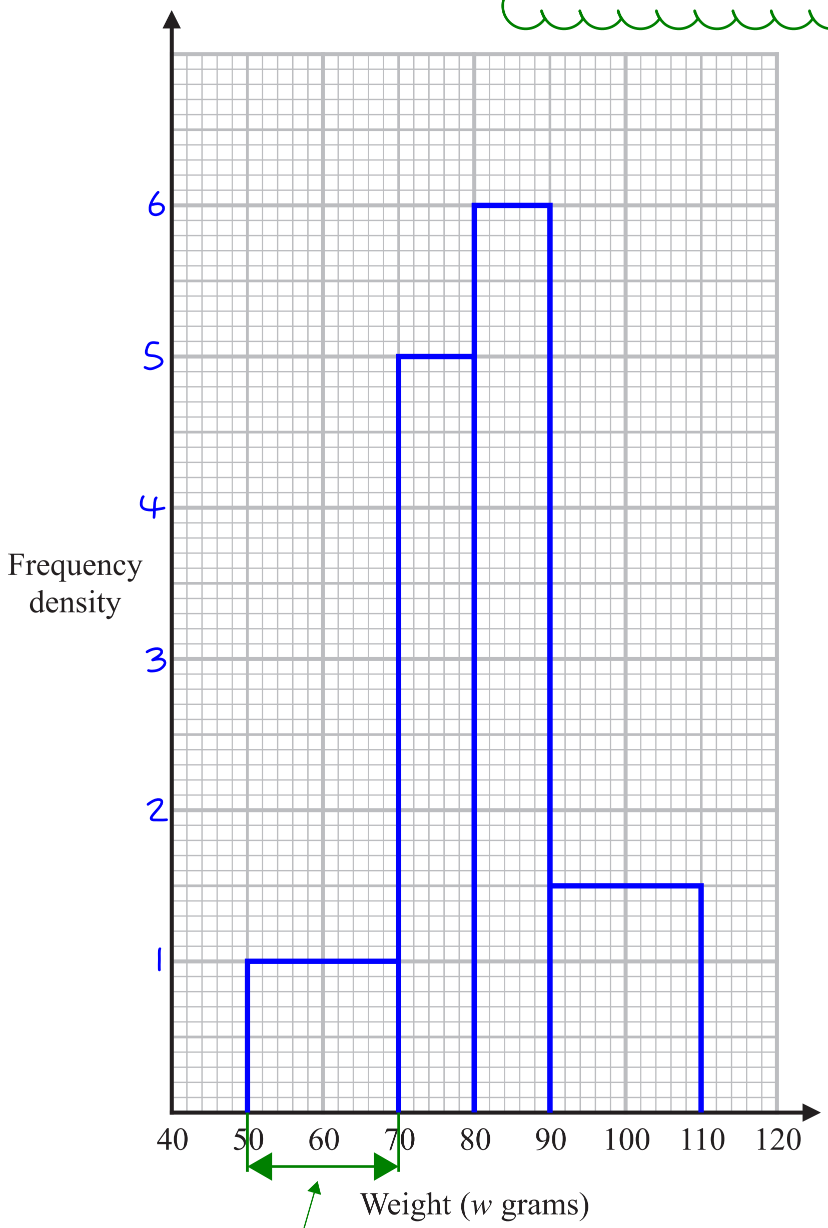
$c^{F}d$

Frequency on a histogram is the area of each box. Frequency = class width x frequency density. Writing this as a formula triangle

Weight (w grams)	Number of potatoes	
$50 < w \leqslant 70$	20	1 ← 20 ÷ 20
$70 < w \leqslant 80$	50	5 ← 50 ÷ 10
$80 < w \leqslant 90$	60	6 ← 60 ÷ 10
$90 < w \leqslant 110$	30	1.5 ← 30 ÷ 20

Dividing the frequencies by the class widths works out the frequency densities

On the grid, draw a histogram for this information.



This is the class width of the first bar. It is 20

(Total for Question 14 is 3 marks)

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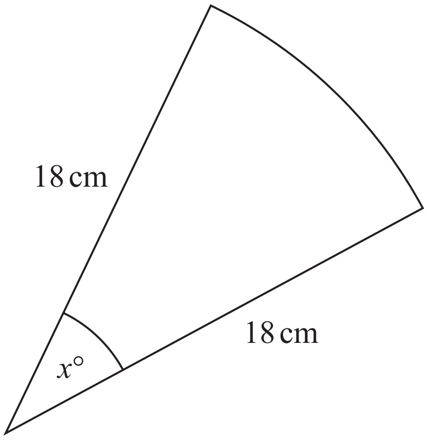
15 The diagram shows a sector of a circle of radius 18 cm.



The length of the arc is 4π cm.

Work out the value of x.

$\frac{x}{360} \times \pi \times 18 \times 2 = 4\pi$

Circumference = π x diameter. Diameter = radius x 2. The radius is 18cm. x/360 is the fraction of the circumference the arc is so doing this fraction of the expression of the circumference. Setting the expression of the arc length equal to the actual value of 4π

$\frac{x}{10} = 4$

18 x 2 = 36. Dividing the 360 and 36 by 36 simplifies the left side. Cancelling out π from both sides by dividing both sides by π

Multiplying both sides by 10 gets x on its own

$x =$ 40

(Total for Question 15 is 3 marks)

16 (a) Prove that

$$(2m + 1)^2 - (2n - 1)^2 = 4(m + n)(m - n + 1)$$

$4m^2+4m+1-(4n^2-4n+1)$ ← Expanding each square bracket on the left side by squaring the first term, doubling the product of the two terms and squaring the last term

$4m^2+4m-4n^2+4n$ ← Subtracting everything in the bracket

$4m^2-4mn+4m+4mn-4n^2+4n$ ← Expanding the brackets on the right side

$4m^2+4m-4n^2+4n$ ← Simplifying by collecting like terms. The right side is the same as the left side

(3)

Sophia says that the result in part (a) shows that the difference of the squares of any two odd numbers must be a multiple of 4

(b) Is Sophia correct?
You must give reasons for your answer.

Yes. 2m + 1 and 2n - 1 represent any two odd numbers. They are squared and subtracted so are expressing difference of two squares of any two odd numbers. This is equal to the right side which has 4 as a factor so is a multiple of 4.

(1)

m and n are integers. Multiplying them by 2 must give an even number. Adding or subtracting 1 will make it odd

(Total for Question 16 is 4 marks)

17 Work out the value of $\left(\frac{8}{27}\right)^{\frac{4}{3}}$

$\left(\frac{2}{3}\right)^4$

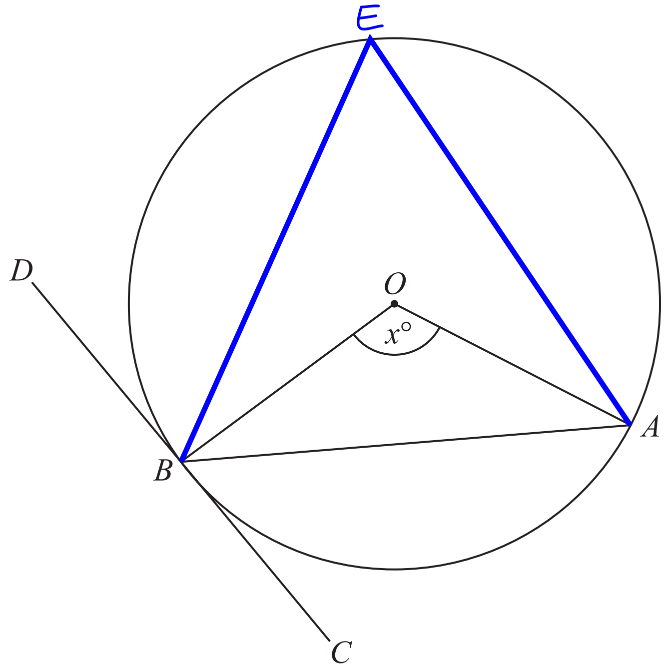
First doing the denominator of the power. Over 3 means to do the cube root. $\sqrt[3]{8} = 2$ and $\sqrt[3]{27} = 3$

Raising to the power of 4 is squaring twice. $2^2 = 4$ then $4^2 = 16$. $3^2 = 9$ then $9^2 = 81$

$\frac{16}{81}$

(Total for Question 17 is 2 marks)

18



A and *B* are points on a circle, centre *O*.
DBC is the tangent to the circle at *B*.
Angle $AOB = x°$

Show that angle $ABC = \frac{1}{2}x°$

You must give a reason for each stage of your working.

Angle BEA = 1/2 x as angle at the circumference is half the angle at the centre

Angle ABC = 1/2 x due to the alternate segment theorem

The angle between the tangent DC and the chord BA is equal to the interior opposite angle, which is angle BEA as it is the angle in the triangle with all three corners on the circle and is opposite the chord

(Total for Question 18 is 3 marks)

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19 Solve $\frac{1}{x} - \frac{1}{x+1} = 4$

Give your answer in the form $a \pm b\sqrt{2}$ where a and b are fractions.

$x + 1 - x = 4x(x+1)$ ← Multiplying all terms by the denominators to eliminate the fractions. Multiplying the first fraction by x cancels out the denominator. Then multiplying by x + 1 gives 1(x + 1) = x + 1. Multiplying the second fraction by x gives 1(x) = x as the numerator. Then multiplying by x + 1 eliminates the denominator. Multiplying the 4 by both x and x + 1 gives 4x(x + 1)

$1 = 4x^2 + 4x$ ← Collecting like terms on the left and expanding the bracket on the right

$0 = 4x^2 + 4x - 1$ ← Bringing into the quadratic form $ax^2 + bx + c = 0$ by subtracting 1 from both sides

$\frac{-4 \pm \sqrt{4^2 - 4 \times 4 \times -1}}{2 \times 4}$ ← $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← The form the answer needs to be in means that it cannot be solved using factorisation. So using the quadratic formula

$\frac{-4 \pm \sqrt{32}}{8}$ ← $4^2 = 16$. $4 \times 4 \times -1 = -16$. $16 - -16 = 32$. $2 \times 4 = 8$

$\sqrt{16} \times \sqrt{2} = 4\sqrt{2}$ ← Simplifying $\sqrt{32}$ using $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ in reverse. Splitting $\sqrt{32}$ into two square roots which are multiplied together where one is the square root of a square number

Dividing both the terms on the numerator by the denominator

$-\frac{4}{8} \pm \frac{4}{8}\sqrt{2}$

(Total for Question 19 is 5 marks)

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20 Alfie has 11 cards.

He has

3 blue cards
7 green cards
and 1 white card.

Alfie takes at random 2 of these cards.

Work out the probability that he takes cards of different colours.

$\frac{3}{11}\times\frac{2}{10}+\frac{7}{11}\times\frac{6}{10}$ ← There are less outcomes for the opposite of getting two different colours, which is getting two of the same colour. Expressing the probability of getting two of the same colour. Blue AND blue OR green AND green OR white AND white. AND means to multiply the probabilities, OR means to add the probabilities. It is not possible to get two white cards so this is ignored. The number of cards in total goes down 1 after the first pick. The number of blue cards goes down 1 after the first blue is picked. The number of green cards goes down 1 after the first green is picked.

$\frac{6}{110}+\frac{42}{110}$ ← Multiplying the fractions by multiplying the numerators and multiplying the denominators. Adding them then gives 48/100 as the probability of getting two of the same colour

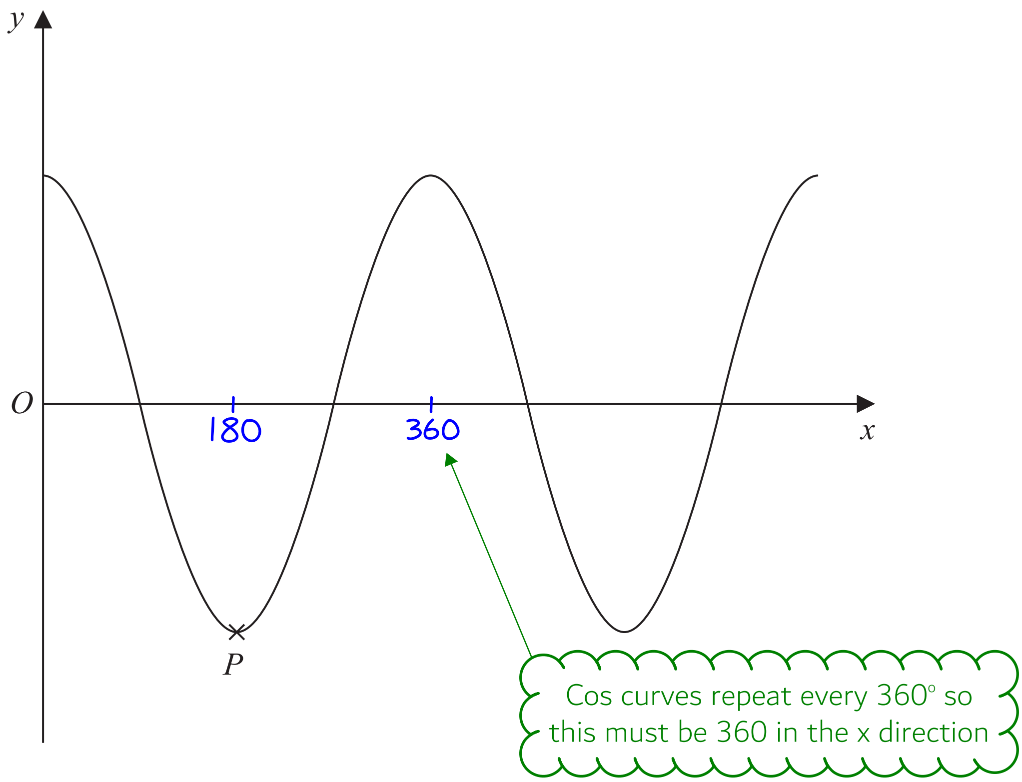
$\frac{110}{110}-\frac{48}{110}$ ← It is certain to either get two of the same colour or to not get two of the same colour (which means they are different colours). The probability of something which is certain is 1. Therefore subtracting the probability of getting two of the same colour from 1 leaves the probability of getting different colours. 1 is expressed as 110/110 so that the fraction can easily be subtracted

$110 - 48 = 62$ ← Subtracting the numerators. The denominator stays the same

$\frac{62}{110}$

(Total for Question 20 is 3 marks)

21



The diagram shows a sketch of part of the curve with equation $y = \cos x°$
P is a minimum point on the curve.

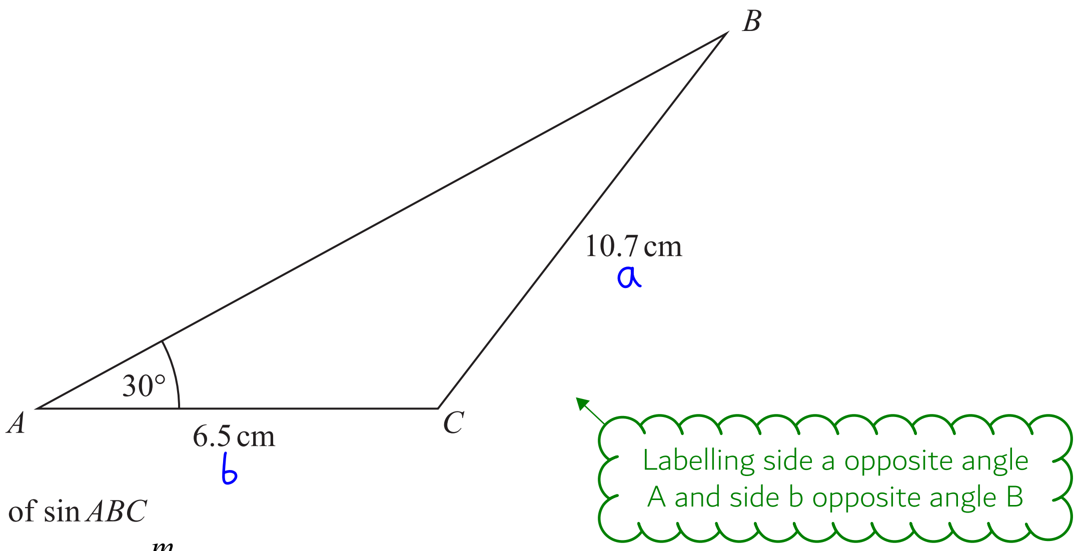
Write down the coordinates of P.

Point P is halfway to 360 in the x direction so must have an x-coordinate of 180. The y-coordinate must be -1 as this is the minimum value on a cos curve

(180 , -1)

(Total for Question 21 is 2 marks)

22 Here is a triangle *ABC*.



Work out the value of $\sin ABC$

Give your answer in the form $\frac{m}{n}$ where *m* and *n* are integers.

$\frac{\sin A}{a} = \frac{\sin B}{b}$ ← There are opposite pairs of sides and angles so the sine rule can be used

$\frac{6.5\sin 30}{10.7} = \sin ABC$ ← Multiplying both sides by b and substituting in the values

0 30 45 60 90
0 1 2 3 4
← Working out sin30 by listing the angles 0, 30, 45, 60, 90 and 0, 1, 2, 3, 4 under these. Square rooting the 1 then putting it over 2 finds that sin30 = 1/2

$2\overline{)6.50}$ = 3.25 ← Doing the 6.5 x 1/2. Multiplying by 1/2 divides by 2

The fraction was 3.25/10.7. Multiplying both the numerator and denominator by 100 converts it into a fraction with integer values for m and n

$\frac{325}{1070}$

(Total for Question 22 is 4 marks)

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23 Here are the first five terms of a geometric sequence.

$$\sqrt{5} \qquad 10 \qquad 20\sqrt{5} \qquad 200 \qquad 400\sqrt{5}$$

(a) Work out the next term of the sequence.

$400\sqrt{5} \times \frac{10}{\sqrt{5}}$ ← Geometric means the the terms are multiplied by the same amount between each term. Dividing the second term by the first term gives 10/√5, which must be what it is multiplying by. Multiplying the 400√5 by this works out the next term

The √5 cancel out as one is the numerator and one is the denominator. This leaves 400 x 10 → 4000

..................4000..................
(2)

The 4th term of a different geometric sequence is $\frac{5\sqrt{2}}{4}$

The 6th term of this sequence is $\frac{5\sqrt{2}}{8}$

Given that the terms of this sequence are all positive,

(b) work out the first term of this sequence.
You must show all your working.

$\frac{5\sqrt{2}}{4}x^2 = \frac{5\sqrt{2}}{8}$ ← Geometric means the the terms are multiplied by the same amount between each term. Let x be the amount each term is multiplied by. The 6th term is 2 terms after the 4th term so the 4th term must be multiplied by x twice to get the 6th term

$x^2 = \frac{5\sqrt{2}}{8} \times \frac{4}{5\sqrt{2}}$ ← Dividing by the 4th term on both sides gets x^2 on its own. To divide by a fraction: keep the first fraction, change the division to multiplication, flip the second fraction

$= \frac{1}{2}$ ← The 5√2 cancel out then 4/8 simplifies to 1/2

$x = \frac{1}{\sqrt{2}}$ ← Square rooting both sides finds x, the amount each term is multiplied by

$\left(\frac{1}{\sqrt{2}}\right)^3$ ← The 1st term is 3 terms before the 4th term so the 4th term must be divided by x 3 times

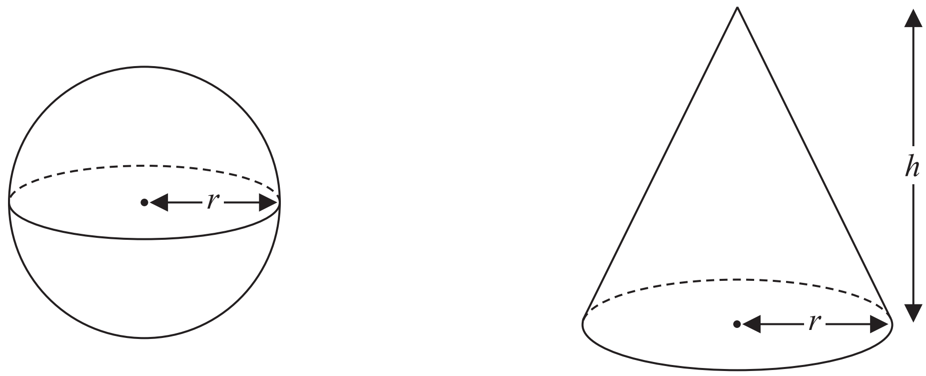
$\frac{1}{2\sqrt{2}}$ ← $1^3 = 1. \sqrt{2}^3 = \sqrt{2} \times \sqrt{2} \times \sqrt{2} = 2\sqrt{2}$

..................5..................
(3)

(Total for Question 23 is 5 marks)

$\frac{5\sqrt{2}}{4} \times \frac{2\sqrt{2}}{1}$ ← Dividing by x^3. To divide by a fraction keep the first fraction, change the division to multiplication, flip the second fraction

24 Here is a solid sphere and a solid cone.



Volume of sphere = $\frac{4}{3}\pi r^3$

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

All measurements are in cm.

The volume of the sphere is equal to the volume of the cone.

(a) Find $r : h$
Give your answer in its simplest form.

$\frac{4}{3}\pi r^3 = \frac{1}{3}\pi r^2 h$ ← Setting the expression of the volume of the sphere equal to the expression of the volume of the cone as they have the same volume

$4r = h$ ← Multiplying both sides by 3 and dividing both sides by π and r^2 simplifies the equation

r could be 1 and h could be 4 → 1:4

(2)

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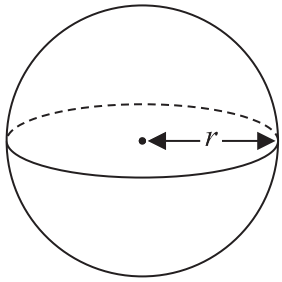
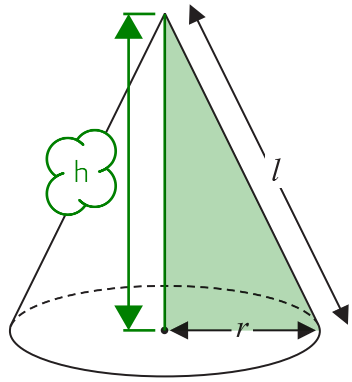
Here is a different solid sphere and a different solid cone.



Surface area of sphere = $4\pi r^2$



Curved area of cone = $\pi r l$

All measurements are in cm.

The surface area of the sphere is equal to the **total** surface area of the cone.

(b) Find $r:h$

Give your answer in the form $1:\sqrt{n}$ where n is an integer.

$a^2+b^2=c^2$ ← Pythagoras' Theorem can be used to express the slant length l in terms of the height h and the radius r as they form a right-angled triangle

$\sqrt{h^2+r^2}=l$ ← Square rooting both sides and substituting in h as a, r as b and l as c

$4\pi r^2=\pi r\sqrt{h^2+r^2}+\pi r^2$ ← Setting the two surface areas equal to each other. The surface area of the cone is the curved surface area + the area of the circle. Using $\sqrt{h^2+r^2}$ instead of l in the formula so that it is just in terms of h and r. Area of circle = π x radius^2

$4r=\sqrt{h^2+r^2}+r$ ← Dividing all terms on both sides of the equation by π and r

$3r=\sqrt{h^2+r^2}$ ← Subtracting r from both sides

$9r^2=h^2+r^2$ ← Squaring both sides

$8r^2=h^2$ ← Subtracting r^2 from both sides

$\sqrt{8}r=h$ ← Square rooting both sides

r could be 1 and h could be $\sqrt{8}$ → $1:\sqrt{8}$

(4)

(Total for Question 24 is 6 marks)

TOTAL FOR PAPER IS 80 MARKS