

# Model Answers

Write your name here						
Surname	Other names					
Pearson Edexcel Level 1/Level 2 GCSE (9 - 1)	Centre Number <table border="1"><tr><td></td><td></td><td></td><td></td><td></td></tr></table>					
	Candidate Number <table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					
<b>Mathematics</b> <b>Paper 3 (Calculator)</b>						
<b>Higher Tier</b>						
Mock Set 1 – Autumn 2016 Time: 1 hour 30 minutes	Paper Reference <b>1MA1/3H</b>					
<b>You must have:</b> Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.	Total Marks <table border="1"><tr><td></td></tr></table>					

## 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.*
- **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.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**



## 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.

**Answer ALL questions.**

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

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

- 1** Buses to Ashby leave a bus station every 24 minutes.  
Buses to Barford leave the same bus station every 20 minutes.

A bus to Ashby and a bus to Barford both leave the bus station at 7 30 a.m.

When will a bus to Ashby and a bus to Barford next leave the bus station at the same time?

Find the lowest common multiple:

24	20
48	40
72	60
96	80
120	100
	120

120 minutes = 2 hours.

Time = 9:30 am

..... 9:30 am .....

**(Total for Question 1 is 3 marks)**

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- 2 Amzol thinks that  $(x+5)^2 = x^2 + 25$  for all values of  $x$ .

Is Amzol right?

You must show how you get your answer.

$$\begin{aligned}(x+5)^2 &= (x+5)(x+5) \\&= x^2 + 5x + 5x + 25 \\&= x^2 + 10x + 25\end{aligned}$$

$x^2 + 10x + 25 \neq x^2 + 25$  so Amzol is incorrect.

(Total for Question 2 is 2 marks)

- 3 Kim, Laura and Molly share £385.

The ratio of the amount of money Kim gets to the amount of money Molly gets is 2 : 5  
Kim gets £105 less than Molly gets.

What percentage of the £385 does Laura get?

Kim : Molly

2 : 5

$$\begin{aligned}5 - 2 &= 3 & 3 \text{ parts} &= £105 \\ \therefore 1 \text{ part} &= £35 & (\text{£}105 \div 3 &= \text{£}35)\end{aligned}$$

Kim : Molly

2 × £35 : 5 × £35

£70 : £175

$$\begin{aligned}\text{Total for Kim and Molly} &= \text{£}70 + \text{£}175 \\&= \text{£}245.\end{aligned}$$

$$\begin{aligned}\text{Total for Laura} &= \text{£}385 - \text{£}245 \\&= \text{£}140\end{aligned}$$

..... 36.4 %

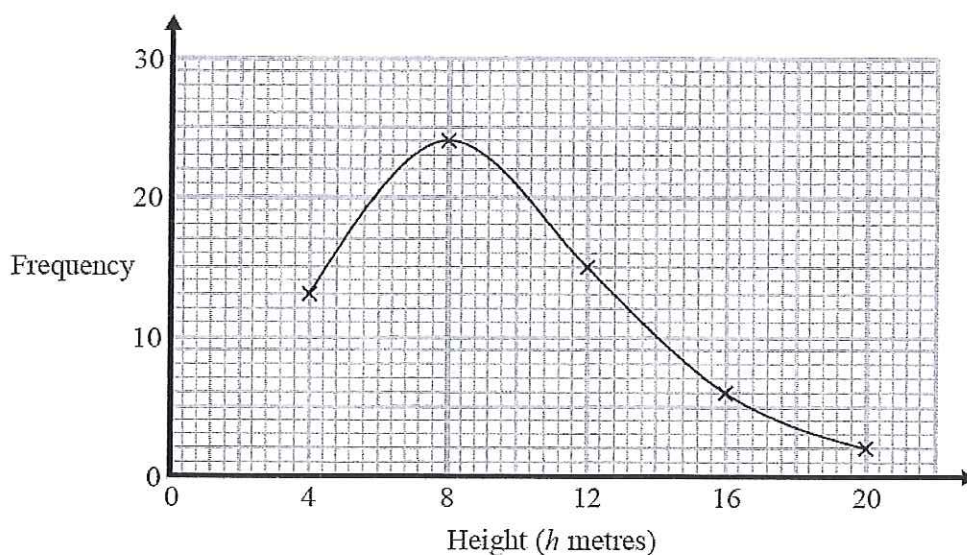
$$\begin{aligned}\text{Laura's percentage} &= \frac{140}{385} \times 100 \\&= 36.4\%\end{aligned}$$

(Total for Question 3 is 4 marks)

- 4 The table shows information about the heights of 60 trees.

Height ( $h$ metres)	Frequency
$0 < h \leq 4$	13
$4 < h \leq 8$	24
$8 < h \leq 12$	15
$12 < h \leq 16$	6
$16 < h \leq 20$	2

Jacob drew this frequency polygon for the information in the table.  
The frequency polygon is **not** correct.



Write down **two** things that are wrong with the frequency polygon.

1. The points should be joined with straight lines.
2. The points should be plotted using the midpoint.

(Total for Question 4 is 2 marks)

- 5 The price of all rail tickets increased by 5 %.  
The price of a rail ticket from London to Ipswich increased by £2.30.

Work out the price of the ticket before the increase.

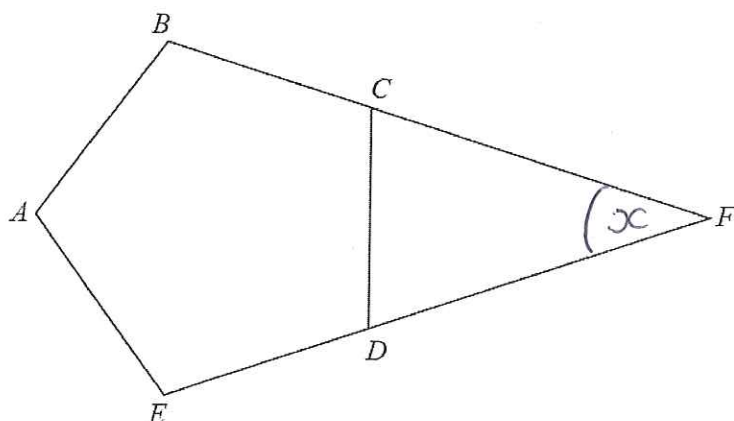
$$\begin{array}{lcl} & 5\% = £2.30 & \downarrow \div 5 \\ \div 5 \left( & 1\% = £0.46 & \downarrow \times 100 \\ \times 100 \left( & 100\% = £46 & \end{array}$$

£ 46 .....

(Total for Question 5 is 2 marks)

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$ABCDE$  is a regular pentagon.  
 $BCF$  and  $EDF$  are straight lines.

Work out the size of angle  $CFD$ .  
 You must show how you get your answer.

Angle  $DCF = \text{Angle } CDF$  [Exterior angles of the regular pentagon]

Exterior angle of regular pentagon:

$$\begin{aligned}\text{Exterior angle} &= 360 \div \text{no. of sides} \\ &= 360 \div 5 \\ &= 72^\circ\end{aligned}$$

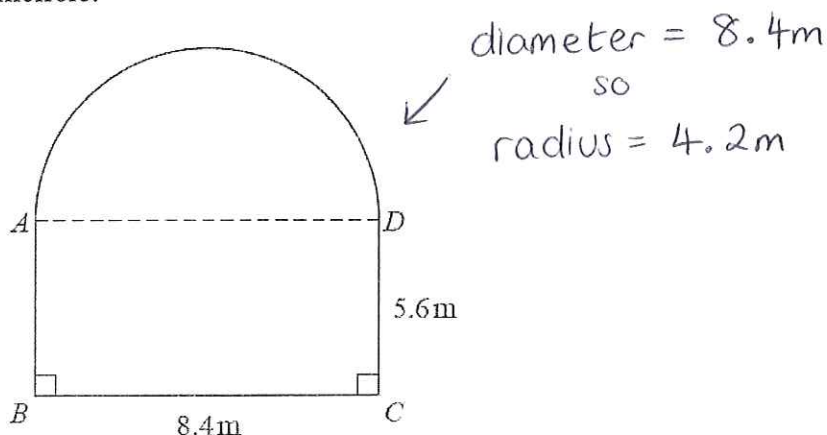
$$72^\circ + 72^\circ = 144^\circ$$

$$\begin{aligned}\text{Angle } CFD &= 180^\circ - 144^\circ \\ &= 36^\circ\end{aligned}$$

..... 36 .....

[Angles in a triangle add up to  $180^\circ$ ] (Total for Question 6 is 3 marks)

- 7 A garden is in the shape of a rectangle,  $ABCD$ , and a semicircle.  $AD$  is the diameter of the semicircle.



Carol is going to cover the garden with fertiliser.

A box of fertiliser costs £4.99.

Carol has been told that one box of fertiliser will cover  $12 \text{ m}^2$  of garden.

- (a) Work out the cost of buying enough fertiliser to cover the garden completely.

$$\begin{aligned} \text{Area of semi-circle} &= \frac{1}{2} \times \pi \times r^2 \\ &= \frac{1}{2} \times \pi \times 4.2^2 = \end{aligned}$$

$$\begin{aligned} \text{Area of rectangle} &= \text{base} \times \text{height} \\ &= 8.4 \times 5.6 = \end{aligned}$$

Total area =

$$\text{Number of boxes needed} = \text{Total area} \div \text{area per box}$$

$\therefore$  7 boxes needed (always round UP!)

£ 34.93

$$\begin{aligned} \text{Total cost} &= 7 \times 4.99 \\ &= £34.93 \end{aligned}$$

(5)

Carol finds out that one box of fertiliser will cover more than  $12 \text{ m}^2$  of garden.

- (b) Explain how this might affect the number of boxes she needs to buy.

She may need to buy fewer boxes

(1)

(Total for Question 27 is 6 marks)

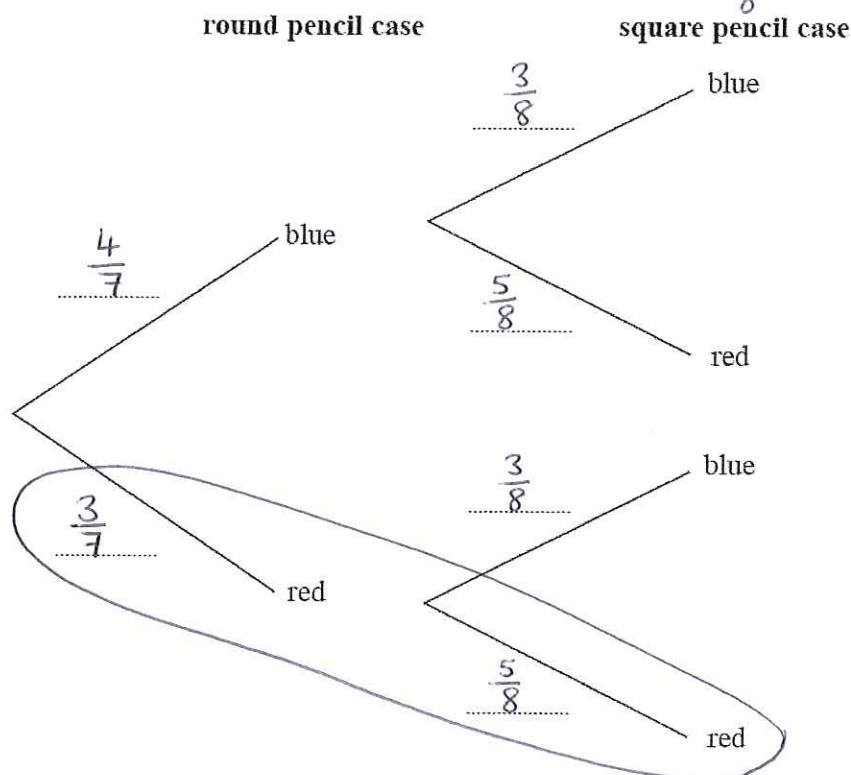
- 8 Sameena has a round pencil case and a square pencil case.

There are 4 blue pens and 3 red pens in the round pencil case.

There are 3 blue pens and 5 red pens in the square pencil case.

Sameena takes at random one pen out of each pencil case.

- (a) Complete the probability tree diagram.



(2)

- (b) Work out the probability that the pens Sameena takes are both red.

$$\text{Red} \rightarrow \text{Red} = \frac{3}{7} \times \frac{5}{8} = \frac{15}{56}$$

(Multiply along the branches)

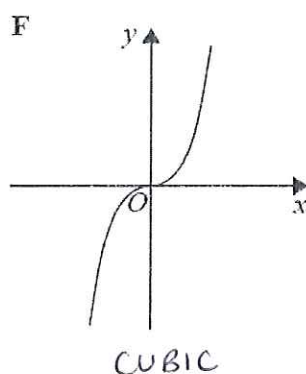
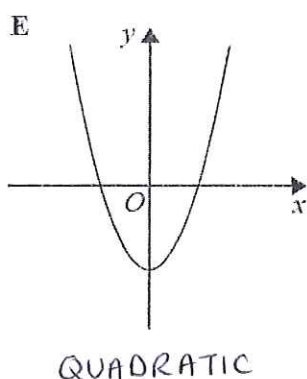
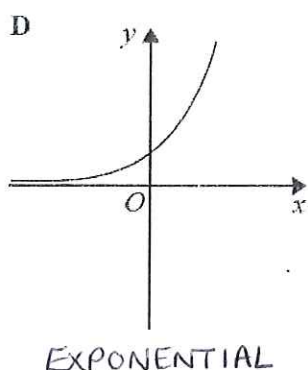
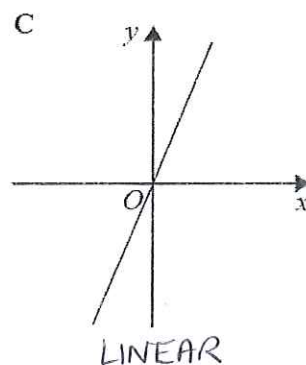
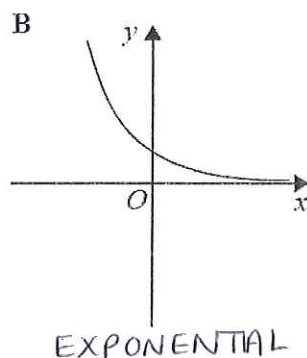
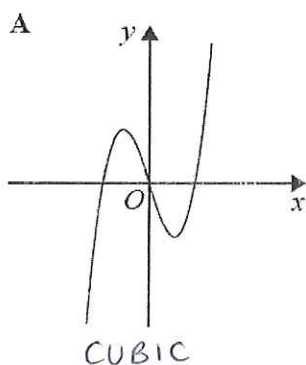
$$\frac{15}{56}$$

(2)

(Total for Question 8 is 4 marks)



9 Here are six graphs.



Write down the letter of the graph that could have the equation

(i)  $y = 2^x$

(Exponential graph)

D

(ii)  $y = x^3 - 3x$

(Cubic graph)

A

(Total for Question 9 is 2 marks)

10 Simplify  $3m^2r \times 4m^3r^6$

$$3 \times 4 \times m^2 \times m^3 \times r \times r^6$$

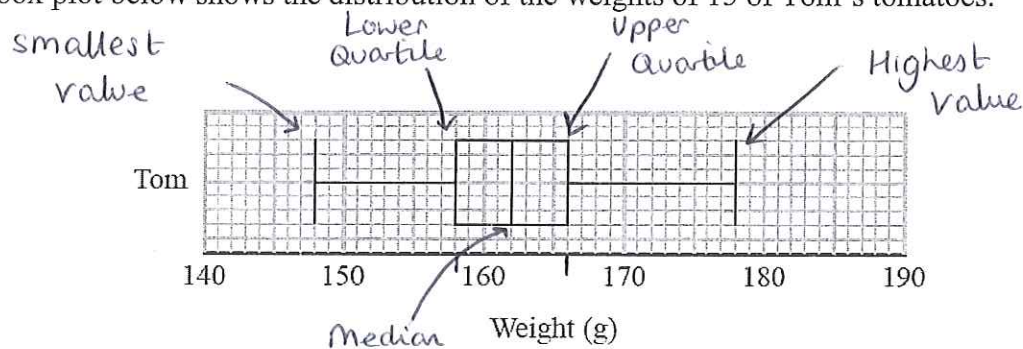
$$12 \times m^5 \times r^7$$

$$= 12m^5r^7$$

collect like terms  
simplify indices (when multiplying, add the indices)  
 $12m^5r^7$

(Total for Question 10 is 2 marks)

- 11 Tom grows tomatoes.  
The box plot below shows the distribution of the weights of 15 of Tom's tomatoes.



- (a) Work out the interquartile range.

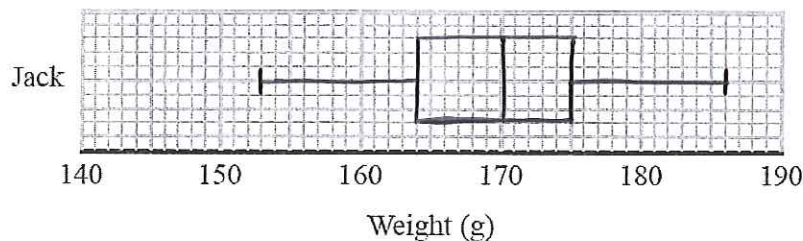
$$\begin{aligned} \text{Interquartile range} &= \text{Upper Quartile} - \text{Lower Quartile} \\ &= 166 - 158 \\ &= (8) \end{aligned} \quad \text{g} \quad (1)$$

Jack also grows tomatoes.

Here are the weights, in grams, of 15 of Jack's tomatoes.

153 155 158 164 166 167 170 170 173 174 175 175 177 179 186  
 smallest ← LQ median (middle!) UQ largest

- (b) On the grid below, draw a box plot for this information.



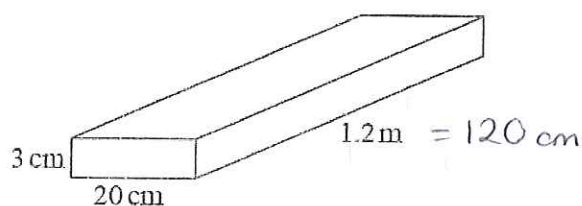
- (c) Compare the distribution of the weights of Tom's tomatoes with the distribution of the weights of Jack's tomatoes.

Tom's tomatoes have a smaller interquartile range so the sizes are more consistent.  
 Jack's median (170g) is higher than Tom's median (162g).

(2)

(Total for Question 11 is 6 marks)

- 12 The diagram shows a piece of wood in the shape of a cuboid.



The piece of wood is 3 cm by 20 cm by 1.2 m.

The mass of the piece of wood is 8 kg.

The piece of wood will float in sea water if the density of the wood is less than the density of the sea water.

In a large pool, 1 litre of sea water has a mass of 1030 g.

Will the piece of wood float in this pool?  
You must show how you get your answer.

(Total for Question 12 is 4 marks)

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$$1.2 \text{ m} = 120 \text{ cm}$$

Wood

$$\text{Volume} = 3 \times 20 \times 120 = 7200 \text{ cm}^3$$

$$\begin{aligned} \text{Mass} &= 8 \text{ kg} \\ &= 8000 \text{ g} \end{aligned}$$



$$\begin{aligned} \text{Density} &= \text{Mass} \div \text{Volume} \\ &= 8000 \div 7200 \\ &= \end{aligned}$$

Pool

$$\begin{aligned} \text{Volume} &= 1 \text{ litre} \\ &= 1000 \text{ cm}^3 \end{aligned}$$

$$\text{Mass} = 1030 \text{ g}$$



$$\begin{aligned} \text{Density} &= \text{Mass} \div \text{Volume} \\ &= 1030 \div 1000 \\ &= 1.030 \text{ g/cm}^3 \end{aligned}$$

$1.11 \dots \text{ g/cm}^3 > 1.030 \text{ g/cm}^3 \therefore$  No the piece of wood will not float in the pool.

- 13 (a) Show that the equation  $x^3 + 5x - 4 = 0$  has a solution between  $x = 0$  and  $x = 1$

$$f(0) = -4 \quad \text{and} \quad f(1) = 2$$

as changed signs must be at least one root

(2)

- (b) Show that the equation  $x^3 + 5x - 4 = 0$  can be arranged to give  $x = \frac{4}{x^2 + 5}$

$$x^3 + 5x = 4$$

$$\text{Factorise: } x(x^2 + 5) = 4$$

$$\div (x^2 + 5) \quad \div (x^2 + 5)$$

$$x = \frac{4}{x^2 + 5}$$

(2)

- (c) Starting with  $x_0 = 0$ , use the iteration formula  $x_{n+1} = \frac{4}{x_n^2 + 5}$  twice, to find an estimate for the solution of  $x^3 + 5x - 4 = 0$

$$x_0 = 0 \quad x_1 = 0.8$$

$$x_1 = \frac{4}{0^2 + 5}$$

$$x_1 = \frac{4}{5}$$

$$x_1 = 0.8$$

$$x_2 = \frac{4}{x_1^2 + 5}$$

$$x_2 = \frac{4}{0.8^2 + 5}$$

$$x_2 = \frac{100}{1441} = 0.709$$

$$x_2 = 0.709 \quad (3)$$

(Total for Question 13 is 7 marks)

- 14 The number of fish in a lake decreases by  $x\%$  each year.

Given that the number of fish halves in 8 years, work out the value of  $x$ .  
Give your answer correct to 1 decimal place.

$$\left(\frac{100-x}{100}\right)^8 = 0.5$$

$$\frac{100-x}{100} = \sqrt[8]{0.5}$$

$$100-x = 100 \times \sqrt[8]{0.5}$$

$$100-x = 91.7$$

$$+x \quad +x$$

$$100 = 91.7 + x$$

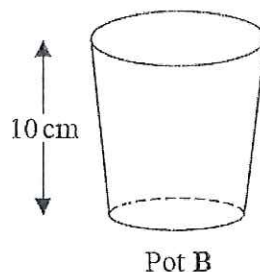
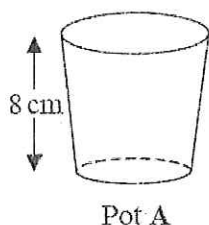
$$-91.7 \quad -91.7$$

$$8.3 = x$$

$$x = 8.3$$

(Total for Question 14 is 3 marks)

- 15 Here are two pots.



Pot A and pot B are mathematically similar.

The area of the base of pot B is  $160 \text{ cm}^2$ .

Work out the area of the base of pot A.

	(A)	(B)	Scale factor
Length	8	10	$\frac{10}{8} = 1.25$
Area		160	$1.25^2$
Volume			$1.25^3$

$\div$  by scale factor

(B) (A)

$$160 \div 1.25^2 = 102.4 \text{ cm}^2$$

$$102.4 \text{ cm}^2$$

(Total for Question 15 is 2 marks)



16

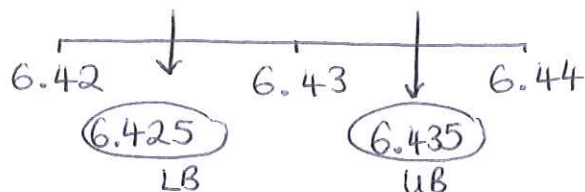
$$v = \sqrt{\frac{a}{b}}$$

$a = 6.43$  correct to 2 decimal places.

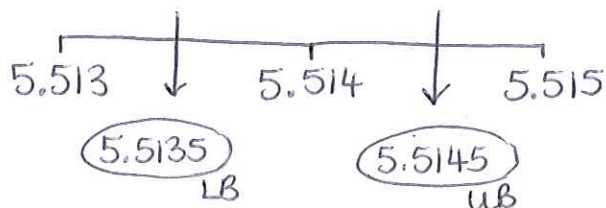
$b = 5.514$  correct to 3 decimal places.

By considering bounds, work out the value of  $v$  to a suitable degree of accuracy.  
Give a reason for your answer.

Bounds for  $a$ :



Bounds for  $b$ :



Upper bound for ' $v$ ':

$$V = \sqrt{\frac{UB}{LB}} = \sqrt{\frac{6.435}{5.5135}} = 1.080340323$$

Lower bound for ' $v$ ':

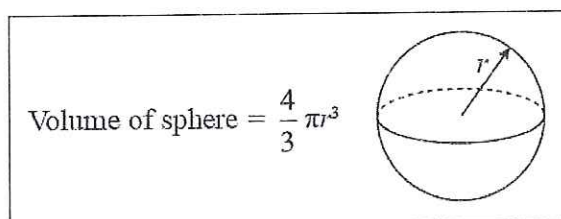
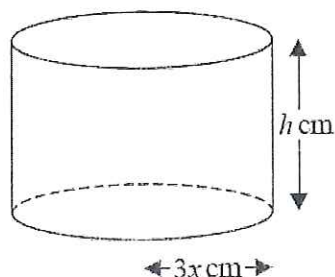
$$V = \sqrt{\frac{LB}{UB}} = \sqrt{\frac{6.425}{5.5145}} = 1.079402689$$

Both numbers round to 1.08 to 2dp

1.08 (2dp)

(Total for Question 16 is 5 marks)

- 17 The diagram shows a solid metal cylinder.



The cylinder has base radius  $3x$  cm and height  $h$  cm.

The metal cylinder is melted.

All the metal is then used to make 270 spheres.

Each sphere has a radius of  $\frac{1}{2}x$  cm

Find an expression, in its simplest form, for  $h$  in terms of  $x$ .

$$\begin{aligned}
 \text{Volume of cylinder} &= \pi r^2 \times h \\
 &= \pi \times (3x)^2 \times h \quad \leftarrow r = 3x \\
 &= \pi \times 9x^2 \times h \\
 &= 9\pi x^2 h
 \end{aligned}$$

$$\begin{aligned}
 \text{Volume of spheres} &= 270 \times \frac{4}{3} \times \pi \times r^3 \quad \leftarrow r = \frac{1}{2}x \\
 &= 270 \times \frac{4}{3} \times \pi \times \left(\frac{1}{2}x\right)^3 \\
 &= 360 \times \pi \times \frac{1}{8}x^3 \\
 &= 45\pi x^3
 \end{aligned}$$

$$\begin{aligned}
 9\pi x^2 h &= 45\pi x^3 \\
 \div \pi & \quad \div \pi \\
 9x^2 h &= 45x^3 \\
 \div x^2 & \quad \div x^2 \\
 9h &= 45x \\
 \div 9 & \quad \div 9
 \end{aligned}$$

$$h = 5x$$

$$h = 5x$$

(Total for Question 17 is 3 marks)

18 Make  $m$  the subject of

$$f = \frac{4-3m}{5+m}$$

Multiply by denominator:  $\times(5+m) \times(5+m)$

$$f(5+m) = 4-3m$$

Expand bracket:  $5f + fm = 4-3m$

Get 'm's onto both sides:

$$\begin{array}{rcl} & +3m & +3m \\ 5f + fm + 3m & = & 4 \end{array}$$

$$\begin{array}{rcl} -5f & & -5f \\ fm + 3m & = & 4-5f \end{array}$$

Factorise:  $m(f+3) = 4-5f$

Divide by  $(f+3)$ :  $\div(f+3) \quad \div(f+3)$

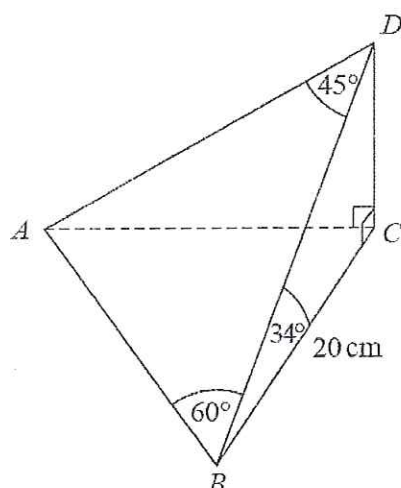
$$m = \frac{4-5f}{f+3}$$

$$m = \frac{4-5f}{f+3}$$

(Total for Question 18 is 4 marks)

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- 19 The diagram shows a pyramid with base  $ABC$ .

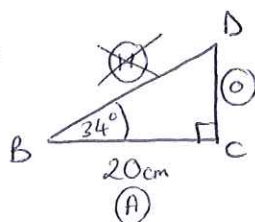


$CD$  is perpendicular to both  $CA$  and  $CB$ .

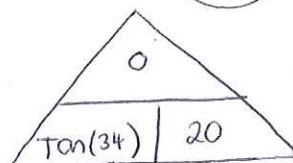
Angle  $CBD = 34^\circ$     Angle  $ADB = 45^\circ$     Angle  $DBA = 60^\circ$   
 $BC = 20$  cm.

Calculate the size of the angle between the line  $AD$  and the plane  $ABC$ .  
 Give your answer correct to 1 decimal place.

- ① Find length  $CD$ :



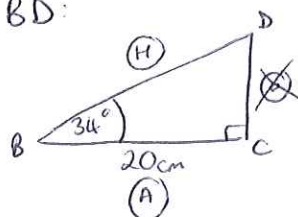
$S^{\circ} H^{\circ} C^{\circ} A^{\circ} H^{\circ} T^{\circ} A^{\circ}$



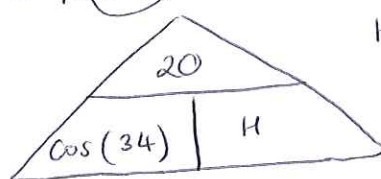
$$O = \tan(34) \times 20$$

$$O = 13.49 \text{ cm}$$

- ② Find length  $BD$ :



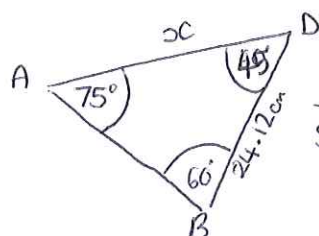
$S^{\circ} H^{\circ} C^{\circ} A^{\circ} H^{\circ} T^{\circ} A^{\circ}$



$$H = 20 \div \cos(34)$$

$$= 24.12 \text{ cm}$$

- ③ Find length  $AD$ :



$$\text{Angle } BAD = 180 - (60 + 45) = 75^\circ$$

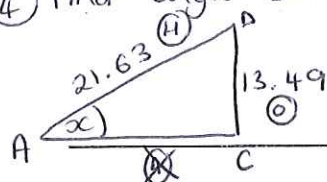
$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{x}{\sin(60)} = \frac{24.12}{\sin(75)}$$

$$x = \frac{24.12}{\sin(75)} \times \sin(60)$$

$$= 21.63 \text{ cm}$$

- ④ Find angle  $DAC$ :



$S^{\circ} H^{\circ} C^{\circ} A^{\circ} H^{\circ} T^{\circ} A^{\circ}$



$$\sin(x) = \frac{13.49}{21.63}$$

$$x = \sin^{-1}(\text{ans})$$

$$x = 38.6^\circ$$

$$38.6^\circ$$

(Total for Question 19 is 5 marks)

20 For all values of  $x$

$$f(x) = 2x - 3 \quad \text{and} \quad g(x) = x^2 + 2$$

(a) Find  $g(-4)$

• Substitute '-4' into  $g(x)$

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

$$= 16 + 2$$

$$= \underline{18}$$

18

(1)

(b) Show that  $gf(x) = 4x^2 - 12x + 11$

• Substitute  $f(x)$  into  $g(x)$

$$gf(x) = (2x - 3)^2 + 2$$

• Expand and simplify

$$\begin{aligned} gf(x) &= 4x^2 - 6x - 6x + 9 + 2 \\ &= 4x^2 - 12x + 11 \end{aligned}$$

(2)

(c) Solve  $fg(x) = gf(x)$

• For  $fg(x)$  substitute  $g(x)$  into  $f(x)$ :

$$fg(x) = 2(x^2 + 2) - 3$$

$$= 2x^2 + 4 - 3$$

$$= 2x^2 + 1$$

• Write equations equal to each other

$$fg(x) = gf(x)$$

$$2x^2 + 1 = 4x^2 - 12x + 11$$

$$\begin{array}{r} -2x^2 \\ 1 = 2x^2 - 12x + 11 \end{array}$$

$$\begin{array}{r} -1 \\ 0 = 2x^2 - 12x + 10 \end{array}$$

$$0 = 2x^2 - 12x + 10$$

$$x = 5, x = 1$$

(4)

Divide through by 2

$$0 = x^2 - 6x + 5$$

Factorise and solve

$$0 = (x - 5)(x - 1)$$

(Total for Question 20 is 7 marks)

$$x - 5 = 0$$

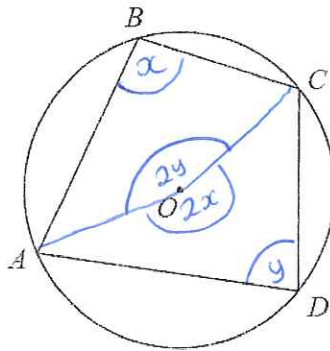
$$x - 1 = 0$$

$$x = 5,$$

$$x = 1$$



- 21  $A, B, C$  and  $D$  are points on the circumference of a circle, centre  $O$ .



Prove that the sum of angle  $ABC$  and angle  $ADC$  is  $180^\circ$

Create two radii at  $AO$  and  $OC$ .

Label angle  $ABC = x^\circ$

$\therefore$  angle (reflex)  $= 2x^\circ$  [Angle at the centre is twice the angle at the circumference]

Label angle  $ADC = y^\circ$

$\therefore$  angle (obtuse)  $= 2y^\circ$  [Angle at the centre is twice the angle at the circumference]

$$2x + 2y = 360^\circ$$

$$\therefore x + y = 180^\circ$$

$$\therefore \text{angle } ABC + \text{angle } ADC = 180^\circ$$

(Total for Question 21 is 4 marks)

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**TOTAL FOR PAPER: 75 MARKS**

