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)

Friday 19 May 2023

Morning (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 ▶

P75148A

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 Work out $8.46 \div 0.15$

$$\begin{array}{r} 056.4 \\ 15\overline{)8^{8}4^{9}6.^{1}0} \end{array}$$

Both the 8.46 and 0.15 can be multiplied by 100 to get rid of the decimal in the 0.15. So 846 ÷ 15 is an equivalent division and gives the same answer

30
45
60
75
90

56.4

(Total for Question 1 is 3 marks)

2 Work out $7\frac{3}{8} - 2\frac{1}{2}$

Give your answer as a mixed number.

$\frac{59}{8} - \frac{5}{2}$ ← Converting both mixed numbers into improper fractions by multiplying the whole numbers by the denominators and adding the result to the numerators

$\frac{59}{8} - \frac{20}{8}$ ← Multiplying both the numerator and denominator of 5/2 by 4 to get 20/8 so that the denominators of both fractions are the same

$\frac{39}{8}$ ← Subtracting the numerators and the denominator stays the same

Dividing the numerator by the denominator to get the whole number and leaving the remainder in the fraction →

$4\frac{7}{8}$

(Total for Question 2 is 3 marks)

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3 A cube has a total surface area of 150 cm^2

Work out the volume of the cube.

$6\overline{)150}$ = 25

There are 6 equal square faces on a cube. So dividing the surface area by 6 works out that the area of one of the square faces is 25 cm^2

$25 \times 5 = 125$

Area of square = length^2, so square rooting the area of each square face works out that the length of the edges on the cube are 5 cm. Volume of cube = length^3 = 5 x 5 x 5 = 25 x 5

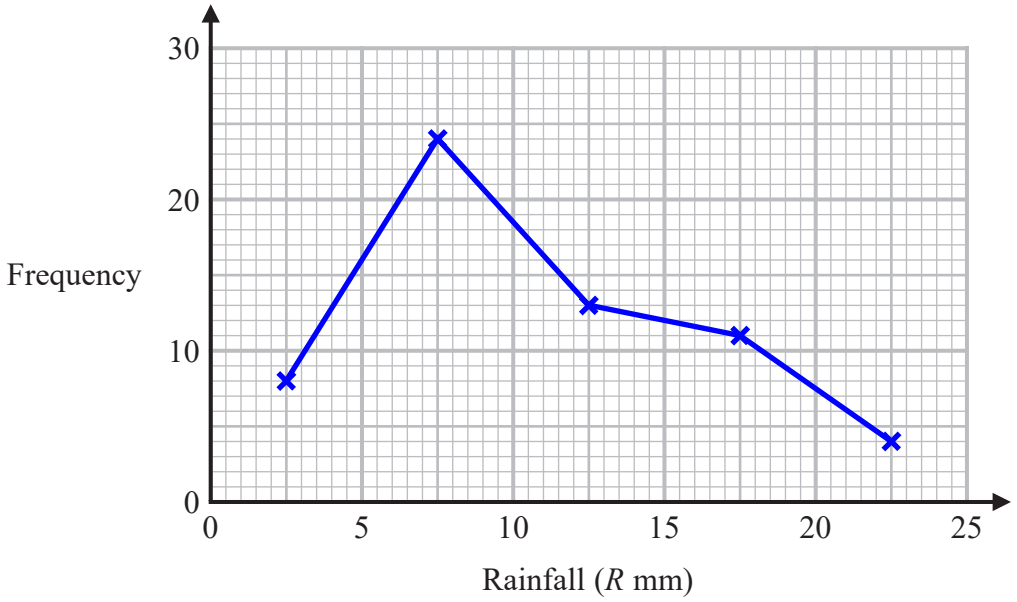
125 ..... cm^3

(Total for Question 3 is 4 marks)

4 The table shows information about the daily rainfall in a town for 60 days.

Rainfall (R mm)	Frequency
$0 \leqslant R < 5$	8
$5 \leqslant R < 10$	24
$10 \leqslant R < 15$	13
$15 \leqslant R < 20$	11
$20 \leqslant R < 25$	4

Draw a frequency polygon for this information.

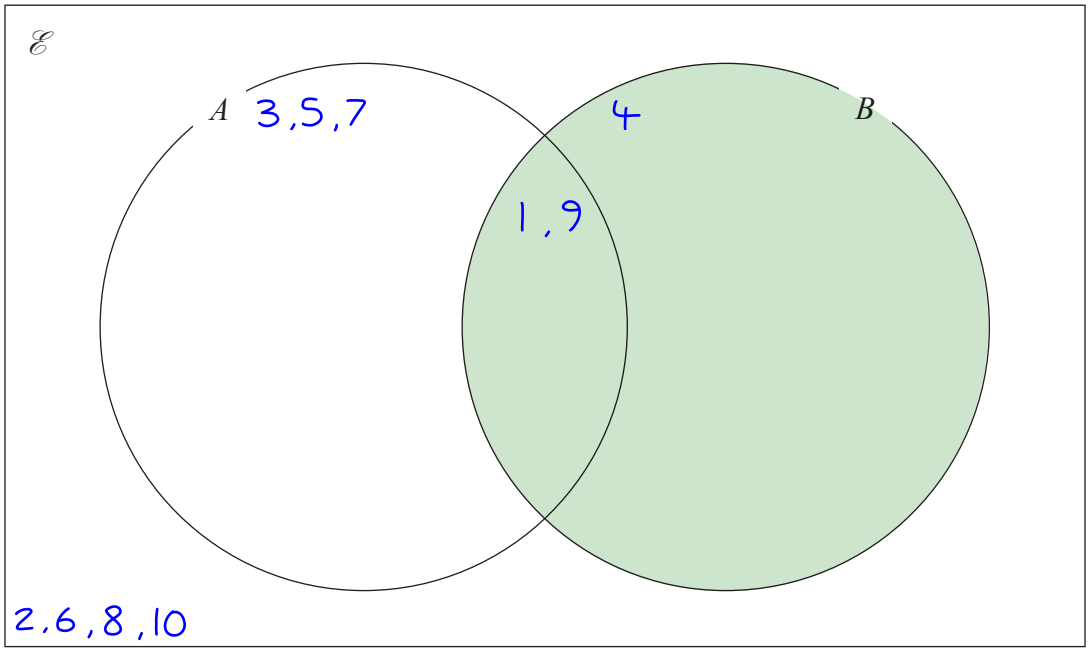


(Total for Question 4 is 2 marks)

Plotted the frequencies at the midpoints for each interval of rainfall then joined up the points with straight lines. The vertical scale goes up 10 over 10 small boxes. Dividing 10 by the 10 small boxes works out that each small box is worth 1

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

(a) Complete the Venn diagram for this information.



(3)

A number is chosen at random from the universal set $\mathscr{E}$

(b) Find the probability that this number is in the set B'

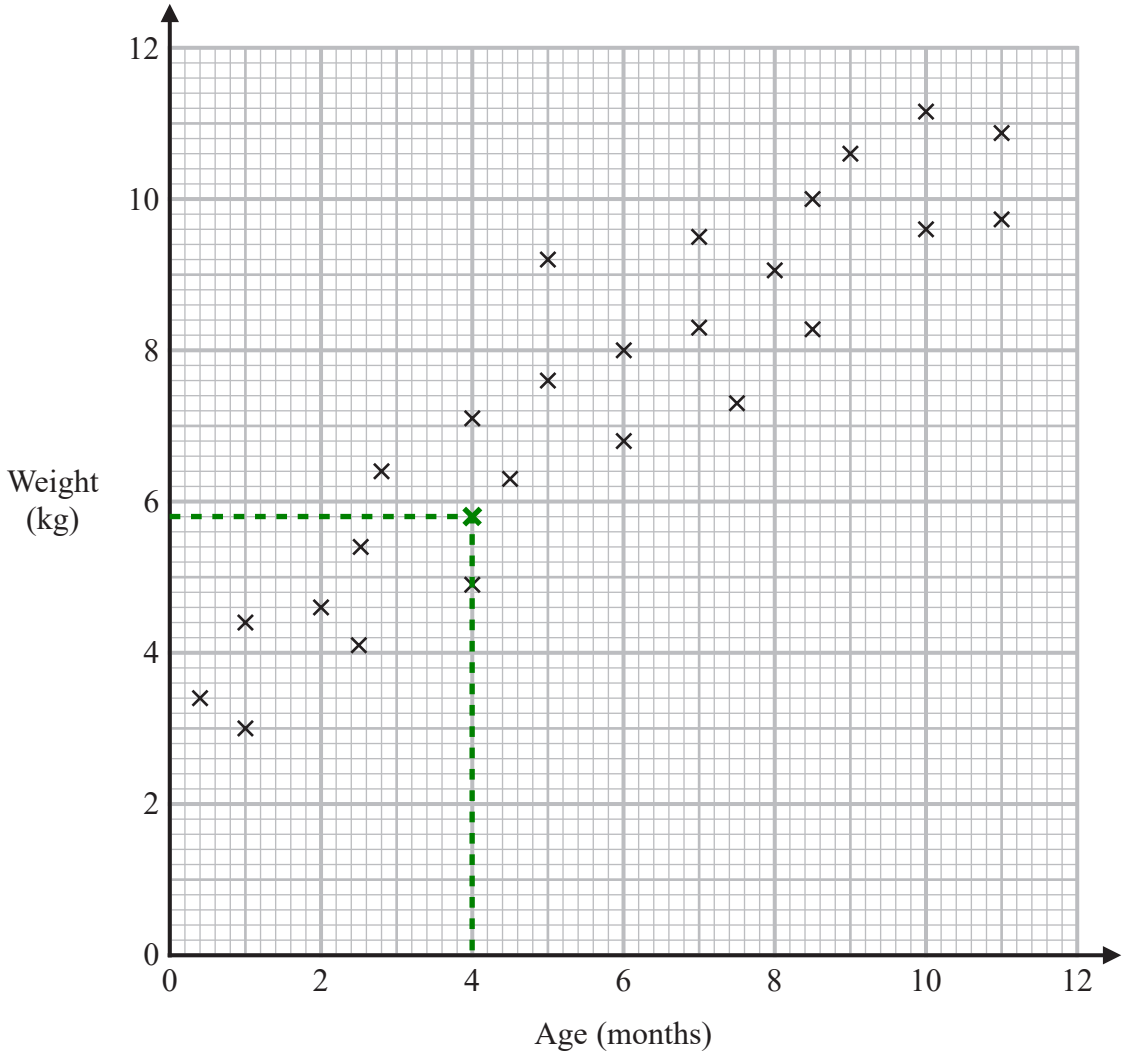
7 out of the 10 numbers are not in B. Everything not shaded in green is not in B

$\frac{7}{10}$

(2)

(Total for Question 5 is 5 marks)

6 The scatter graph shows information about the ages and weights of some babies.



(a) Describe the relationship between the age and the weight of the babies.

Positive correlation

As one variable goes up so does the other. The weight increases as the age increases

(1)

Another baby has a weight of 5.8 kg

(b) Using the scatter graph, find an estimate for the age of this baby.

The vertical scale goes up 2 over 10 small boxes. Dividing the 2 by the 10 small boxes works out that each small box is worth 0.2. So 5.8 is 1 box down from 6. Reading across from 5.8 on the vertical axis to a point which is roughly in the middle of the surrounding points then down to the horizontal axis

4 months

(2)

(Total for Question 6 is 3 marks)

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7 The price of a holiday increases by 20%
This 20% increase adds £240 to the price of the holiday.

Work out the price of the holiday before the increase.

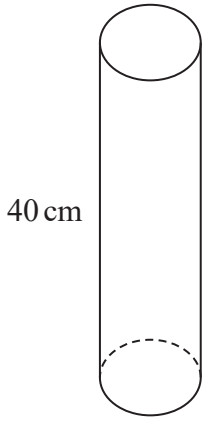
$$20\overline{)240} \quad 012 \times 100$$

Dividing the £240 by the 20% which represents it works out that 1% of the price of the holiday is £12. Multiplying this by 100 works out the full 100% of the price of the holiday

£ 1200

(Total for Question 7 is 2 marks)

8 The diagram shows a solid cylinder on a horizontal floor.



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

The cylinder has a

volume of $1200\,\text{cm}^3$
height of 40 cm.

The cylinder exerts a force of 90 newtons on the floor.

Work out the pressure on the floor due to the cylinder.

Volume of cylinder = area of circle x height.
So area of circle = volume of cylinder ÷ height.
This works out that the area of the circle is 30 cm^2

0030
40 | 1'2'00

Putting the force over the area works out the pressure

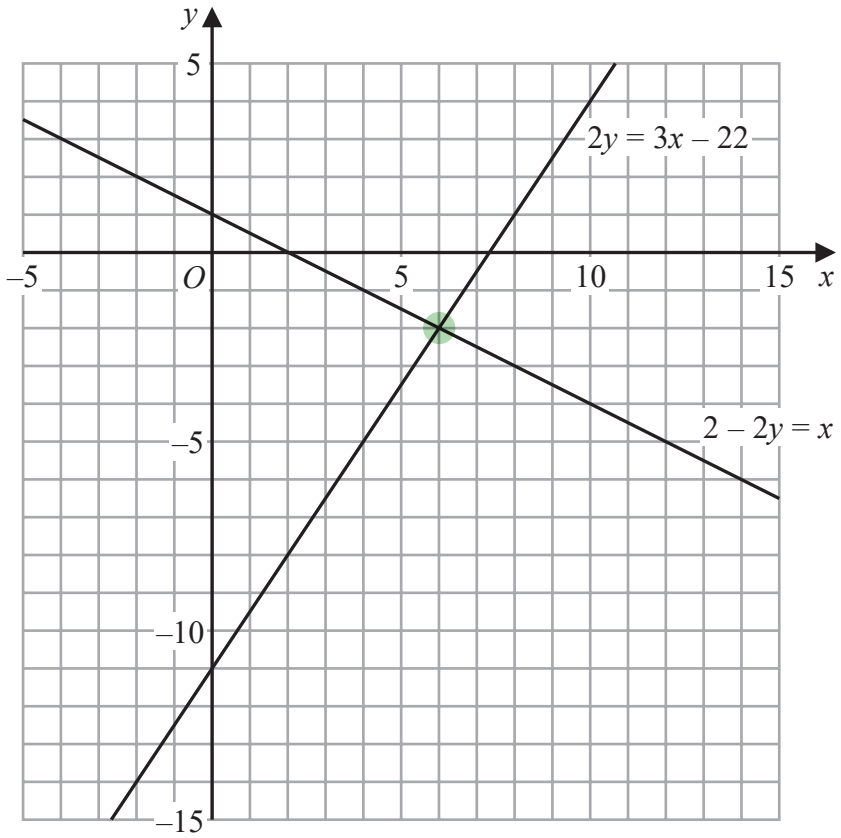
90/30

90/30 = 9/3 = 3

3 ..... newtons/cm^2

(Total for Question 8 is 3 marks)

9



Use these graphs to solve the simultaneous equations

$$2 - 2y = x$$
$$2y = 3x - 22$$

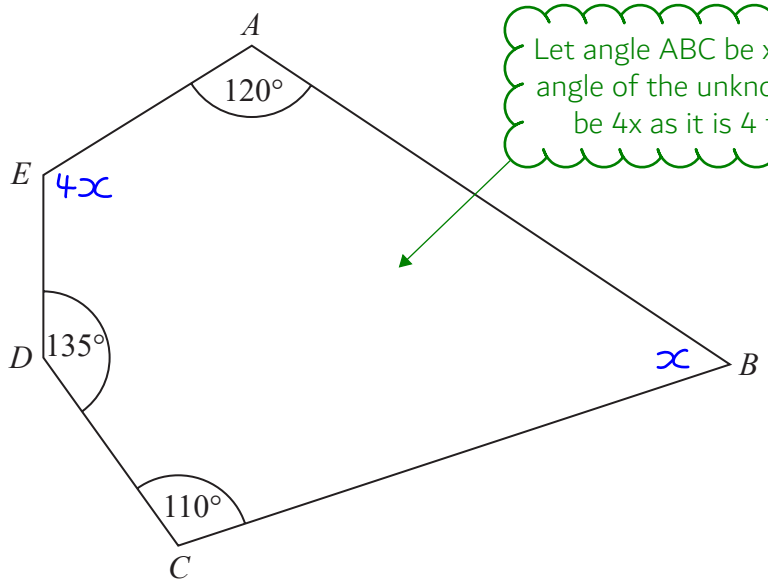
Simultaneous equations can be solved graphically by finding where they cross.
They cross at (6 , -2). The x-coordinate is 6 and the y-coordinate is -2

$x =$ 6

$y =$ -2

(Total for Question 9 is 1 mark)

10 Here is a pentagon.



Let angle ABC be x as this the smaller angle of the unknown two. AED must be 4x as it is 4 times angle ABC

Angle $AED = 4 \times$ angle ABC

Work out the size of angle AED.
You must show all your working.

120
+135
+110
365

← Adding up the three given angles works out that there are 365° in the pentagon so far

180
x 3
540

← (n - 2) x 180 works out how many degrees there are in a polygon where n is the number of sides. n is 5 and 5 - 2 = 3 so doing 180 x 3 works out that there are 540° in a pentagon

~~5~~13 ~~4~~0
-365
175

← Subtracting the 365° in the pentagon so far from the total of 540° works out that there are 175° left in the pentagon

035
5|175

← x + 4x = 5x so the remaining angles are also 5x. Therefore 5x = 175 and dividing both sides by 5 finds that x = 35

35
x 4
140

← x is angle ABC so multiplying it by 4 works out angle AED

140 °

(Total for Question 10 is 4 marks)

11 Write $\dfrac{(6x^5y^3)^2}{3x^2y^7 \times 4xy^{-3}}$ in the form ax^by^c where a, b and c are integers.

$\dfrac{36x^{10}y^6}{12x^3y^4}$

For the numerator: raising everything in the bracket to the power of 2. $(a^x)^y = a^{xy}$ so multiplying the powers of x and y by 2.

For the denominator: $a^x \times a^y = a^{x+y}$ so adding the powers of x and y where they are multiplied together

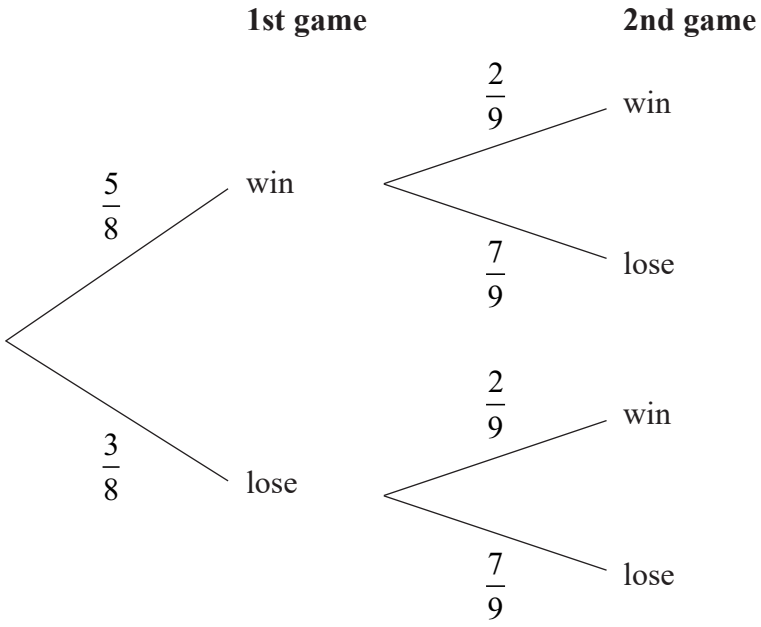
$a^x/a^y = a^{x-y}$ so subtracting the powers of x and y on the denominator from the powers of x and y on the numerator. Dividing the 36 by the 12

$3x^7y^2$

(Total for Question 11 is 3 marks)

12 Martha plays a game twice.

The probability tree diagram shows the probabilities that Martha will win or lose each game.



Find the probability that Martha will lose at least one game.

$\frac{5}{8} \times \frac{2}{9}$ ←

The opposite of losing at least one game is winning both games. Working out that the probability of winning both games is 10/72. 'And' means to multiply the probabilities. Fractions can be multiplied by multiplying the numerators and multiplying the denominators

$\frac{72}{72} - \frac{10}{72}$ ←

Subtracting the probability of winning both games from 1 leaves the probability of losing at least one game as it is certain to either win both games or lose at least one game and the probability of something which is certain is 1. Expressing 1 as 72/72 so that the denominators are the same

The fractions are subtracted by subtracting the numerators. The denominator stays the same →

$\frac{62}{72}$

(Total for Question 12 is 3 marks)

13 y is directly proportional to x.

$y = 24$ when $x = 1.5$

Work out the value of y when $x = 5$

0 1 6
15 | 2 ²4 ⁹0
15, 30, 45, 60, 75, 90

x has been multiplied by 5/1.5 from 1.5 to 5. y must be multiplied by the same amount. To multiply an amount by a fraction, divide the amount by the denominator then multiply the result by the numerator. So first dividing the 24 by 1.5, which is the same as 240 ÷ 15. Listing the 15 times table to help with the division

16
× 5
80

Then multiplying the 16 by the numerator of 5/1.5

$y =$ 80

(Total for Question 13 is 3 marks)

14 (a) Write $\frac{1}{16}$ in the form 4^n where n is an integer.

$16 = 4^2$, then as it is the reciprocal of 16 the power becomes negative

4^{-2}

(1)

(b) Work out the value of $8^{\frac{5}{3}} - 9^{\frac{3}{2}}$

2, 4, 8, 16, 32

The 3 as the denominator of the power of 8 means to cube root. The cube root of 8 is 2. Then raising this 2 to the power of the 5 by listing out the powers of 2 until the fifth is found

3, 9, 27

The 2 as the denominator of the power of 9 means to do the positive square root. The positive square root of 9 is 3. Then raising this 3 to the power of the 3 by listing out the powers of 3 until the third is found

²3²2
-27
5

Subtracting the 27 (which is $9^{3/2}$) from the 32 (which is $8^{5/3}$)

5

(3)

(Total for Question 14 is 4 marks)

15 The equation of line $\mathbf{L_1}$ is $y = 2x - 5$
The equation of line $\mathbf{L_2}$ is $6y + kx - 12 = 0$

$\mathbf{L_1}$ is perpendicular to $\mathbf{L_2}$

Find the value of k.
You must show all your working.

$6y = -kx + 12$ ← The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. Starting to rearrange the equation of L_2 into this form by subtracting kx and adding 12 to both sides

$y = \frac{-k}{6}x + 2$ ← Dividing both sides by 6 puts it into the form of y = mx + c

$\frac{-k}{6} = \frac{-1}{2}$ ← -k/6 is the gradient of line L_2. The gradient is also -1/2 as this is the negative reciprocal of 2, which is the gradient of L_1. Perpendicular gradients are the negative reciprocal of each other. So these must be equal to each other

$= \frac{-3}{6}$ ← Multiplying the numerator and denominator of the right side by 3 gives the same denominator as the left side

$-k = -3$ ← Multiplying both sides by 6

$k =$ 3

Dividing both sides by -1 gets rid of the negative in front of k and solves the equation

(Total for Question 15 is 3 marks)

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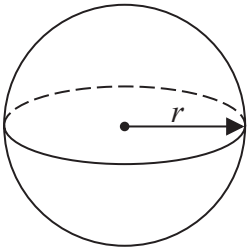
16 Here is a sphere.



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

$\frac{3}{8}$ of the surface area of this sphere is $75\pi\,\text{cm}^2$

Find the diameter of the sphere.
Give your answer in the form $a\sqrt{b}$ where a is an integer and b is a prime number.

25
3|75

Dividing the 75π by 3 finds 1/8 of the surface area. The π can be ignored for now

25 x 8 = 200

Multiplying the 1/8 of the surface area by 8 works out that the surface area of the sphere is 200π cm^2

050
4|200

$4\pi r^2 = 200\pi$. Dividing both sides by π cancels it out. Then dividing both sides by 4 finds that $r^2 = 50$

$\sqrt{50} = \sqrt{25} \times \sqrt{2}$

Square rooting finds that the radius is $\sqrt{50}$. This can be simplified using $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ to split the $\sqrt{50}$ into two other surds multiplied together, one of which is a square number

$= 5\sqrt{2}$

Square rooting the 25 gives 5

The diameter is double the radius

$10\sqrt{2}$ cm

(Total for Question 16 is 4 marks)

17 Make x the subject of the formula $y = \dfrac{4(2x - 7)}{5x + 3}$

$5xy+3y=8x-28$ ← Multiplying both sides by 5x + 3 and expanding the brackets

$3y+28=8x-5xy$ ← Subtracting 5xy from both sides so that all the terms involving x are on the right. Adding 28 to both sides to get all the terms not involving x on the left

$=x(8-5y)$ ← Bringing x out as a factor on the right

Dividing both sides by 8 - 5y →

$x=\dfrac{3y+28}{8-5y}$

(Total for Question 17 is 4 marks)

18 7 kg of carrots and 5 kg of tomatoes cost a total of 480p

cost of 1 kg of carrots : cost of 1 kg of tomatoes = 5 : 9

Work out the cost of 1 kg of carrots and the cost of 1 kg of tomatoes.

$7\times\frac{5}{9}T+5T$ ← Let T be the cost of 1 kg of tomatoes. The cost of 1 kg of carrots is 5/9 of the cost of 1 kg of carrots so is 5/9 T. Expressing the total cost of 7kg of carrots and 5 kg of tomatoes in terms of T

$\frac{35}{9}T+\frac{45}{9}T$ ← 7/1 x 5/9 = 35/9. Converting 5/1 into 45/9 by multiplying both the numerator and denominator by 9 so that it has the same denominator

$\frac{80}{9}T=480$ ← Adding the fractions of T by adding the numerators and the denominators stay the same. Setting the expression of the total cost equal to the 480p

6×9 ← Dividing both sides by 80 gives 1/9 T = 6. So multiplying both sides by 9 finds T is 54

6×5 ← Dividing the 54 by the 9 parts which represent it in the ratio gives 6 then multiplying this by the 5 parts works out the cost of 1 kg of carrots

carrots ..... 30 ..... p

tomatoes ..... 54 ..... p

(Total for Question 18 is 4 marks)

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19 The menu in a restaurant has starters, main courses and desserts.

There are 5 starters.
There are 12 main courses.
There are x desserts.

There are 420 different ways to choose one starter, one main course and one dessert.

Work out the value of x.

0 8 4
5 | 4 2 0
84 ÷ 12

Using the product rule for counting: 5 x 12 x x = 420.
So dividing both sides by 5 then 12 finds x

$x =$ 7

(Total for Question 19 is 2 marks)

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20 For $x \geqslant 0$, the functions f and g are such that

$$f(x) = 3x + 4 \qquad g(x) = \frac{\sqrt{x} + 2}{5}$$

(a) Find $g^{-1}(x)$

$x = \frac{\sqrt{y}+2}{5}$

$5x = \sqrt{y} + 2$

$5x - 2 = \sqrt{y}$

Switched g(x) with x and x with y then rearranged to make y the subject. This does the exact opposite and works out the inverse function

$g^{-1}(x) =$ $(5x-2)^2$

(2)

(b) Solve $gf(x) = 3$

$\frac{\sqrt{3x+4}+2}{5} = 3$ ← Expressing gf(x) by substituting f(x) for x in g(x). Setting equal to the 3

$\sqrt{3x+4} = 13$ ← Multiplying both sides by 5 and subtracting 2 from both sides

$13 \times 13 = 39 + 130 = 169$

$3x + 4 = 169$ ← Squaring both sides of the equation to eliminate the square root. Working out that 13^2 is 169

$3x = 165$ ← Subtracting 4 from both sides

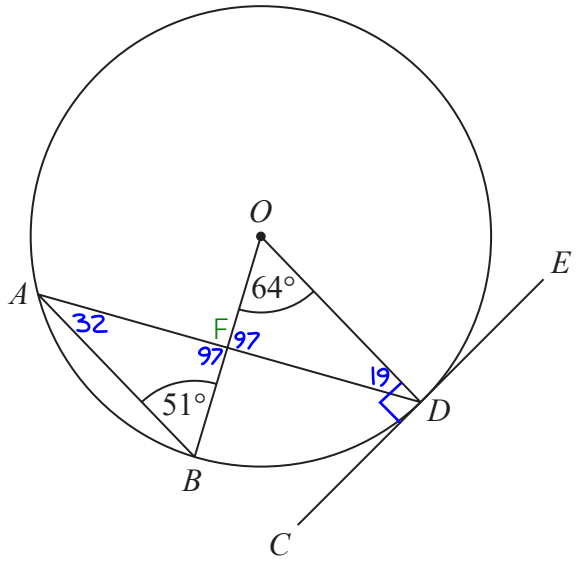
$3 \overline{)165}$ → 055 ← Dividing both sides by 3

$x =$ 55

(3)

(Total for Question 20 is 5 marks)

21 *A*, *B* and *D* are points on a circle with centre *O*.
CDE is the tangent to the circle at *D*.



Work out the size of angle *ADC*.
Write down any circle theorems you use.

32
$2\overline{)64}$ ← The angle at the centre is double the angle at the circumference. So this works out that angle BAD is 32°

$32 + 51 = 83$
$180 - 83 = 97$ ← Adding up the two angles in triangle ABF works out that there are 83° in the triangle so far. Subtracting this from 180° (as there are 180° in total in a triangle) works out that angle AFB is 97°

$64 + 97 = 161$
$180 - 161 = 19$ ← Angle OFD is vertically opposite to angle AFB so is also 97°. Adding the two angles in triangle OFD works out that there are 161° in the triangle so far. Subtracting this from 180° (as there are 180° in total in a triangle) works out that angle ODF is 19°

$90 - 19 = 71$ ← Angle ODC is 90° as the radius meets the tangent at 90°. Subtracting angle ODF from this leaves angle ADC

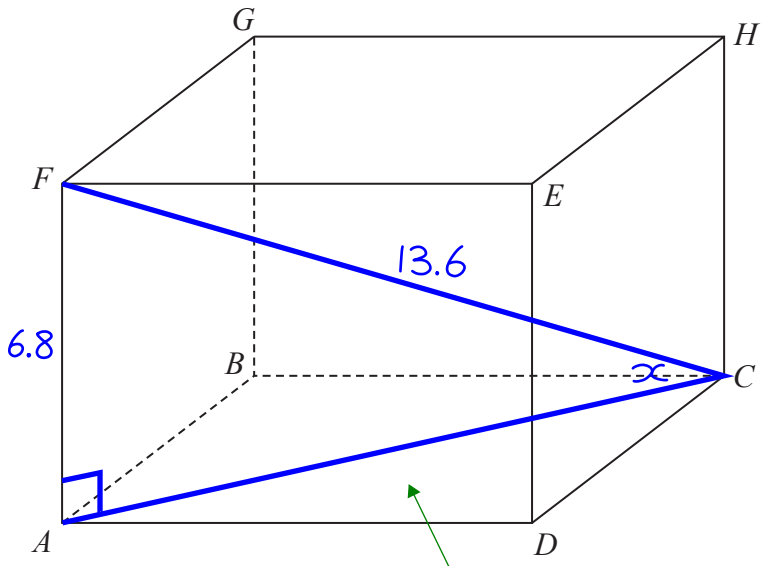
The angle at the centre is double the angle at the circumference
The radius meets the tangent at 90°

Writing down the circle theorems used

71 °

(Total for Question 21 is 4 marks)

22 *ABCDEFGH* is a cuboid.



Drawing on FC and a straight line on the plane ABCD which forms a right-angled triangle. Writing on the information given and labelling the angle we are looking for as x

$AF = 6.8\,\text{cm}$
$FC = 13.6\,\text{cm}$

Work out the size of the angle between FC and the plane $ABCD$.

SOH CAH TOA

Right-angled trigonometry can be used to work out the angle x. Writing SOH CAH TOA as formula triangles. Ticking O as we have the opposite and H as we have the hypotenuse

$\sin x = \frac{6.8}{13.6}$

There are two ticks on SOH so this formula triangle can be used. From the formula triangle, sin of the angle = opposite/hypotenuse

$= \frac{68}{136}$

Multiplying both the numerator and denominator by 10 to get rid of the decimals

$2\overline{)68}$ $2\overline{)136}$ → $\frac{34}{68}$

Dividing both the numerator and denominator by 2 to simplify the fraction to 34/68

$2\overline{)34}$ $2\overline{)68}$ → $\frac{17}{34}$

Dividing both the numerator and denominator by 2 to simplify the fraction to 17/34

$\sin x = \frac{1}{2}$

Dividing both the numerator and denominator by 17 gives 1/2

0 30 45 60 90
0 1 2 3 4

Writing the angles we need to know the trig values for. Writing 0, 1, 2, 3, 4 under these for the sin values. Square rooting these then putting them over 2 works out the sin values. Sin30 = $\sqrt{1}/2 = 1/2$

30 °

(Total for Question 22 is 2 marks)

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23 Write $\frac{3\sqrt{3}}{4-\sqrt{3}} - \frac{2}{\sqrt{3}}$ in the form $\frac{a\sqrt{3}+b}{c}$ where a, b and c are integers.

$\frac{3\sqrt{3}(4+\sqrt{3})}{(4-\sqrt{3})(4+\sqrt{3})}$ ← Rationalising the denominator of the first fraction by flipping the sign of 4 - $\sqrt{3}$ and multiplying both the numerator and denominator by this

$16+4\sqrt{3}-4\sqrt{3}-3$ ← Expanding the bracket on the denominator

$\frac{12\sqrt{3}+9}{13} - \frac{2\sqrt{3}}{3}$ ← Simplifying the denominator. Expanding the bracket on the numerator. Rationalising the second fraction by multiplying both the numerator and denominator by $\sqrt{3}$

$\frac{36\sqrt{3}+27}{39} - \frac{26\sqrt{3}}{39}$ ← Making the denominators of both fractions the same so that they can be subtracted. Multiplying both the numerator and denominator of the first fraction by 3 and multiplying both the numerator and denominator of the second fraction by 13

Subtracted the numerators and the denominator stays the same → $\frac{10\sqrt{3}+27}{39}$

(Total for Question 23 is 4 marks)

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24 Find the set of possible values of x for which

$$4x^2 - 25 < 0 \quad \textbf{and} \quad 12 - 5x - 3x^2 > 0$$

You must show all your working.

$4x^2 < 25$ ← Rearranging to solve for x in the first inequality. First adding 25 to both sides so that the term involving x is on its own

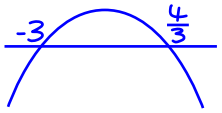
$x^2 < \frac{25}{4}$ ← Dividing both sides by 4 to get the x^2 on its own

$-\frac{5}{2} < x < \frac{5}{2}$ ← Square rooting both sides. As there is a negative solution and square rooting flips the sign for this, the inequality symbol also needs to be flipped for this solution

$-3x^2 - 5x + 12 = 0$ ← Putting the second inequality in the quadratic form and replacing the inequality symbol with equals so it can be solved using the quadratic formula

$\frac{--5 \pm \sqrt{(-5)^2 - 4 \times -3 \times 12}}{2 \times -3}$ ← $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← The equation is in the form $ax^2 + bx + c = 0$. a is -3, b is -5 and c is 12.

$x = -3, x = \frac{4}{3}$



← A negative x^2 graph is n-shaped. Sketching this and putting the solutions where it crosses the x-axis. So as it is greater than 0 for the second inequality, $-3 < x < 4/3$

-5/2 is less negative than -3 so this must be the lower bound in this case. 5/2 is over 2. 4/3 is less than 2. 4/3 is less positive so this must be the upper bound in this case

$-\frac{5}{2} < x < \frac{4}{3}$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS