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Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify  $g^6 \times g^4$

$$g^{6+4}$$

$$g^{10} \quad (1)$$

(b) Simplify  $k^{10} \div k^3$

$$k^{10-3}$$

$$k^7 \quad (1)$$

(c) Simplify  $(3cd^4)^2$

$$3^2 c^2 d^{4 \times 2}$$

$$9c^2d^8 \quad (2)$$

(d) Solve the inequality  $4x + 7 > 2$

$$-7 \quad -7$$

$$4x > -5$$

$$x > -\frac{5}{4}$$

$$x > -1.25 \quad (2)$$

(Total for Question 1 is 6 marks)



- 2 The table shows information about the lengths of time, in minutes, 120 customers spent in a supermarket.

Length of time ( $L$ minutes)	Frequency
$20 < L \leq 30$	6
$30 < L \leq 40$	26
$40 < L \leq 50$	31
$50 < L \leq 60$	40
$60 < L \leq 70$	17

120

- (a) Write down the modal class.

50 < L ≤ 60

(1)

- (b) Work out an estimate for the mean length of time spent by the 120 customers in the supermarket.

$$\begin{aligned}
 & 25 \times 6 + 35 \times 26 + 45 \times 31 + 55 \times 40 + 65 \times 17 \\
 = & 150 + 910 + 1395 + 2200 + 1105 \\
 = & 5760
 \end{aligned}$$

Est.

$$\begin{aligned}
 \text{Mean} & \Rightarrow 5760 \div 120 \\
 & = 48
 \end{aligned}$$

48

minutes

(4)

(Total for Question 2 is 5 marks)



3

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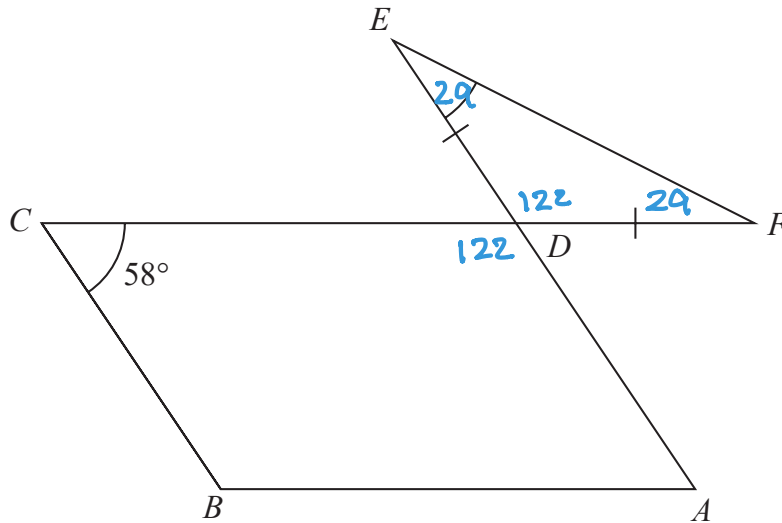


Diagram NOT accurately drawn

The diagram shows a parallelogram  $ABCD$  and an isosceles triangle  $DEF$  in which  $DE = DF$

$CDF$  and  $ADE$  are straight lines.

Angle  $BCD = 58^\circ$

Work out the size of angle  $DEF$ .

Give a reason for each stage of your working.

$$\begin{aligned}\hat{CDA} &= 180 - 58 \\ &= 122\end{aligned}$$

contenecr angles are equal

$$\hat{EDF} = 122$$

vertically opposite angles are equal

$$\hat{DEF} = \hat{DFE}$$

2 angles in an isosceles are equal

$$\frac{180 - 122}{2} = 29$$

29

(Total for Question 3 is 5 marks)



P 6 2 6 5 7 A 0 5 2 4

4 Andreas, Isla and Paulo share some money in the ratios 3 : 2 : 5

The **total** amount of money that Isla and Paulo receive is £76 more than the amount of money that Andreas receives.

Andreas buys a video game for £48.50 with some of his share of the money.

Work out how much money Andreas has left from his share of the money when he has bought the video game.

$$\begin{array}{ccc} A & I & P \\ 3 & 2 & 5 \\ \hline & 7 & \end{array}$$

$76 \div 4 = 19$

$$\begin{array}{r} 3 \times 19 \\ = 57 \end{array}$$

$$\begin{array}{r} 2 \times 19 \\ = 38 \end{array}$$

$$\begin{array}{r} 5 \times 19 \\ 95 \end{array}$$

$$\begin{array}{r} 38 + 95 \\ = 133 \\ 133 - 57 \\ = 76 \checkmark \end{array}$$

$$\begin{array}{r} 57 - 48.50 \\ = 8.5 \end{array}$$

£ 8.50

(Total for Question 4 is 4 marks)

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5 Himari's annual salary is 3 130 000 Japanese Yen (JPY).  
She gets a salary increase of 4%

(a) Work out Himari's salary after this increase.

$$3\,130\,000 \times 1.04$$

$$\underline{3\,255\,200} \text{ JPY}$$

(3)

Kaito bought a car.

The value of the car when Kaito bought it was 750 000 JPY.

At the end of each year, the value of his car had depreciated by 15%

(b) Work out the value of Kaito's car at the end of 3 years.

Give your answer correct to the nearest JPY.

$$750\,000 \times 0.85^3$$
$$= 460\,593.75$$

↑

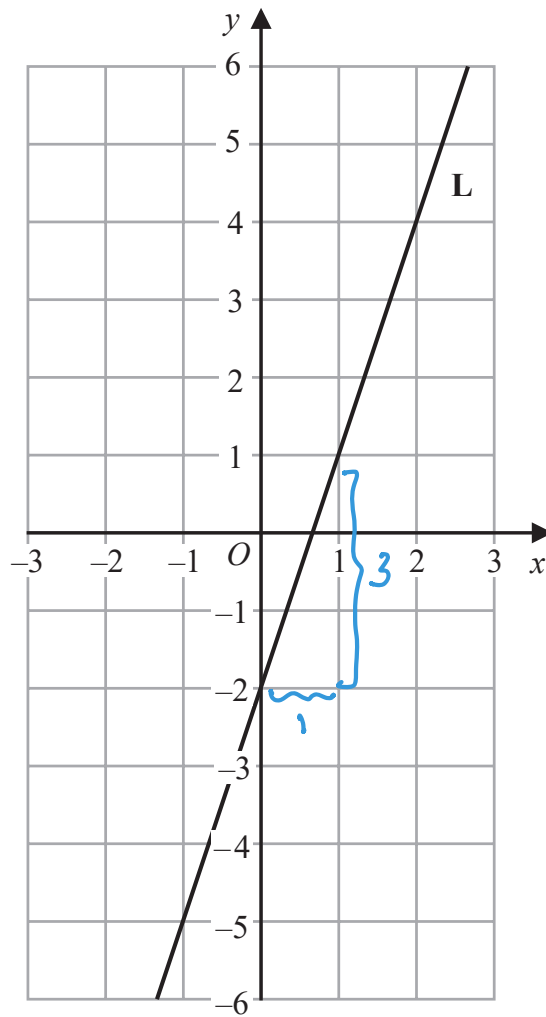
$$\underline{460\,594} \text{ JPY}$$

(3)

(Total for Question 5 is 6 marks)



6 The line **L** is shown on the grid.



Find an equation for **L**.

$$\text{intercept} = -2$$

$$\text{gradient} = \frac{3}{1} = 3$$

$$y = 3x - 2$$

(Total for Question 6 is 2 marks)

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7 The diagram shows a right-angled triangle.

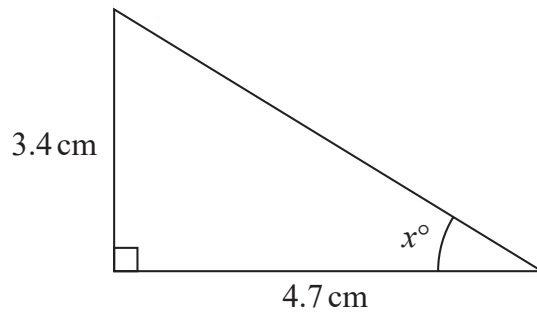


Diagram **NOT**  
accurately drawn

Calculate the value of  $x$ .  
Give your answer correct to one decimal place.

$$\tan x = \frac{3.4}{4.7}$$

$$x = \tan^{-1}\left(\frac{3.4}{4.7}\right)$$

$$= 35.882\dots$$

↑  
(1dp)

$$x = \dots 35.9 \dots$$

(Total for Question 7 is 3 marks)



8 The diagram shows an isosceles triangle.

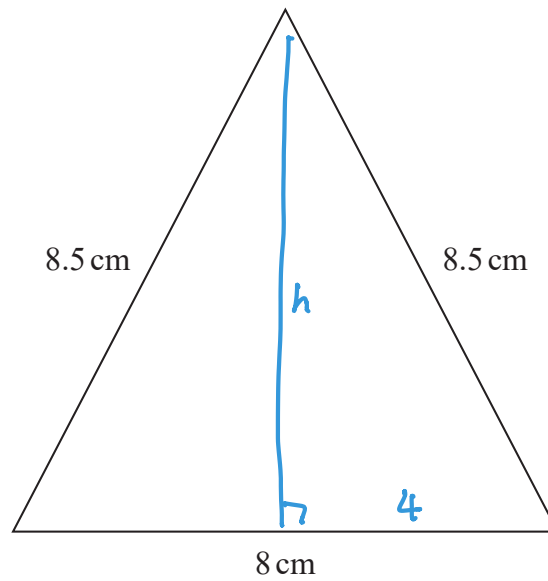


Diagram **NOT**  
accurately drawn

Work out the area of the triangle.

$$h^2 = 8.5^2 - 4^2$$

$$= 56.25$$

$$h = \sqrt{56.25}$$

$$= 7.5$$

$$\text{Area} = \frac{1}{2} \times 8 \times 7.5$$

$$= 30$$

.....30.....cm<sup>2</sup>

(Total for Question 8 is 4 marks)

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- 9 The diagram shows a solid cylinder with radius 3 m.

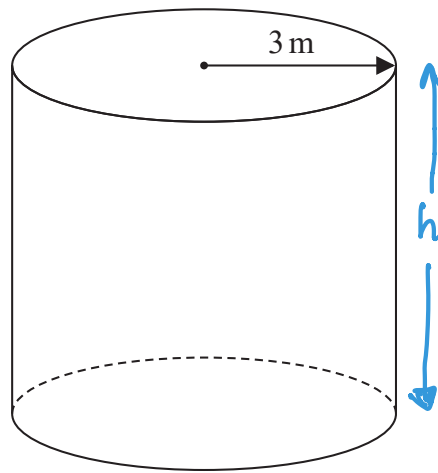


Diagram NOT accurately drawn

The volume of the cylinder is  $72\pi \text{ m}^3$

Calculate the **total** surface area of the cylinder.  
Give your answer correct to 3 significant figures.

$$\begin{aligned} \pi r^2 \times h &= 72\pi \\ 3^2 \times h &= 72 \\ h &= \frac{72}{9} = 8 \end{aligned}$$

surface area

$$\begin{aligned} 2 \times \pi r^2 + \pi \times d \times h \\ &= 2 \times \pi \times 3^2 + \pi \times 6 \times 8 \\ &= 66\pi \\ &= 207.345... \\ &\quad \uparrow \\ &\quad (3.\text{sf.}) \end{aligned}$$

207.....m<sup>2</sup>

(Total for Question 9 is 5 marks)



10 The table shows information about the number of minutes each of 120 buses was late last Monday.

Number of minutes late ( $L$ )	Frequency
$0 < L \leq 10$	10
$10 < L \leq 20$	16
$20 < L \leq 30$	44
$30 < L \leq 40$	29
$40 < L \leq 50$	15
$50 < L \leq 60$	6

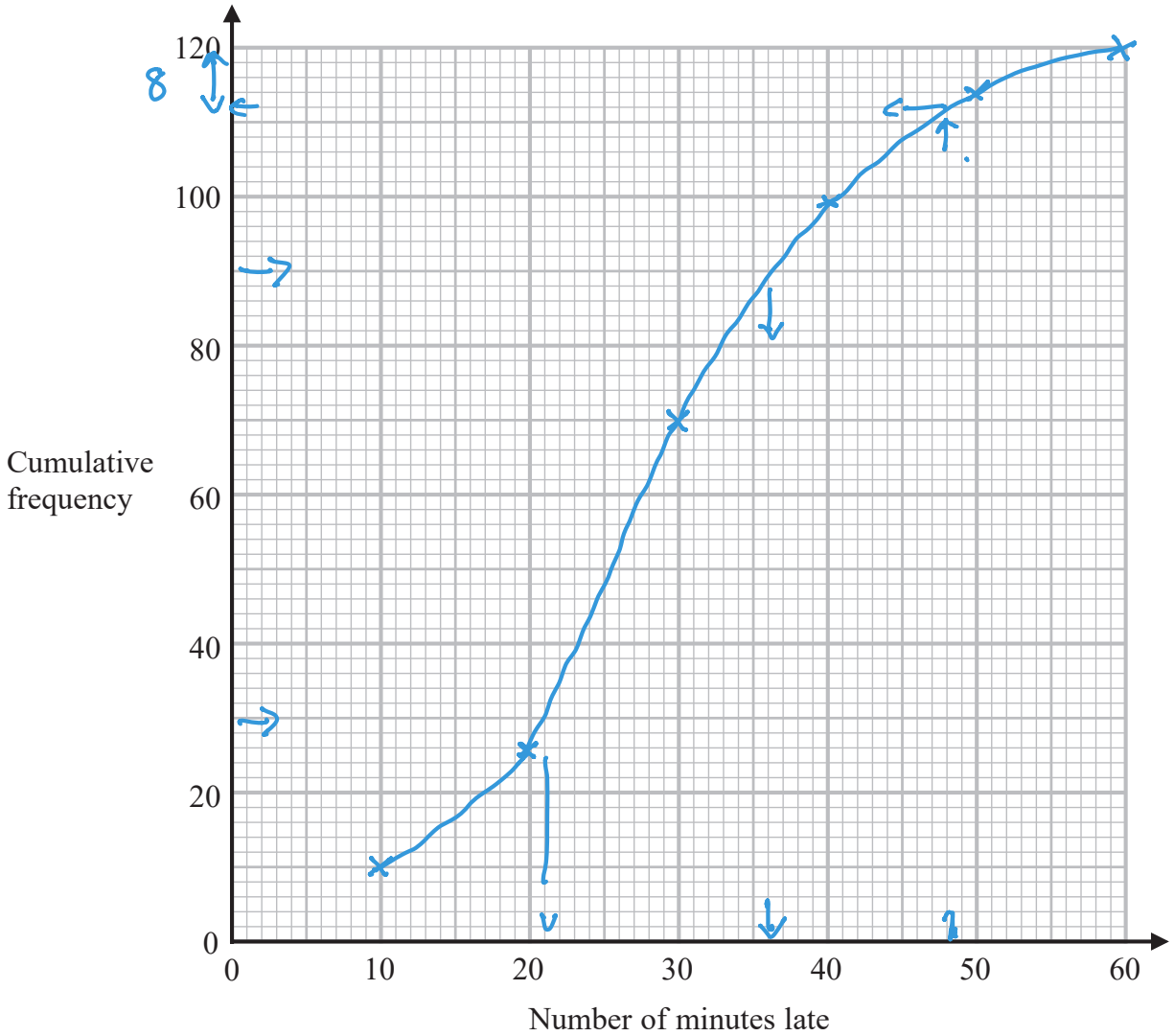
(a) Complete the cumulative frequency table below.

Number of minutes late ( $L$ )	Cumulative frequency
$0 < L \leq 10$	10
$0 < L \leq 20$	26
$0 < L \leq 30$	70
$0 < L \leq 40$	99
$0 < L \leq 50$	114
$0 < L \leq 60$	120

(1)



(b) On the grid, draw a cumulative frequency graph for your table.



(2)

(c) Use your graph to find an estimate for the interquartile range.

$LQ = 21$        $VQ = 36$   
 $IQR = 36 - 21$

..... <sup>15</sup> ..... minutes  
 (accept 14-18) (2)

(d) Use your graph to find an estimate for the number of buses that were more than 48 minutes late last Monday.

..... <sup>8</sup> .....  
 (accept 7-10) (2)

(Total for Question 10 is 7 marks)

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11 (a) Simplify fully  $(8e^{15})^{\frac{2}{3}}$

$$(\sqrt[3]{8})^2 e^{15 \times \frac{2}{3}}$$

$$4e^{10}$$

(2)

(b) Express  $\left(\frac{y}{2}\right)^{-4}$  in the form  $ay^n$  where  $a$  and  $n$  are integers.

$$\left(\frac{2}{y}\right)^4 = 2^4 y^{-4}$$

$$16y^{-4}$$

(2)

(c) Solve  $\frac{4x-2}{3} - \frac{5-3x}{4} = 6$

Show clear algebraic working.

$$12 \times \frac{4x-2}{3} - \frac{3(5-3x)}{4} = 12 \times 6$$

$$\Rightarrow 16x - 8 - 15 + 9x = 72$$

$$\Rightarrow 25x = 72 + 23$$

$$25x = 95$$

$$x = \frac{95}{25}$$

$$x = 3.8$$

(4)

(Total for Question 11 is 8 marks)

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12 Given that  $\frac{3^x}{9^{3x}} = 81$

$$9^{3x} = (3^2)^{3x} = 3^{6x}$$

$$81 = 3^4$$

find the value of  $x$ .

Show clear algebraic working.

$$\frac{3^x}{3^{6x}} = 3^4$$

$$3^{x-6x} = 3^4$$

so  $x - 6x = 4$

$$-5x = 4$$

$$x = -\frac{4}{5}$$

$$x = -0.8$$

(Total for Question 12 is 3 marks)

13 Use algebra to show that  $0.\overline{681} = \frac{15}{22}$

$$\begin{array}{r} 100x = 68.\overline{181} \\ x = 0.\overline{681} \\ \hline 99x = 67.5 \end{array}$$

$$99x = 67.5$$

$$x = \frac{67.5}{99}$$

$$x = \frac{675}{990}$$

$$\frac{675}{990} \stackrel{\div 45}{=} \frac{15}{22} \quad \text{as required.}$$

(Total for Question 13 is 2 marks)



14  $\mathcal{E} = \{\text{integers } x \text{ such that } 10 \leq x \leq 25\}$

$A = \{x : x < 18\}$

10 11 12 13 14 15 16 17

$B = \{x : 13 \leq x < 22\}$

13 14 15 16 17 18 19 20 21

(a) Write down  $n(A)$

8

(1)

(b) List the members of the set  $(A \cup B)'$

22 23 24 25

(2)

(c) List the members of the set  $A' \cap B$

$A' = 18 \ 19 \ 20 \ 21 \ 22 \ 23 \ 24 \ 25$   
✓ ✓ ✓ ✓

18 19 20 21

(2)

$C \subset A, C \subset B$  and  $n(C) = 5$

(d) List the members of the set  $C$

13 14 15 16 17

(1)

(Total for Question 14 is 6 marks)



15 Make  $x$  the subject of  $y = \frac{5-2x}{x+3}$

$$y(x+3) = 5-2x$$

$$yx + 3y = 5-2x$$

$$yx + 2x = 5-3y$$

$$x(y+2) = 5-3y$$

$$x = \frac{5-3y}{y+2}$$

$$x = \frac{5-3y}{y+2}$$

(Total for Question 15 is 4 marks)



16 Solve the simultaneous equations

$$\begin{aligned}3xy - y^2 &= 8 \\ x - 2y &= 1\end{aligned}$$

Show clear algebraic working.

$$x = 1 + 2y$$

$$3 \times (1 + 2y)y - y^2 = 8$$

$$(3 + 6y)y - y^2 = 8$$

$$3y + 6y^2 - y^2 - 8 = 0$$

$$5y^2 + 3y - 8 = 0$$

$$(5y + 8)(y - 1) = 0$$

$$y = -\frac{8}{5} \quad y = 1$$

$$x = 1 + 2\left(-\frac{8}{5}\right)$$

$$= -\frac{11}{5}$$

$$= -2.2$$

$$x = 1 + 2 \times 1$$

$$= 3$$

$$x = -2.2$$

$$y = -1.6$$

$$x = 3$$

$$y = 1$$

(Total for Question 16 is 5 marks)

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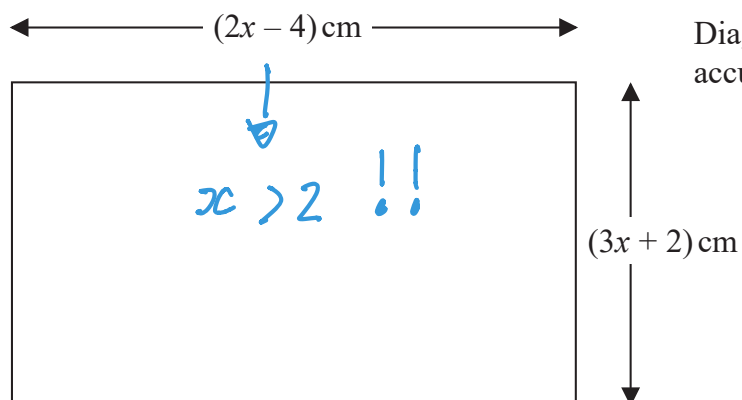
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17 The diagram shows a rectangle.



The area of the rectangle is  $A \text{ cm}^2$

Given that  $A < 3x + 27$   
find the range of possible values for  $x$ .

$$(2x - 4)(3x + 2) < 3x + 27$$

$$6x^2 + 4x - 12x - 8 - 3x - 27 < 0$$

$$6x^2 - 11x - 35 < 0$$

$$(2x - 7)(3x + 5) < 0$$

$$\downarrow$$

$$3.5$$

$$\downarrow$$

$$-\frac{5}{3}$$

not valid

$$2 < x < 3.5$$

(Total for Question 17 is 5 marks)



18 The diagram shows cuboid  $ABCDEFGH$ .

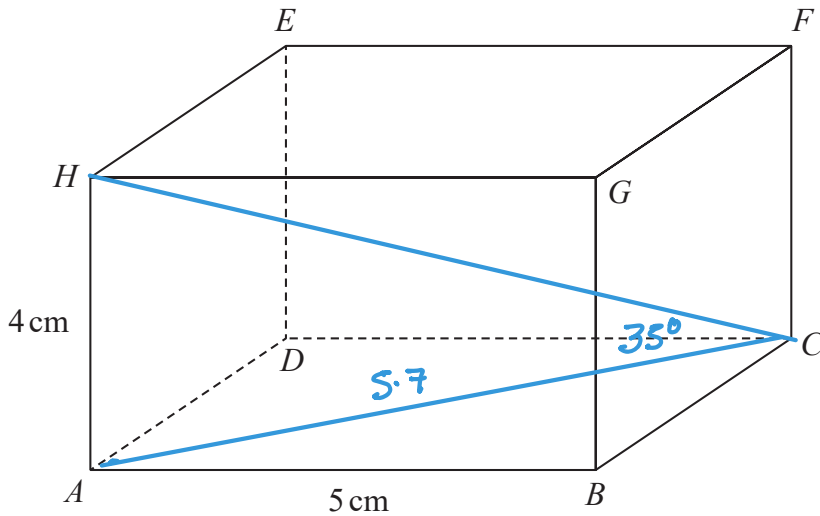


Diagram **NOT** accurately drawn

$$AB = 5 \text{ cm}$$

$$AH = 4 \text{ cm}$$

The size of the angle between  $CH$  and the plane  $ABCD$  is  $35^\circ$

Calculate the volume of the cuboid.

Give your answer correct to 3 significant figures.

$$\tan 35 = \frac{4}{AC}$$

$$AC = \frac{4}{\tan 35} = 5.7125 \dots$$

$$BC^2 = 5.71^2 - 5^2$$

$$= 7.6337$$

$$BC = \sqrt{7.6337}$$

$$= 2.76 \dots$$

$$\text{Volume} = 2.76 \dots \times 5 \times 4$$

$$= 55.2583 \dots$$

↑  
(3sf)

$$\dots 55.3 \dots \text{cm}^3$$

(Total for Question 18 is 5 marks)

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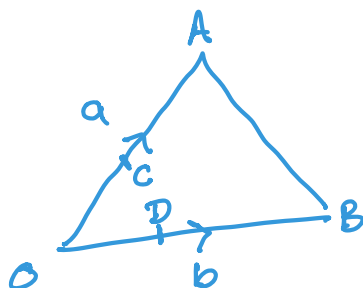
19  $OAB$  is a triangle.

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

The point  $C$  lies on  $OA$  such that  $OC : CA = 1 : 2$

The point  $D$  lies on  $OB$  such that  $OD : DB = 1 : 2$

Using a vector method, prove that  $ABDC$  is a trapezium.



$$\vec{AB} = \mathbf{b} - \mathbf{a}$$

$$\vec{OC} = \frac{1}{3}\mathbf{a}$$

$$\vec{OD} = \frac{1}{3}\mathbf{b}$$

$$\vec{CD} = \frac{2}{3}\mathbf{a} + (\mathbf{b} - \mathbf{a}) - \frac{2}{3}\mathbf{b}$$

$$= -\frac{1}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$$

$$= \frac{1}{3}(\mathbf{b} - \mathbf{a})$$

$\therefore \vec{CD} = \frac{1}{3}\vec{AB}$  so  $AB$  and  $CD$  are parallel and  $ABDC$  is a trapezium.

(Total for Question 19 is 3 marks)



20 A bag contains  $X$  counters.

There are only red counters and blue counters in the bag.

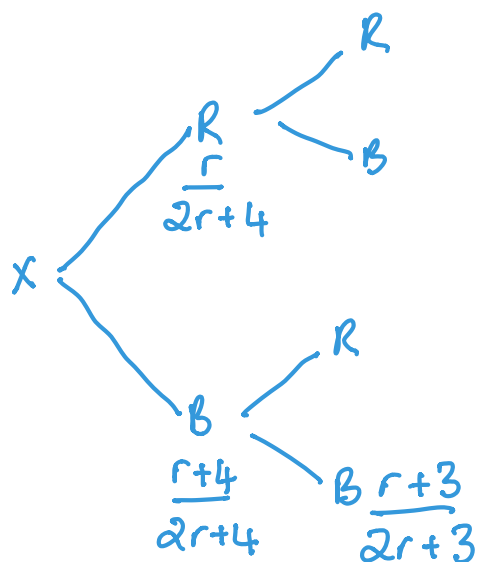
There are 4 more blue counters than red counters in the bag.

Finty takes at random 2 counters from the bag.

The probability that Finty takes 2 blue counters from the bag is  $\frac{3}{8}$

Work out the value of  $X$ .

Show clear algebraic working.



$$\text{if red} = r \quad \text{blue} = r + 4$$

$$\text{Total } X = 2r + 4$$

$$\frac{r+4}{2r+4} \times \frac{r+3}{2r+3} = \frac{3}{8}$$

$$\frac{(r+4)(r+3)}{(2r+4)(2r+3)} = \frac{3}{8}$$

$$\frac{r^2 + 7r + 12}{4r^2 + 6r + 8r + 12} = \frac{3}{8}$$

$$8(r^2 + 7r + 12) = 3(4r^2 + 14r + 12)$$

$$8r^2 + 56r + 96 = 12r^2 + 42r + 36$$

$$0 = 4r^2 - 14r - 60$$

$$2r^2 - 7r - 30 = 0$$

$$r = 6$$

$$\therefore X = 2 \times 6 + 4$$

$$= 16$$

16

(Total for Question 20 is 5 marks)



21 The function  $f$  is such that  $f(x) = 5 + 6x - x^2$  for  $x \leq 3$

(a) Express  $5 + 6x - x^2$  in the form  $p - (x - q)^2$  where  $p$  and  $q$  are constants.

$$\begin{aligned} & 5 - (x^2 - 6x) \\ &= 5 - [(x - 3)^2 - 9] \\ &= 5 - (x - 3)^2 + 9 \end{aligned}$$

14 - (x - 3)^2  
(2)

(b) Using your answer to part (a), find the range of values of  $x$  for which  $f^{-1}(x)$  is positive.

$$\begin{aligned} y &= 14 - (x - 3)^2 \\ (x - 3)^2 &= 14 - y \\ x &= 3 \pm \sqrt{14 - y} \\ f^{-1}(x) &= 3 \pm \sqrt{14 - x} \text{ but given } x \leq 3 \\ \text{so } f^{-1}(x) &= 3 - \sqrt{14 - x} \end{aligned}$$

$$0 = 3 - \sqrt{14 - x}$$

$$14 - x = 9$$

$$14 - 9 = x$$

$$x = 5$$

L bound      UB = 14

5 < x ≤ 14  
(5)

(Total for Question 21 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS

