Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | Candidate Number

Thursday 4 June 2020

Morning (Time: 2 hours) | Paper Reference **4MA1/2H**

Mathematics A

Paper 2H

Higher Tier

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.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators may be used.**
- You must **NOT** write anything on the formulae page.
  Anything you write on the formulae page will gain NO credit.

Information

- The total mark for this paper is 100.
- 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.
- Check your answers if you have time at the end.

Turn over ▶

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P 6 2 6 5 7 A 0 1 2 4

Pearson

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

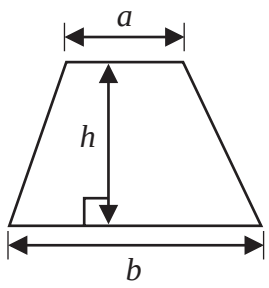
Sum to n terms, $S_n = \frac{n}{2}[2a + (n-1)d]$

The quadratic equation

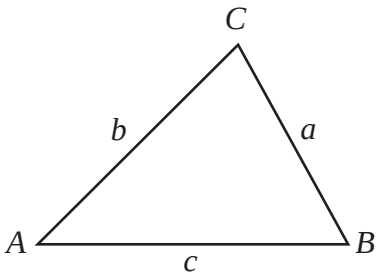
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Area of trapezium $= \frac{1}{2}(a + b)h$



Trigonometry



In any triangle *ABC*

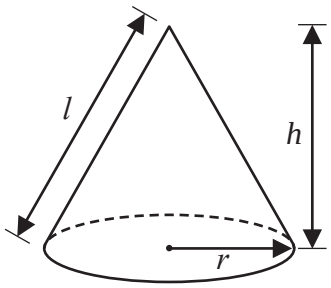
Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$

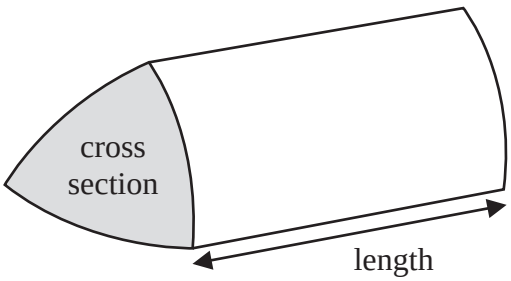
Area of triangle $= \frac{1}{2}ab\sin C$

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

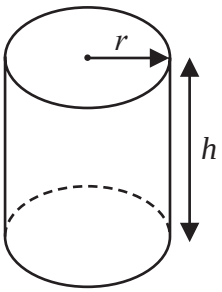
Curved surface area of cone $= \pi rl$



Volume of prism
= area of cross section × length

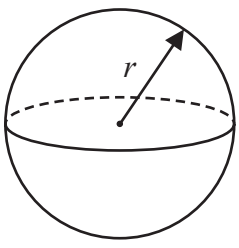


Volume of cylinder $= \pi r^2 h$
Curved surface area of cylinder $= 2\pi rh$



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

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



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 $g^6 \times g^4$

$g^6 \times g^4 = g^{6+4} = g^{10}$

g^{10} (1)

(1)

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

$\frac{k^{10}}{k^3} = k^{10-3} = k^7$

k^7 (1)

(1)

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

$(3cd^4)^2 = 3^2 \times c^2 \times d^{4\times 2}$ (1)

$= 9 \times c^2 \times d^8$

$= 9c^2d^8$ (1)

$9c^2d^8$

(2)

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

$4x + 7 > 2$

$4x > 2 - 7$ (−7)

$4x > -5$ (1)

$x > -\frac{5}{4}$ (÷4) (1)

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

(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
$20 < L \leqslant 30$	6
$30 < L \leqslant 40$	26
$40 < L \leqslant 50$	31
$50 < L \leqslant 60$	40
$60 < L \leqslant 70$	17

(a) Write down the modal class.

↳ class with highest frequency

$50 < L \leqslant 60$ (1)

.....

(1)

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

$$\text{mean} = \frac{\text{sum of median} \times \text{frequency}}{\text{total frequency}}$$

$$\text{mean} = \frac{(25 \times 6) + (35 \times 26) + (45 \times 31) + (55 \times 40) + (65 \times 17)}{120} \quad (1)$$

$$= \frac{150 + 910 + 1395 + 2200 + 1105}{120} \quad (1)$$

$$= \frac{5760}{120} \quad (1) = 48 \quad (1)$$

48 minutes

.....

(4)

(Total for Question 2 is 5 marks)

3

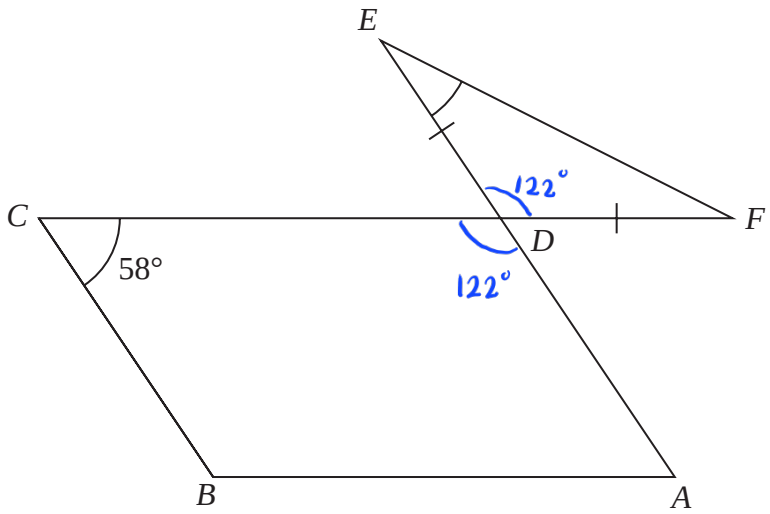


Diagram **NOT** accurately drawn

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

CDF and *ADE* are straight lines.
Angle *BCD* = 58°

Work out the size of angle *DEF*.
Give a reason for each stage of your working.

angle ADC = $180^\circ - 58^\circ$

$= 122^\circ$ (1)

(co-interior angles add up to 180°) (1)

angle EDF = angle ADC = 122°

(vertically opposite angles are equal)

angle DEF = $\frac{180^\circ - 122^\circ}{2}$ (1) = $\frac{58^\circ}{2}$ ← (base angles in isosceles are the same)

$= 29^\circ$ (1)

(angles in triangle adds up to 180°) (1)

29 °

(Total for Question 3 is 5 marks)

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.

Let : Andreas = $3x$

Isla = $2x$

Paulo = $5x$

$\therefore 5x + 2x - 3x = £76$

$x = £19$ (1)

Andreas has $3x \rightarrow 3 \times £19$

$= £57$ (1)

∴ Money Andreas has after buying video game :

$£57 - £48.50$ (1)

$= £8.50$ (1)

£ 8.50

(Total for Question 4 is 4 marks)

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.

$3\,130\,000 + \frac{4}{100} \times 3\,130\,000$ (1)

$= 3\,130\,000 + 125\,200$ (1)

$= 3255\,200$ (1)

3 255 200 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.

Initial value : 750 000 JPY

End of year 1 : $\frac{85}{100} \times 750\,000$ JPY $= 637\,500$ JPY (1)

End of year 2 : $\frac{85}{100} \times 637\,500$ JPY $= 541\,875$ JPY (1)

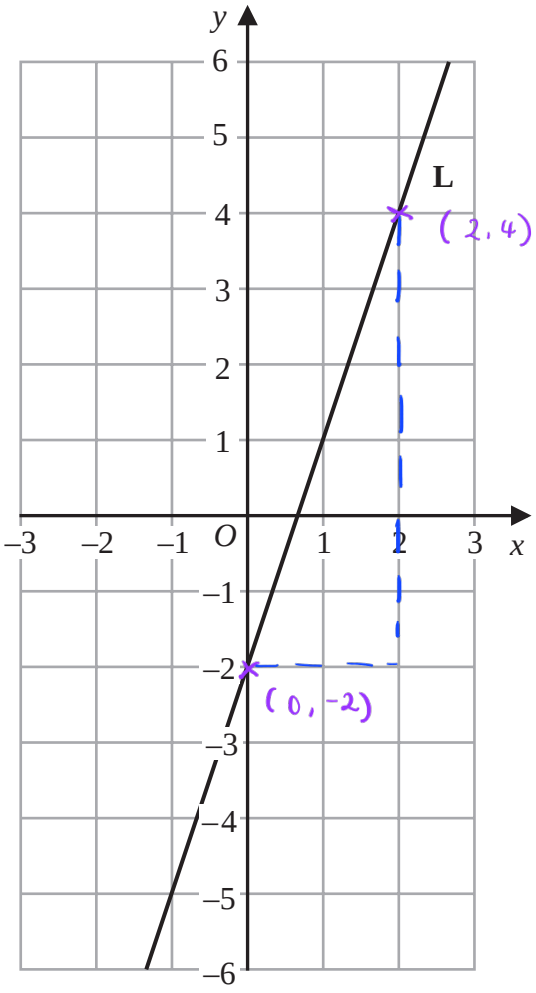
End of year 3 : $\frac{85}{100} \times 541\,875$ JPY $= 460\,594$ JPY (1)

460 594 JPY

(3)

(Total for Question 5 is 6 marks)

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



Find an equation for **L**.

$m = \frac{y_2 - y_1}{x_2 - x_1}$

y-intercept = −2

$m = \frac{4 - (-2)}{2 - 0} = \frac{6}{2} = 3$ (1)

$y = mx + c$

$y = 3x - 2$ (1)

$y = 3x - 2$

(Total for Question 6 is 2 marks)

7 The diagram shows a right-angled triangle.

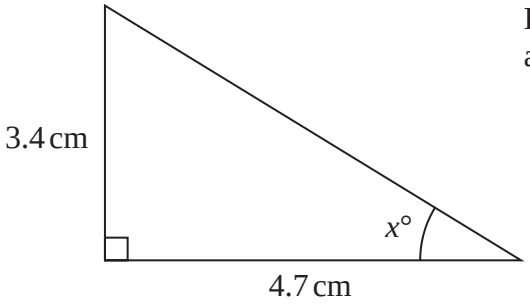


Diagram **NOT** accurately drawn

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

$\tan x^\circ = \frac{3.4 \text{ cm}}{4.7 \text{ cm}}$ (1)

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

$= 35.9^\circ$ (1)

$x =$ 35.9

(Total for Question 7 is 3 marks)

8 The diagram shows an isosceles triangle.

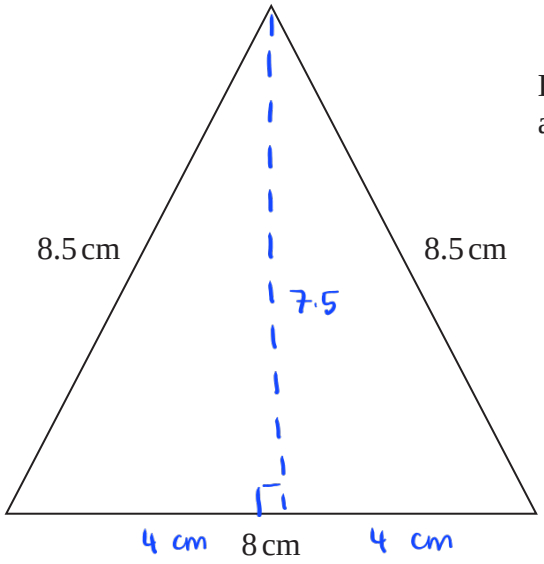


Diagram **NOT** accurately drawn

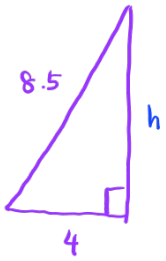
Work out the area of the triangle.

By using Pythagoras theorem :

$h = \sqrt{8.5^2 - 4^2}$

$= \sqrt{56.25}$ (1)

$= 7.5$ cm (1)



Area of triangle : $\frac{1}{2}$ x base x height

$= \frac{1}{2} \times 8 \text{ cm} \times 7.5 \text{ cm}$ (1)

$= 30 \text{ cm}^2$ (1)

30 ..... cm^2

(Total for Question 8 is 4 marks)

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

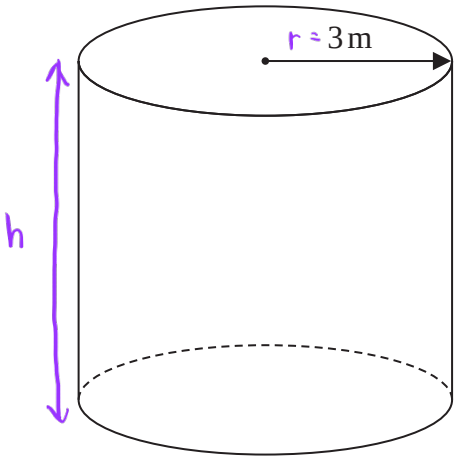


Diagram **NOT** accurately drawn

The volume of the cylinder is 72π m^3

Volume of cylinder = $\pi r^2 h$

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

Volume = $72\pi = \pi \times 3^2 \times h$ (1)

$h = \frac{72\pi}{9\pi} = 8$ m (1)

Area of base = $\pi \times r^2 = \pi \times 3^2$
$= 9\pi$

2 bases = $2 \times 9\pi$
$= 18\pi$

Area of lateral face = $2 \times \pi \times r \times h$
$= 2 \times \pi \times 3 \times 8$
$= 48\pi$ (1)

Total surface area = $18\pi + 48\pi$
$= 66\pi = 207$ m^2 (1)
(1)

207 ..... m^2

(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.

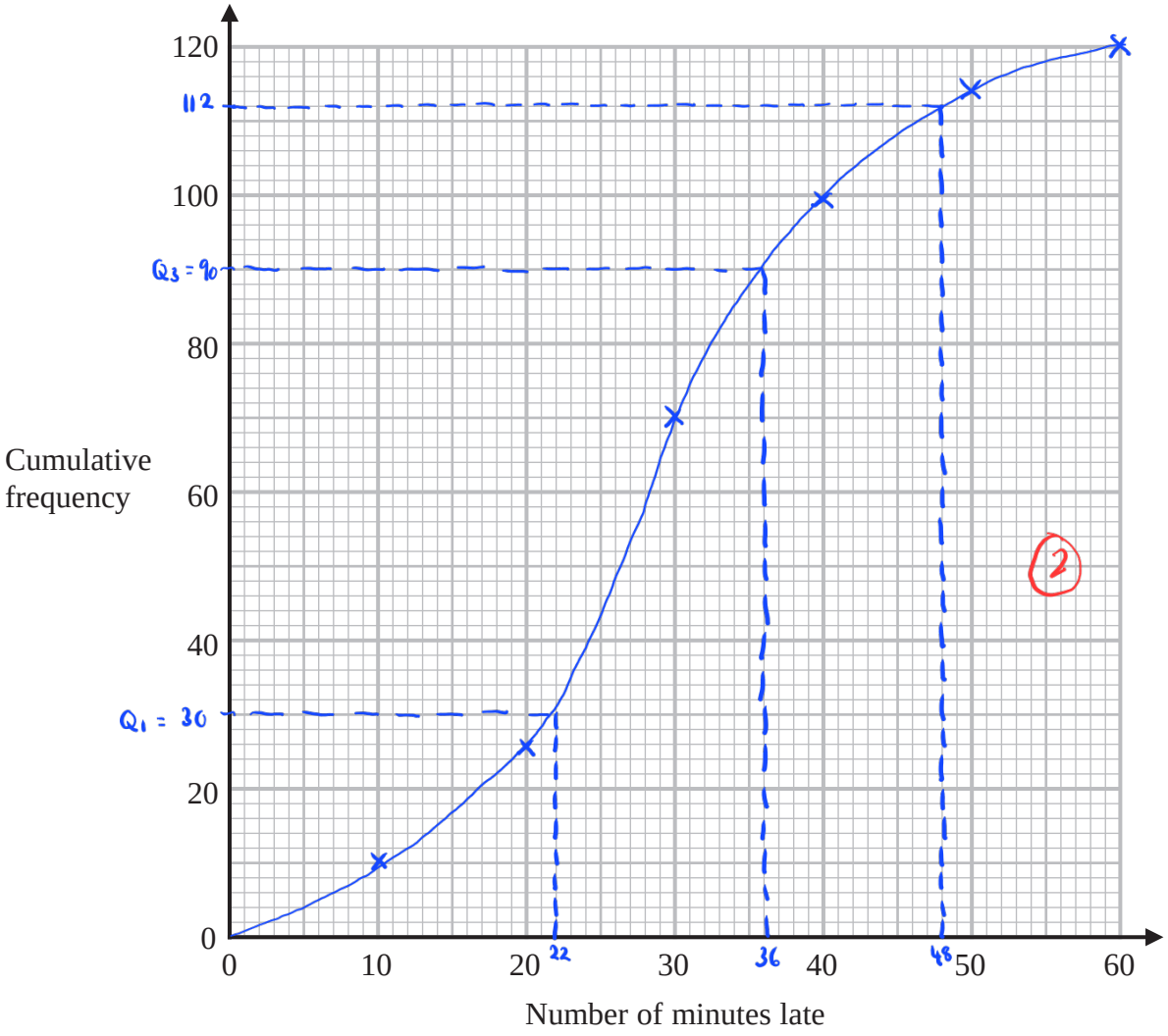
Number of minutes late (L)	Frequency
$0 < L \leqslant 10$	10
$10 < L \leqslant 20$	16
$20 < L \leqslant 30$	44
$30 < L \leqslant 40$	29
$40 < L \leqslant 50$	15
$50 < L \leqslant 60$	6

(a) Complete the cumulative frequency table below.

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

$Q_1 = \frac{1}{4} \times 120 = 30$th
$= 22$ (from graph)

$Q_3 = \frac{3}{4} \times 120 = 90$th
$= 36$ (from graph)
(1)

IQR $= Q_3 - Q_1$
$= 36 - 22 = 14$ (1)

14 minutes

(2)

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

More than 48 minutes $= 120 - 112$ (1)
$= 8$ (1)

8

(2)

(Total for Question 10 is 7 marks)

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

$(8e^{15})^{\frac{2}{3}} = 8^{\frac{2}{3}} \times e^{\frac{2}{3}(15)}$

$= 4 \times e^{10}$

$= 4e^{10}$

$4e^{10}$

(2)

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

$\left(\frac{y}{2}\right)^{-4} = \frac{y^{-4}}{2^{-4}}$ (1)

$= \frac{16}{y^4} = 16y^{-4}$ (1)

$16y^{-4}$

(2)

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

Show clear algebraic working.

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

$(4x-2) \times 4 - (5-3x) \times 3 = 6 \times 4 \times 3$ (1)

$16x - 8 - 15 + 9x = 72$ (1)

$25x = 95$ (1)

$x = \frac{95}{25} = 3.8$ (1)

$x =$ 3.8

(4)

(Total for Question 11 is 8 marks)

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

find the value of x.
Show clear algebraic working.

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

$= 3^{6x}$

$81 = 3^4$

$\therefore \frac{3^x}{9^{3x}} = 81 \rightarrow \frac{3^x}{3^{6x}} = 3^4$ (1)

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

$x - 6x = 4$ (1)

$-5x = 4$

$x = -\frac{4}{5} = -0.8$ (1)

$x =$ −0.8

(Total for Question 12 is 3 marks)

13 Use algebra to show that $0.6\dot{8}\dot{1} = \frac{15}{22}$

Let $x = 0.6\dot{8}\dot{1}$

$10x = 6.\dot{8}\dot{1}$

$100x = 68.\dot{1}\dot{8}$

$100x - x = 68.\dot{1}\dot{8} - 0.6\dot{8}\dot{1}$ (1)

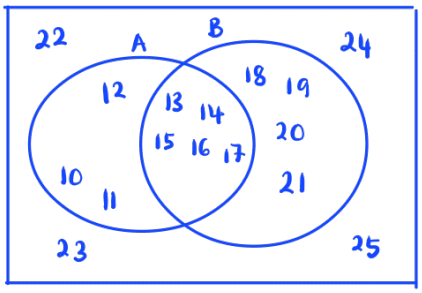
$99x = 67.5$

$x = \frac{67.5}{99}$ (1)

$= \frac{15}{22}$ (shown)

(Total for Question 13 is 2 marks)

14 $\mathscr{E}$ = {integers x such that $10 \leqslant x \leqslant 25$}
$A = \{x : x < 18\}$
$B = \{x : 13 \leqslant x < 22\}$



(a) Write down n(A)

10, 11, 12, 13, 14, 15, 16, 17

8 (1)

(1)

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

↳ is not in A or B

22, 23, 24, 25 (1)

(2)

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

↳ is not in A and is in B

18, 19, 20, 21 (1)

(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)

(1)

(Total for Question 14 is 6 marks)

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

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

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

$$yx + 3y = 5 - 2x \quad (1)$$

$$yx + 2x = 5 - 3y \quad (1)$$

$$x(y+2) = 5 - 3y \quad (1)$$

$\div\ y+2$

$$x = \frac{5 - 3y}{y+2} \quad (1)$$

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

(Total for Question 15 is 4 marks)

16 Solve the simultaneous equations

$$3xy - y^2 = 8 \quad -(1)$$
$$x - 2y = 1$$

Show clear algebraic working.

$x = 1 + 2y \quad -(2)$

Substitute (2) into (1) :

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

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

$5y^2 + 3y - 8 = 0$ (1)

$$y = \frac{-3 \pm \sqrt{3^2 - 4(5)(-8)}}{2(5)}$$ (1)

$$= \frac{-3 \pm \sqrt{169}}{10}$$

$$= \frac{-3 \pm 13}{10}$$

$y = 1$ or $y = -\frac{8}{5}$ - substitute into (2)

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

$= 3$ $\quad = -\frac{11}{5}$

(1)

$x = 3, y = 1$ and $x = -\frac{11}{5}, y = \frac{-8}{5}$

(Total for Question 16 is 5 marks)

17 The diagram shows a rectangle.

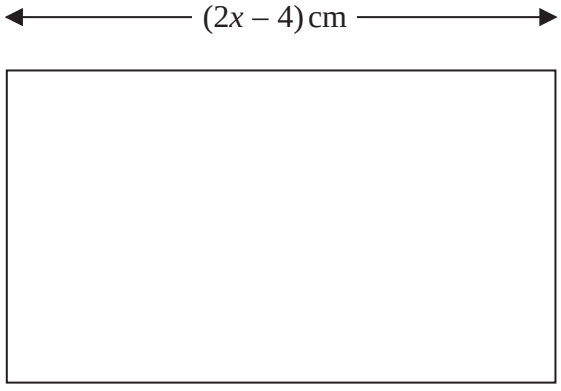


Diagram **NOT** accurately drawn

The area of the rectangle is A cm^2

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

Area of rectangle = $A = (2x-4)(3x+2)$

$A = 6x^2 - 8x - 8$

Given : $A < 3x + 27$

$\therefore 6x^2 - 8x - 8 < 3x + 27$ (1)

$\therefore 6x^2 - 11x - 35 < 0$ (1)

$x = \dfrac{11 \pm \sqrt{11^2 - 4(6)(-35)}}{2(6)}$ (1)

$= \dfrac{11 \pm \sqrt{961}}{12}$

$= \dfrac{11 \pm 31}{12}$

$\therefore x = \dfrac{42}{12} = \dfrac{7}{2}$ or $x = \dfrac{-20}{12} = \dfrac{-5}{3}$ (1) (length of side will be negative)

$\therefore$ Since length of sides cannot be ≤ 0,

$\therefore x > 2$ hence, $2 < x < \dfrac{7}{2}$ (1)

↑ comes from inequalities $2x - 4 > 0$

$2 < x < \dfrac{7}{2}$

(Total for Question 17 is 5 marks)

18 The diagram shows cuboid *ABCDEFGH*.

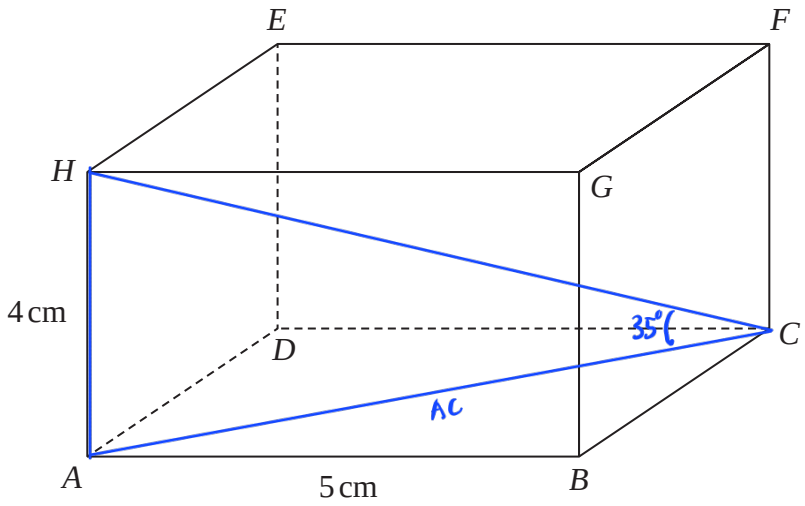


Diagram **NOT** accurately drawn

AB = 5 cm
AH = 4 cm
The size of the angle between *CH* and the plane *ABCD* is 35°

Calculate the volume of the cuboid.
Give your answer correct to 3 significant figures.

① Find length BC

② Volume = $4 \times 5 \times BC$

$\tan 35^\circ = \frac{4\text{ cm}}{AC}$ (1)

$AC = \frac{4\text{ cm}}{\tan 35^\circ}$

$= 5.71\text{ cm}$ (1)

$AC^2 = AB^2 + BC^2$

$BC^2 = AC^2 - AB^2$

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

$BC = \sqrt{5.71^2 - 5^2}$ (1)

$= 2.76\ldots$

Volume of cuboid : $4 \times 5 \times 2.76$ (1)

$= 55.3$ (1)

55.3 ..... cm^3

(Total for Question 18 is 5 marks)

19 *OAB* is a triangle.

$\overrightarrow{OA} = \mathbf{a}$ $\overrightarrow{OB} = \mathbf{b}$

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.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= -\underline{a} + \underline{b}$ (1)

$\overrightarrow{CD} = \overrightarrow{CA} + \overrightarrow{AB} + \overrightarrow{BD}$

$= \frac{2}{3}\underline{a} + (-\underline{a} + \underline{b}) + (-\frac{2}{3}\underline{b})$

$= \frac{2}{3}\underline{a} - \underline{a} + \underline{b} - \frac{2}{3}\underline{b}$

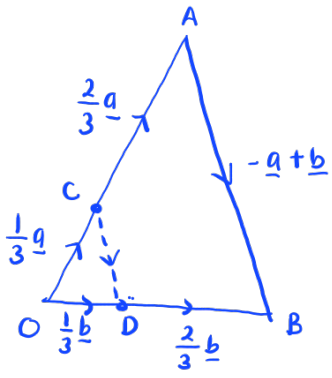
$= -\frac{1}{3}\underline{a} + \frac{1}{3}\underline{b}$

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

$= \frac{1}{3}(\overrightarrow{AB})$ (1)

∴ since $\overrightarrow{AB}$ and $\overrightarrow{CD}$ are parallel,

ABDC is a trapezium. (1)



(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.

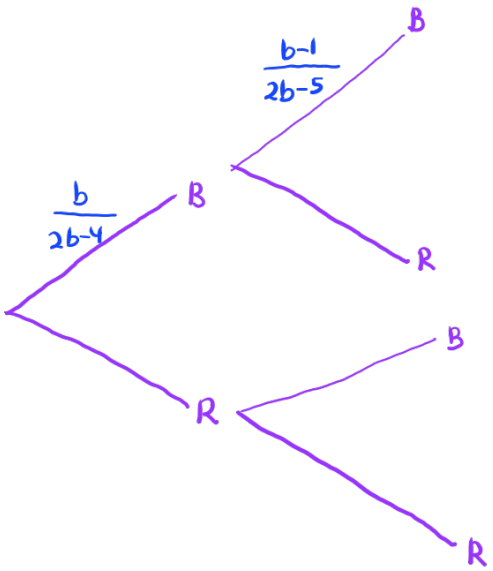
The probability that Finty takes 2 blue counters from the bag is $\frac{3}{8}$

Work out the value of X.
Show clear algebraic working.

$b + r = x$ $\quad b = r + 4$

$b + b - 4 = x$ $\quad b - 4 = r$

$2b - 4 = x$



$\left(\frac{b}{2b-4}\right)\left(\frac{b-1}{2b-5}\right) = \frac{3}{8}$ (1) (1)

$8b(b-1) = 3(2b-4)(2b-5)$

$8b^2 - 8b = 3(4b^2 - 10b - 8b + 20)$ (1)

$8b^2 - 8b = 12b^2 - 54b + 60$

$12b^2 - 8b^2 - 54b + 8b + 60 = 0$

$4b^2 - 46b + 60 = 0$

$2b^2 - 23b + 30 = 0$ $\quad \div 2$ (1)

$(2b - 3)(b - 10) = 0$

$b = \frac{3}{2}$ or $b = 10$

substitute b values into $(2b - 4 = x)$

$2\left(\frac{3}{2}\right) - 4 = x$ $\quad$ x has to be positive integers

$x = -1$ (not possible)

$2(10) - 4 = x$

$x = 16$ (1)

16

(Total for Question 20 is 5 marks)

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

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

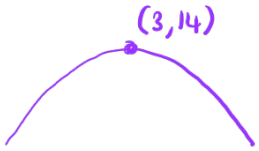
$-x^2 + 6x + 5$

$-(x^2 - 6x - 5)$

$-[(x-3)^2 - 9 - 5]$ (1)

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

$\therefore 14 - (x-3)^2$ (1) where $p = 14$, $q = 3$



$14 - (x-3)^2$

(2)

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

$f(x) = 14 - (x-3)^2$

Range of $f^{-1}(x)$

$y \leq 3$

Let $f(x) = y$: $y = 14 - (x-3)^2$ (1)

Find x in terms of y

$y = 14 - (x-3)^2$

$y - 14 = -(x-3)^2$

$(x-3)^2 = 14 - y$

$x - 3 = \pm\sqrt{14-y}$

$x = 3 \pm \sqrt{14-y}$ (1)

$f^{-1}(x) = 3 - \sqrt{14-x}$ — since y should be ≤ 3 (1)

If $f^{-1}(x) > 0$

$3 - \sqrt{14-x} > 0$ (1)

$3 > \sqrt{14-x}$

$9 > 14 - x$

$x > 5$

or

$3 - \sqrt{14-x} \leq 3$

$0 \leq \sqrt{14-x}$

$x \leq 14$

$\therefore$ Hence, $5 < x \leq 14$ (1)

$5 < x \leq 14$

(5)

(Total for Question 21 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS

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