

Write your name here

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Other names

**Pearson Edexcel**  
**Level 1/Level 2 GCSE (9 - 1)**

Centre Number

Candidate Number

# Mathematics

## Paper 3 (Calculator)

**Higher Tier**

Mock Set 3 – Autumn 2017  
**Time: 1 hour 30 minutes**

Paper Reference

**1MA1/3H**

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. 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 be used.**
- If your calculator does not have a  $\pi$  button, take the value of  $\pi$  to be 3.142 unless the question instructs otherwise.

### 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**

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 (a) Write 168 as a product of its prime factors.  
You must show your working.

$$\begin{array}{r} 2 \overline{)168} \\ 2 \overline{)84} \\ 2 \overline{)42} \\ 3 \overline{)21} \\ 7 \overline{)7} \\ 1 \end{array}$$

$$168 = 2 \times 2 \times 2 \times 3 \times 7$$

$$168 = 2^3 \times 3 \times 7$$

.....  
(3)

- (b) Find the highest common factor (HCF) of 168 and 180

$$\begin{array}{r} 2 \overline{)180} \\ 2 \overline{)90} \\ 3 \overline{)45} \\ 3 \overline{)15} \\ 5 \overline{)5} \\ 1 \end{array}$$

$$180 = 2 \times 2 \times 3 \times 3 \times 5$$

$$168 = 2 \times 2 \times 2 \times 3 \times 7$$

$$HCF = 2 \times 2 \times 3 = 12$$

.....  
12  
(2)

(Total for Question 1 is 5 marks)

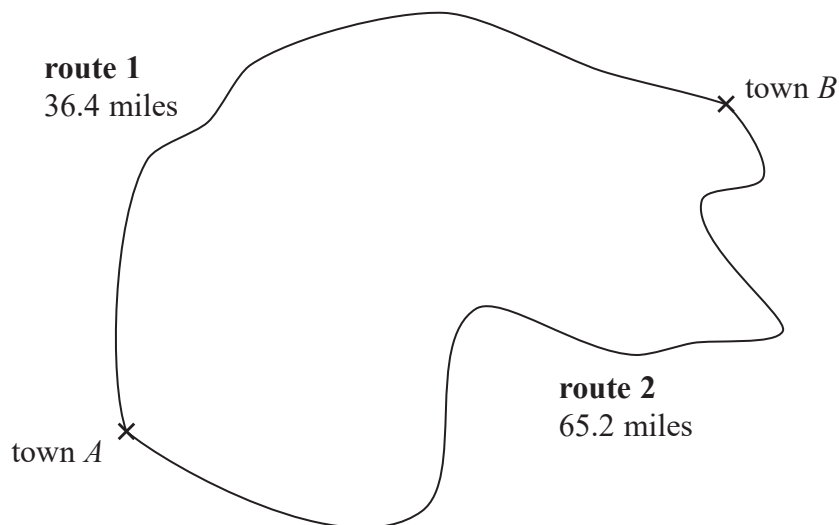


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- 2 Eric and Geraldine both drove from town  $A$  to town  $B$ .



Both Eric and Geraldine left town  $A$  at 2 pm.

Eric drove on route 1  
He got to town  $B$  at 2 48 pm.

Geraldine drove on route 2  
She got to town  $B$  at 3 25 pm.

Who drove at the greater average speed?  
You must show all your working.

$$\text{Eric } 36.4 \text{ miles in } \frac{48}{60} \text{ hr}$$

$$\begin{aligned} \text{Avg speed} &= 36.4 \div \frac{48}{60} \\ &= 36.4 \times \frac{60}{48} = 45.5 \text{ mph} \end{aligned}$$

$$\text{Geraldine } 65.2 \text{ miles in } \frac{85}{60} \text{ hrs}$$

$$\begin{aligned} \text{Avg Speed} &= 65.2 \div \frac{85}{60} \\ &= 65.2 \times \frac{60}{85} = 46.0 \text{ mph} \end{aligned}$$

$$46.0 > 45.5$$

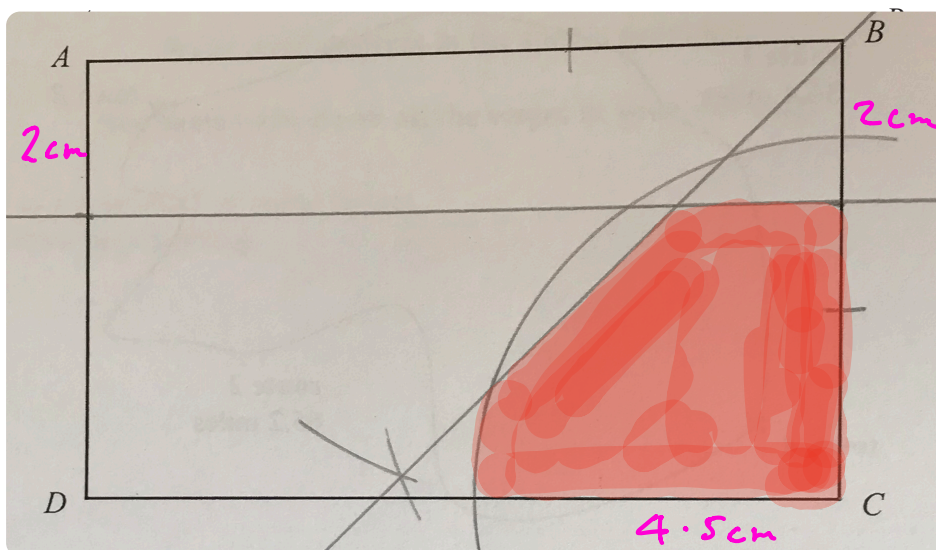
so Geraldine had the greater average speed

(Total for Question 2 is 3 marks)



S 5 7 4 9 6 A 0 3 2 4

3 Here is an accurate scale drawing of a school playground.



1 cm represents 2 m

Nasim is going to put a seat in the playground.

The seat has to be

less than 9 m from  $C$   
 closer to  $BC$  than to  $AB$   
 more than 4 m from  $AB$

arc on  $C$  radius 4.5 cm  
 Angle bisector of  $\angle ABC$   
 line parallel to  $AB$  2cm from it

Show, by shading on the diagram, the region where Nasim can put the seat.

(Total for Question 3 is 4 marks)



- 4 There are only red counters, blue counters and green counters in a bag.

number of red counters : number of blue counters : number of green counters = 1 : 3 : 7

A counter is going to be taken at random from the bag.

- (a) Complete the table below to show each of the probabilities that the counter will be red or blue or green.

Colour	red	blue	green
Probability	$\frac{1}{11}$	$\frac{3}{11}$	$\frac{7}{11}$

(2)

Jamie takes at random a counter from the bag and records the colour of the counter. He then puts the counter back in the bag.

Jamie does this a number of times.  
He records a total of 68 blue counters.

- (b) Work out an estimate for the total number of times Jamie takes a counter from the bag.

$$68 \approx \frac{3}{11} \text{ of total}$$

$$68 \times \frac{11}{3} \approx \text{total}$$

$$249.3 \approx \text{total}$$

Estimate

249

(2)

(Total for Question 4 is 4 marks)



- 5 Maryam is trying to expand and simplify  $(n - 2)^2$   
Here is her working.

$$\begin{aligned}(n - 2)^2 &= (n - 2)(n - 2) \\ &= n^2 - 2n - 2n - 4 \quad \times \\ &= n^2 - 4n - 4\end{aligned}$$

Maryam's answer is wrong.

- (a) Find Maryam's mistake.

$$\begin{aligned}&= n^2 - 2n - 2n + 4 \\ &= n^2 - 4n + 4\end{aligned}$$

(1)

Josh is trying to factorise  $x^2 - 6x + 8$   
His reasoning is,

$$\begin{aligned}\text{because } 4 \times 2 &= 8 \\ \text{and } 4 + 2 &= 6\end{aligned}$$

$$\text{then } x^2 - 6x + 8 = (x + 4)(x + 2)$$

- (b) Explain what is wrong with Josh's reasoning.

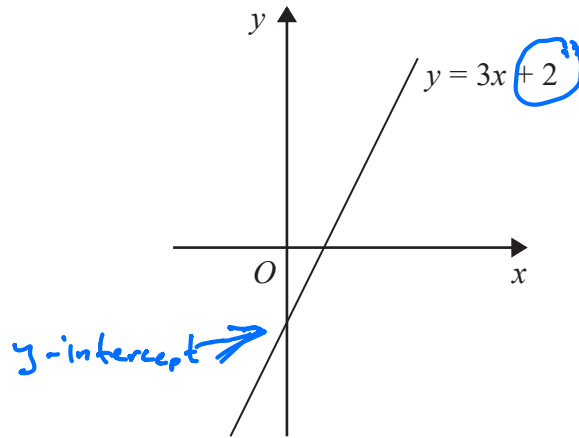
Factors of 8 should add to -6 not +6

$$x^2 - 6x + 8 = (x - 4)(x - 2)$$

(1)



Shona has to draw the line with equation  $y = 3x + 2$   
Here is her line.



(c) Explain why Shona's line **cannot** be correct.

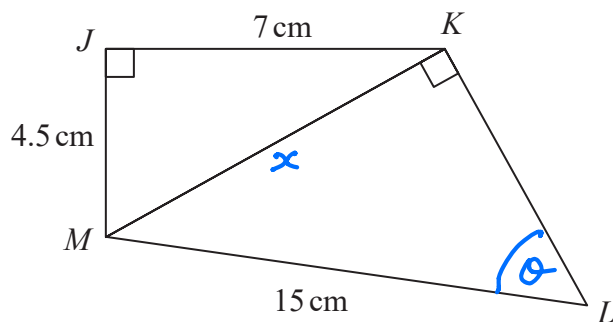
y-intercept should be +2 but it is clearly  
negative on this graph

(1)

(Total for Question 5 is 3 marks)



6 The diagram shows a quadrilateral  $JKLM$ .



Work out the size of angle  $KLM$ .

Give your answer correct to 3 significant figures.

By Pythagoras

$$x^2 = 4.5^2 + 7^2$$

$$x^2 = 69.25$$

$$x = \sqrt{69.25}$$

$$x = 8.322 \text{ cm}$$

$$\sin \theta = \frac{x}{15} = \frac{8.322}{15}$$

$$\theta = \sin^{-1} \left( \frac{8.322}{15} \right)$$

$$\theta = 33.7^\circ$$

$$\text{Angle } KLM = 33.7^\circ$$

(Total for Question 6 is 4 marks)





7 Liquid A has a density of  $1.42 \text{ g/cm}^3$

$7 \text{ cm}^3$  of liquid A is mixed with  $125 \text{ cm}^3$  of liquid B to make liquid C.

Liquid C has a density of  $1.05 \text{ g/cm}^3$

Find the density of liquid B.

Give your answer correct to 2 decimal places.

	A	B	C
Density	$1.42 \text{ g/cm}^3$	?	$1.05 \text{ g/cm}^3$
Mass	$9.94 \text{ g}$	$128.66 \text{ g}$	$138.6 \text{ g}$
Volume	$7 \text{ cm}^3$	$125 \text{ cm}^3$	$\rightarrow 132 \text{ cm}^3$

$$\begin{aligned} \text{Mass A} \\ &= 1.42 \times 7 \\ &= 9.94 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Mass B} \\ &= 138.6 - 9.94 \\ &= 128.66 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Mass C} \\ &= 132 \times 1.05 \\ &= 138.6 \text{ g} \end{aligned}$$

$$\text{Density of B} = \frac{\text{Mass}}{\text{Volume}} = \frac{128.66}{125} = 1.03$$

.....  $1.03 \text{ g/cm}^3$

(Total for Question 7 is 3 marks)

8 Kiera used her calculator to work out the value of a number  $x$ .  
She wrote down the first two digits of the answer on her calculator.

She wrote down 7.3

Write down the error interval for  $x$ .

$$7.3 \leq x < 7.4$$

(Total for Question 8 is 2 marks)



9 Francesco carried out a survey about the ages of the people in his office.

The table shows information about his results.

Age ( $a$ years)	Cumulative frequency
$20 < a \leq 30$	10
$20 < a \leq 40$	26
$20 < a \leq 50$	58
$20 < a \leq 60$	66
$20 < a \leq 70$	70

(a) On the grid opposite, draw a cumulative frequency graph for this information.

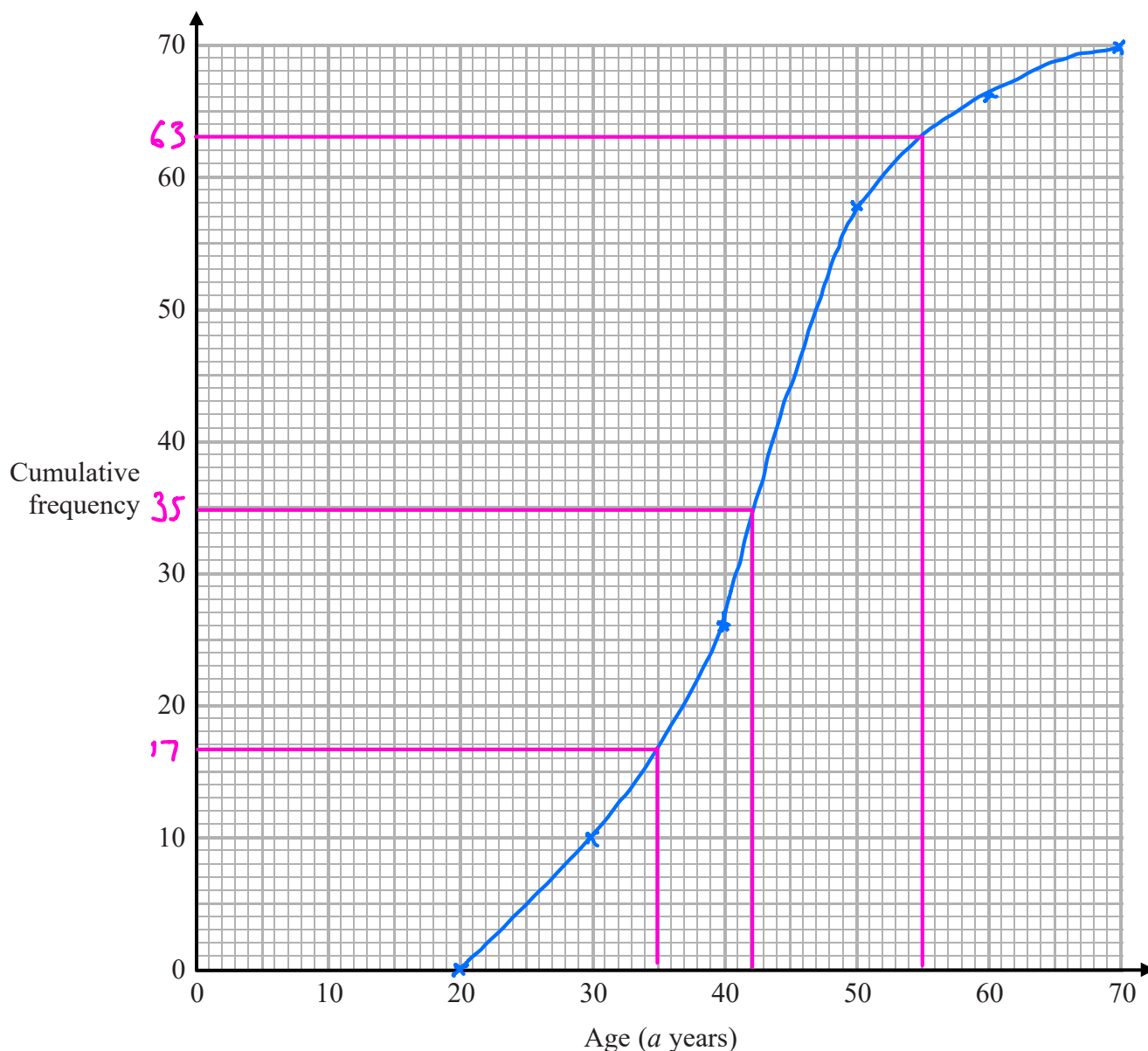
(2)



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(b) Use your graph to find an estimate for the median age.

..... 42 ..... years  
(1)

Francesco says,

“More than 60% of the people in the office are between 35 and 55 years old.”

(c) Use your graph to determine if Francesco is correct.

63 - 17 = 46 people between 35 and 55 years old

$\frac{46}{70} = 65.7\%$  so Francesco is correct

(3)

(Total for Question 9 is 6 marks)



S 5 7 4 9 6 A 0 1 1 2 4

10 In a sale, the price of a TV is reduced by 25%

A week later, the sale price of the TV is reduced by 15%  
The price of the TV is now £293.25

What was the price of the TV before the sale?

$$\text{Original Price} \times 0.75 \times 0.85 = \pounds 293.25$$

$$\text{Original Price} = \pounds 293.25 \div 0.75 \div 0.85 = \pounds 460$$

£ 460

(Total for Question 10 is 3 marks)

11 Expand and simplify  $(x + 2)(x + 8)(x - 4)$

$$= (x^2 + 2x + 8x + 16)(x - 4)$$

$$= (x^2 + 10x + 16)(x - 4)$$

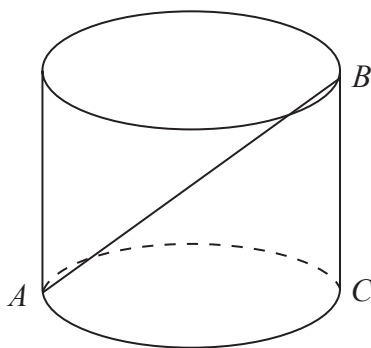
$$= x^3 + 10x^2 + 16x - 4x^2 - 40x - 64$$

$$= x^3 + 6x^2 - 24x - 64$$

(Total for Question 11 is 3 marks)



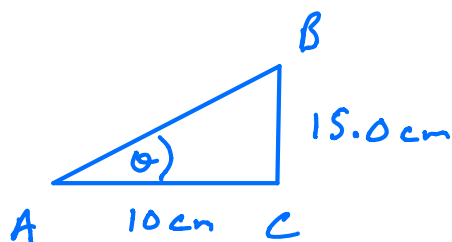
12 The diagram shows a metal rod,  $AB$ , resting inside a cylindrical tin.



The tin is on a horizontal table.  
 $AC$  is a diameter of the base of the tin.  
 $B$  is on the top edge of the tin.  
 $BC$  is vertical.

The radius of the base of the tin is 5 cm.  
 The volume of the tin is  $1178 \text{ cm}^3$

Find the angle between the rod and the base of the tin.  
 Give your answer correct to the nearest degree.



$$V = \pi r^2 h$$

$$\frac{V}{(\pi r^2)} = h$$

$$\frac{1178}{(\pi \times 5^2)}$$

$$= h$$

$$15.0 \text{ cm} = h$$

$$\tan \theta = \frac{15.0}{10}$$

$$\theta = \tan^{-1}\left(\frac{15}{10}\right) = 56.3^\circ$$

$$= 56^\circ \text{ to nearest degree}$$

56

(Total for Question 12 is 4 marks)



13 For any three consecutive whole numbers, prove algebraically that

the largest number and the smallest number are factors of the number that is one less than the square of the middle number.

Let numbers be  $n, n+1, n+2$

$$\begin{aligned} \text{middle squared} &= (n+1)(n+1) \\ &= n^2 + n + n + 1 \\ &= n^2 + 2n + 1 \end{aligned}$$

$$\begin{aligned} \text{One less than this} &= n^2 + 2n \\ &= n(n+2) \end{aligned}$$

so both  $n$  and  $n+2$  are factors

(Total for Question 13 is 3 marks)

14 Prove algebraically that the recurring decimal  $0.4\dot{5}\dot{7}$  can be written as  $\frac{151}{330}$

$$\text{Let } x = 0.4\dot{5}\dot{7}$$

$$x = 0.4575757 \dots$$

$$10x = 4.575757 \dots \quad \textcircled{1}$$

$$1000x = 457.5757 \dots \quad \textcircled{2}$$

$$\textcircled{2} - \textcircled{1}$$

$$990x = 453$$

$$x = \frac{453}{990} = \frac{151}{330}$$

(Total for Question 14 is 3 marks)



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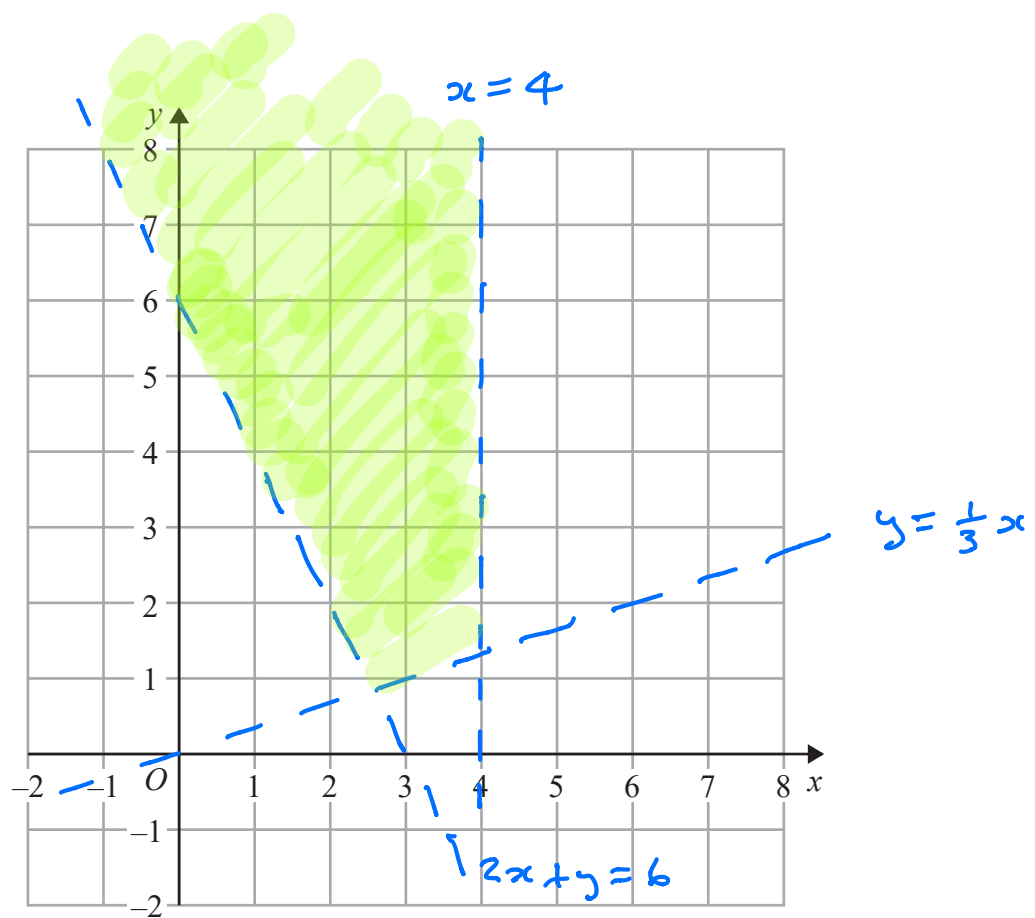
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15 On the grid show, by shading, the region defined by the inequalities

$$x < 4 \quad 2x + y > 6 \quad y > \frac{1}{3}x$$

Label the region **R**.



(Total for Question 15 is 3 marks)



- 16 There is a large number of cubes in a bag.  
Jason wants to work out an estimate for the number of cubes in the bag.

He takes at random 10 cubes from the bag.

He puts a mark on each cube and then puts each cube back in the bag.

Jason shakes the bag and then takes at random 20 of the cubes.

There is a mark on 3 of the cubes.

Work out an estimate for the total number of cubes in the bag.

$$\frac{20}{3} \times 10 = \frac{200}{3} = 66.7$$

Estimate 67

67

(Total for Question 16 is 3 marks)





- 17 At the start of year  $n$ , the quantity of a radioactive metal is  $P_n$   
At the start of the following year, the quantity of the same metal is given by

$$P_{n+1} = 0.87P_n$$

At the start of 2016 there were 30 grams of the metal.

What will be the quantity of the metal at the start of 2019?

Give your answer to the nearest gram.

$$P_{2017} = P_{2016} \times 0.87$$

$$P_{2018} = P_{2016} \times 0.87^2$$

$$P_{2019} = P_{2016} \times 0.87^3$$

$$= 30 \times 0.87^3$$

$$= 19.75509$$

$$= 20g$$

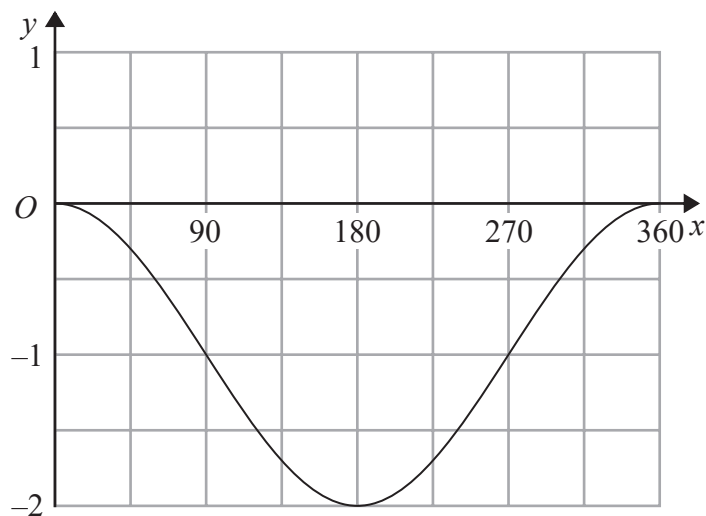
to nearest g

20

.....grams

(Total for Question 17 is 3 marks)

- 18 Here is a sketch of the curve  $y = \sin(x + a)^\circ + b$



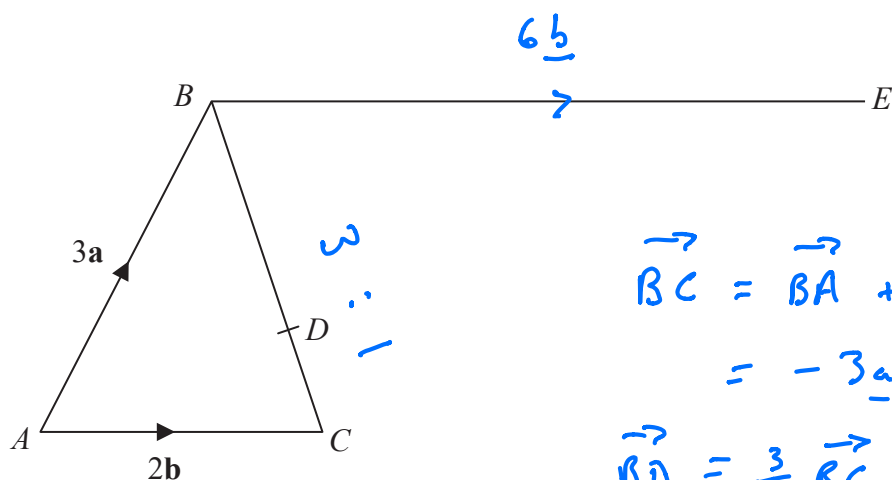
Given that  $0 < a < 360$   
find the value of  $a$  and the value of  $b$ .

$$a = 90$$

$$b = -1$$

(Total for Question 18 is 2 marks)





The diagram shows triangle  $ABC$ .

$$\vec{AB} = 3\mathbf{a}$$

$$\vec{AC} = 2\mathbf{b}$$

$$\vec{BE} = 3\vec{AC}$$

$D$  is the point on  $BC$  such that  $BD:DC = 3:1$

Prove that  $ADE$  is a straight line.

$$\begin{aligned} \vec{AE} &= \vec{AB} + \vec{BE} \\ &= 3\mathbf{a} + 6\mathbf{b} \\ &= 4\left(\frac{3}{4}\mathbf{a} + \frac{6}{4}\mathbf{b}\right) = 4\vec{AD} \end{aligned}$$

$\therefore \vec{AE}$  is parallel to  $\vec{AD}$

Since both pass through  $A$ ,  $\vec{AE}$  is an extension of  $\vec{AD}$   $\therefore ADE$  is a straight line

(Total for Question 19 is 4 marks)



20 There are 9 counters in a bag.

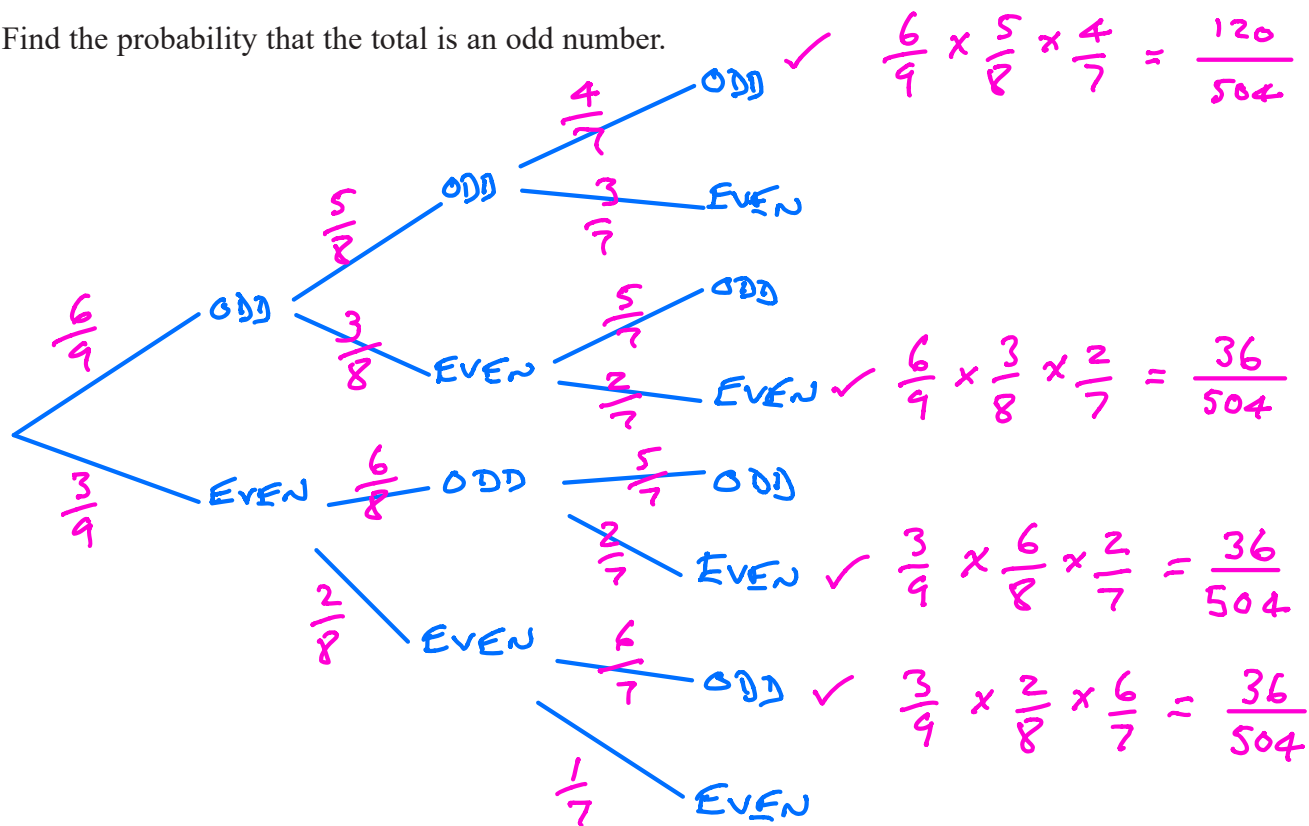
There is an even number on 3 of the counters.

There is an odd number on 6 of the counters.

Three counters are going to be taken at random from the bag.

The numbers on the counters will be added together to give the total.

Find the probability that the total is an odd number.



$$P(\text{Odd total}) = \frac{120 + 36 + 36 + 36}{504} = \frac{228}{504} = \frac{19}{42}$$

(Total for Question 20 is 5 marks)



21  $f(x) = x^3$   
 $g(x) = 4x - 1$

(a) Find  $fg(2)$

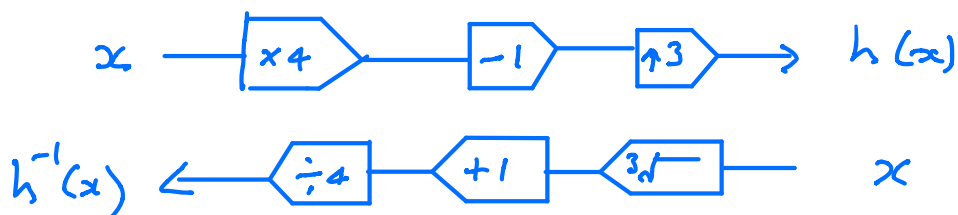
$$fg(x) = f(4x-1) = (4x-1)^3$$

$$fg(2) = (4(2)-1)^3 = 7^3 = 343$$

$$\frac{343}{(2)}$$

$h(x) = fg(x)$

(b) Find an expression for  $h^{-1}(x)$



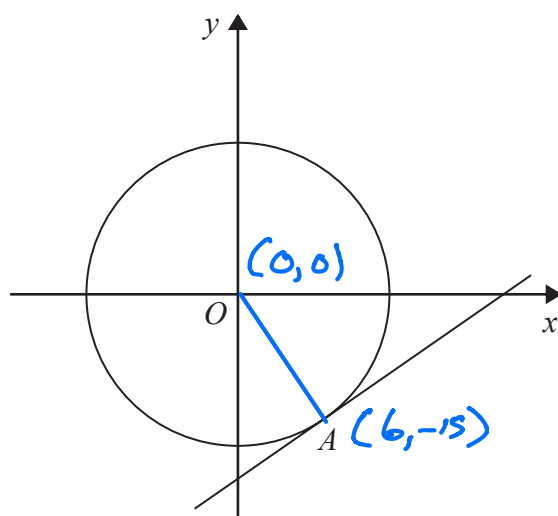
$$h^{-1}(x) = \frac{\sqrt[3]{x} + 1}{4}$$

$h^{-1}(x) = \dots\dots\dots$   
 (3)

(Total for Question 21 is 5 marks)



22 The diagram shows the circle with equation  $x^2 + y^2 = 261$



$$\begin{aligned}
 p^2 + (-15)^2 &= 261 \\
 p^2 + 225 &= 261 \\
 p^2 &= 261 - 225 \\
 p^2 &= 36 \\
 p &= \pm 6 \\
 p &= 6 \quad \text{as } p > 0
 \end{aligned}$$

A tangent to the circle is drawn at point  $A$  with coordinates  $(p, -15)$ , where  $p > 0$

Find an equation of the tangent at  $A$ .

$$\therefore A(6, -15)$$

$$\text{gradient } OA = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-15 - 0}{6 - 0} = \frac{-15}{6} = -\frac{5}{2}$$

$$\text{gradient of tangent} = +\frac{2}{5}$$

$$\text{Eqn of tangent} \quad y - y_1 = m(x - x_1)$$

$$y - (-15) = \frac{2}{5}(x - 6)$$

$$y + 15 = \frac{2}{5}x - \frac{12}{5}$$

$$y = \frac{2}{5}x - \frac{12}{5} - 15$$

$$y = \frac{2}{5}x - \frac{12}{5} - \frac{45}{5}$$

$$y = \frac{2}{5}x - \frac{57}{5}$$

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



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