Answer ALL TWENTY FOUR questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Here are some integers where $a < b < c < d$

$a \quad b \quad c \quad d \quad d \quad d$

The mode of the integers is 9
The median of the integers is 8
The range of the integers is 4

Work out the value of a, the value of b, the value of c and the value of d

a b c 9 9 9

↑ median = 8 so c = 7

a b 7 9 9 9

range = 4 so a = 9 − 4 = 5

5 b 7 9 9 9

∴ b = 6

$a =$ 5

$b =$ 6

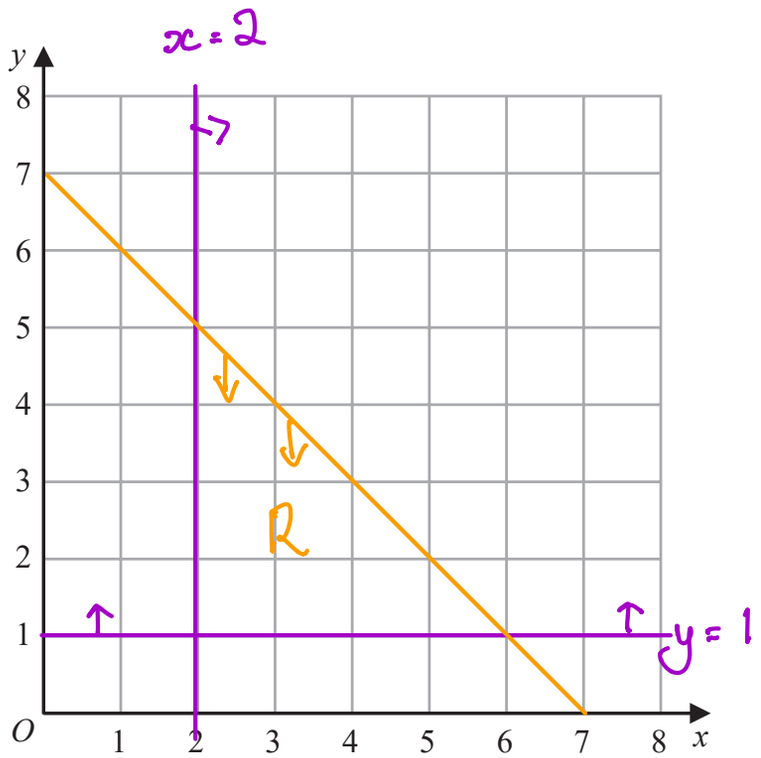
$c =$ 7

$d =$ 9

(Total for Question 1 is 3 marks)

2 (a) On the grid, draw and label with its equation the straight line with equation

(i) $y = 1$ (ii) $x = 2$ (iii) $x + y = 7$



(3)

(b) Show, by shading on the grid, the region that satisfies **all three** of the inequalities

$y \geqslant 1$ $x \geqslant 2$ $x + y \leqslant 7$

Label the region **R**.

(1)

(Total for Question 2 is 4 marks)

3 An aeroplane travelled from New York City to Los Angeles.

The aeroplane travelled a distance of 3980 kilometres in 5 hours 24 minutes.

Work out the average speed of the aeroplane.
Give your answer in kilometres per hour correct to the nearest whole number.

= 324 minutes

$S = \frac{3980}{324} \times 60$

$= 737.03...$ km/hr.

737 kilometres per hour

(Total for Question 3 is 3 marks)

4 Show that $5\frac{1}{3} - 2\frac{6}{7} = 2\frac{10}{21}$

$5\frac{1}{3} = \frac{16}{3}$ $\quad \frac{16}{3} = \frac{112}{21}$

$2\frac{6}{7} = \frac{20}{7}$ $\quad \frac{20}{7} = \frac{60}{21}$

$\frac{112}{21} - \frac{60}{21} = \frac{52}{21}$

21
42.

$\frac{52}{21} = 2\frac{10}{21}$ as required.

(Total for Question 4 is 3 marks)

5 The diagram shows an 8-sided shape *ABCDEFGH*.

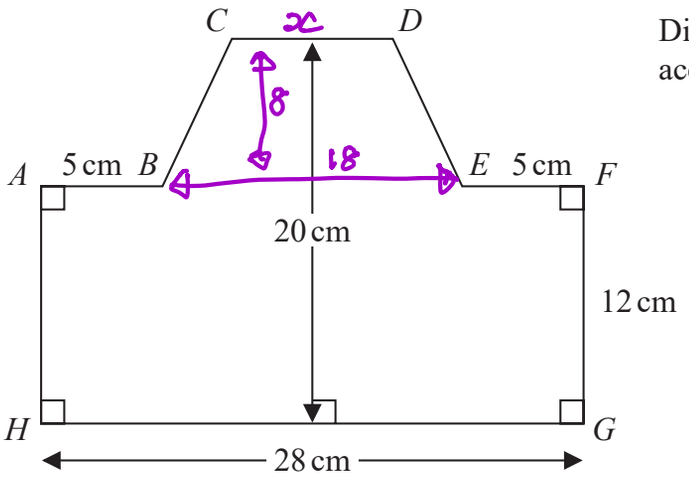


Diagram **NOT** accurately drawn

HG = 28 cm *FG* = 12 cm *AB* = *EF* = 5 cm
The height of the shape is 20 cm
CD is parallel to *HG*

The area of shape *ABCDEFGH* is 434 cm^2

Find the length of *CD*.

$434 = 12 \times 28 + \frac{1}{2}(18 + x) \times 8^{4}$

$\frac{434 - 336}{4} = 18 + x$

$\therefore \quad x = \frac{98}{4} - 18$

$= 6.5$

6.5 ..... cm

(Total for Question 5 is 4 marks)

6 The diagram shows triangle PQR.

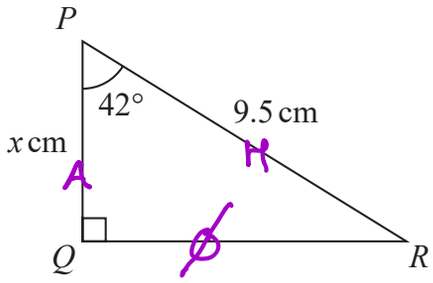


Diagram **NOT** accurately drawn

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

$\cos 42 = \frac{x}{9.5}$

$x = 9.5 \times \cos 42$

$= 7.059...$

$1\text{dp} \Rightarrow 7.1$

$x =$ 7.1

(Total for Question 6 is 3 marks)

7 Change a speed of 81 kilometres per hour to a speed in metres per second.

81 km/hr = 81000 m/hr

so 81000 m = 3600 seconds) ÷3600

22.5 m = 1 second

22.5 metres per second

(Total for Question 7 is 3 marks)

8 Behnaz makes 300 celebration cards so that

$$\text{number of birthday cards} : \text{number of anniversary cards} : \text{number of congratulations cards} = 7:5:3$$

$\frac{2}{5}$ of the birthday cards have numbers on them.
36% of the anniversary cards have numbers on them.
None of the congratulations cards have numbers on them.

Work out what fraction of the 300 cards have numbers on them.
Give your answer in its simplest form.

B A C
7 5 3 = 15
$\frac{7}{15}$ $\frac{5}{15}$ $\frac{3}{15}$

x20

140 : 100 : 60 = 300

#'s $\frac{2}{5} \times 140 + 0.36 \times 100 + 0$

$= 56 + 36 + 0$

So $= \frac{92}{300}$

$\frac{92}{300} = \frac{23}{75}$

$\frac{23}{75}$

(Total for Question 8 is 5 marks)

9 Pasha invests 50 000 dollars in a savings account for 4 years.
He gets 1.3% per year compound interest.

Work out how much money Pasha will have in his savings account at the end of 4 years.
Give your answer correct to the nearest dollar.

50000×1.013^4

$= 52651.14$

nearest dollar = 52651

52651 dollars

(Total for Question 9 is 3 marks)

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10 Solve the simultaneous equations

$$7x + 3y = 3 \quad (1)$$
$$3x - y = 7 \quad (2) \times 3$$

Show clear algebraic working.

$7x + 3y = 3$ (1)

$9x - 3y = 21$ (3)

(3) + (1) $16x = 24$

$x = \frac{24}{16} = 1.5$

sub into (2)

$3 \times \frac{3}{2} - y = 7$

$y = \frac{9}{2} - 7$

$= -\frac{5}{2}$

$x =$ 3/2 (1.5)

$y =$ -5/2 (-2.5)

(Total for Question 10 is 3 marks)

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11 (i) Factorise $x^2 + 5x - 24$

1, 24

2, 12

3, 8 ✓

$(x + 8)(x - 3)$

$(x + 8)(x - 3)$

(2)

(ii) Hence, solve $x^2 + 5x - 24 = 0$

$x = -8$ $x = 3$

(1)

(Total for Question 11 is 3 marks)

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12 Larry is a delivery man.

He has 7 parcels to deliver.
The mean weight of the 7 parcels is 2.7 kg

Larry delivers 3 of the parcels.
Each of these 3 parcels has a weight of W kg

The mean weight of the other 4 parcels is 3.3 kg

Work out the value of W

7 parcels → mean = 2.7

Total = $2.7 \times 7 = 18.9$ kg

$18.9 - 3W = 4(3.3)$

$18.9 - 13.2 = 3W$

$W = \frac{5.7}{3}$

$= 1.9$

$W =$ 1.9

(Total for Question 12 is 3 marks)

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13 The table gives information about the ages, in years, of 80 people in a train carriage.

Age (a years)	Frequency
$0 < a \leqslant 20$	7
$20 < a \leqslant 30$	25
$30 < a \leqslant 40$	20
$40 < a \leqslant 50$	14
$50 < a \leqslant 60$	8
$60 < a \leqslant 70$	6

(a) Complete the cumulative frequency table.

Age (a years)	Cumulative frequency
$0 < a \leqslant 20$	7
$0 < a \leqslant 30$	32
$0 < a \leqslant 40$	52
$0 < a \leqslant 50$	66
$0 < a \leqslant 60$	74
$0 < a \leqslant 70$	80

(1)

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

(2)

(c) Use your graph to find an estimate for the median age of the 80 people.

dependent on your graph

34 ..... years

(1)

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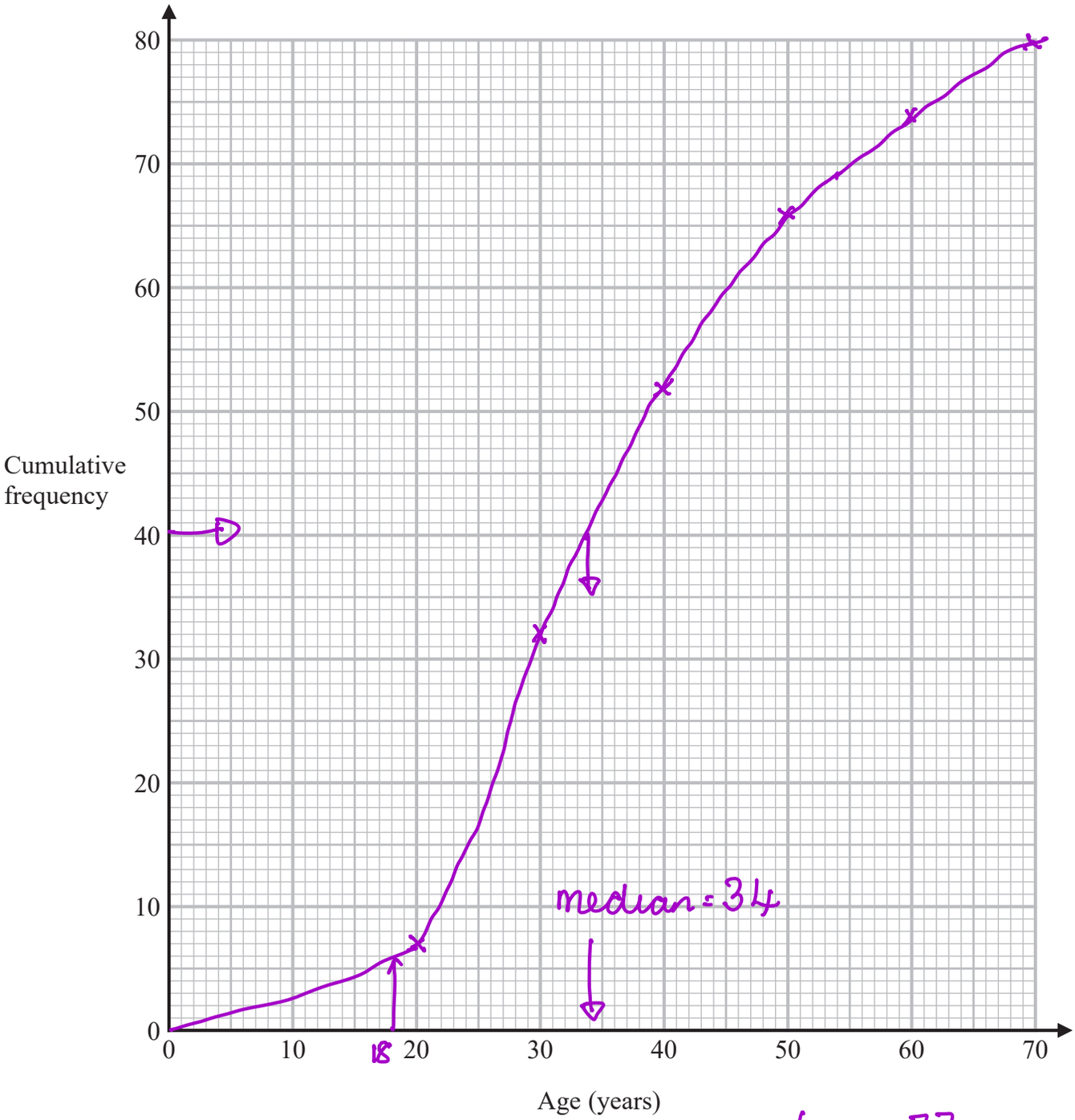


$b_2 = 77$

Of the people in the train carriage, 60% of those who are aged between 18 and 65 are going to work. None of the other people in the train carriage are going to work.

(d) Use your graph to find an estimate for the number of people in the train carriage who are going to work.

$77 - 6 = 71$

$0.6 \times 71 = 42.6$

eg → 43 .....

(3)

(Total for Question 13 is 7 marks)

14 (a) Expand and simplify $(5 - x)(2x + 3)(x + 4)$
Show your working clearly.

$(5-x)(2x^2+8x+3x+12)$

$= (5-x)(2x^2+11x+12)$

$= 10x^2 + 55x + 60 - 2x^3 - 11x^2 - 12x$

$= -2x^3 - x^2 + 43x + 60$

$-2x^3-x^2+43x+60$

(3)

(b) Make c the subject of $g = \frac{c+3}{4+c} - 7$

$g(4+c) = c+3-7(4+c)$

$4g + gc = c + 3 - 28 - 7c$

$gc - c + 7c = -25 - 4g$

$gc + 6c = -25 - 4g$

$c(g+6) = -(4g+25)$

$c = \frac{-(4g+25)}{g+6}$

$c = \frac{-(4g+25)}{g+6}$

(4)

(Total for Question 14 is 7 marks)

15 (a) Solve $\frac{4x+5}{3} - \frac{3-2x}{2} = 13$

Show clear algebraic working.

$2(4x+5) - 3(3-2x) = 78$

$8x + 10 - 9 + 6x = 78$

$14x = 77$

$x = \frac{77}{14}$

$= 5.5$

$x =$ 5.5

(4)

(b) Solve the inequality $2y^2 - 7y - 30 \leqslant 0$

Show your working clearly.

$2 \times 30 = 60$

1, 60
2, 30
3, 20
4, 15
5, 12

$2y^2 - 12y + 5y - 30 \leq 0$

$2y(y-6) + 5(y-6) \leq 0$

$(2y+5)(y-6) \leq 0$

$-2.5 \qquad 6$

$-2.5 \leq y \leq 6$

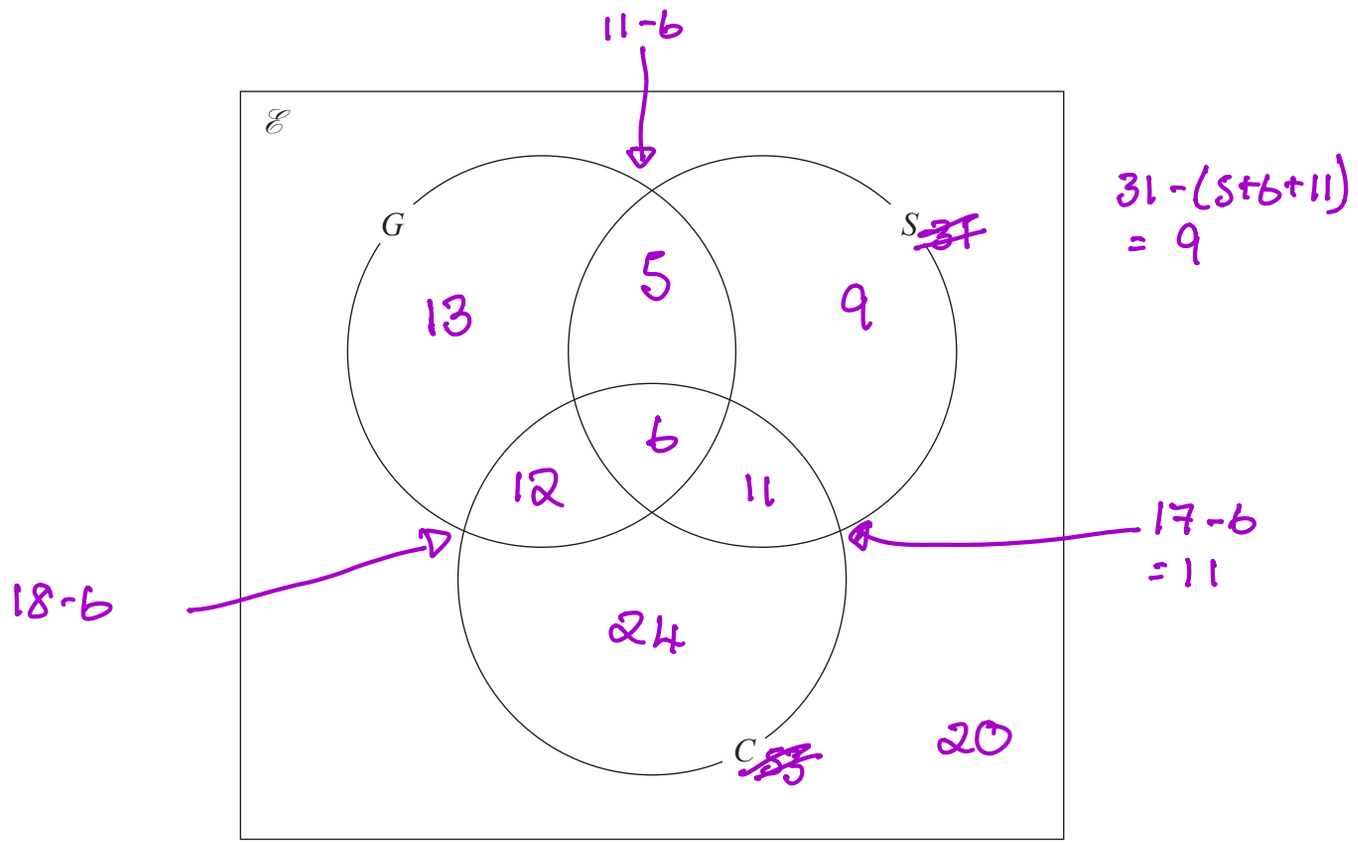
(3)

(Total for Question 15 is 7 marks)

16 100 farmers are asked if they have goats (G), sheep (S) or chickens (C) on their farms.

Of these farmers
- 31 have sheep
- 53 have chickens
- 6 have goats, sheep and chickens
- 11 have sheep and goats
- 17 have sheep and chickens
- 18 have goats and chickens
- 20 do not have any goats, sheep or chickens

(a) Using this information, complete the Venn diagram to show the number of farmers in each appropriate subset.



(3)

(b) Find

(i) n(G) $13 + 5 + 6 + 12 =$

36

(1)

(ii) n($[G \cup S]'$)

44

(1)

(iii) n($G' \cap C$)

35

(1)

One of the farmers who has chickens is chosen at random.

(c) Find the probability that this farmer also has goats.

$\frac{18}{53}$

(2)

(Total for Question 16 is 8 marks)

17 M varies directly as the cube of h
$M = 4$ when $h = 0.5$

Find the value of h when $M = 500$

$M \propto h^3 \qquad M = kh^3$

$4 = k \times 0.5^3$

$k = \frac{4}{0.5^3} = 32$

$\therefore \quad M = 32h^3$

when $M = 500 \quad \frac{500}{32} = h^3$

$\therefore h = \sqrt[3]{500/32}$

$= \frac{5}{2}$ 2.5

(Total for Question 17 is 4 marks)

18 $X = \dfrac{2a - b}{f}$

$a = 7.5$ correct to 1 decimal place.
$b = 3.42$ correct to 2 decimal places.
$f = 2$ correct to the nearest whole number.

Work out the upper bound of the value of X
Show your working clearly.

$a = 7.5$
$7.45 \swarrow \quad \searrow 7.55$

$b = 3.42$
$3.415 \swarrow \quad \searrow 3.425$

$f = 2$
$1.5 \swarrow \quad \searrow 2.5$

$$X_{UB} = \frac{2UB - LB}{LB}$$

$$= \frac{2 \times 7.55 - 3.415}{1.5}$$

$$= 7.79$$

7.79

(Total for Question 18 is 3 marks)

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19 $a = \dfrac{14}{3x - 7}$ $\quad x = \dfrac{7}{4y - 3}$

Express a in the form $\dfrac{py + q}{ry + s}$ where p, q, r and s are integers.

Give your answer in its simplest form.

$3x - 7 = 3\left(\dfrac{7}{4y-3}\right) - 7$

$= \dfrac{21}{4y-3} - 7 = \dfrac{21 - 7(4y-3)}{4y-3}$

$a = 14 \div \dfrac{21 - 28y + 21}{4y-3}$

$= 14 \div \dfrac{42 - 28y}{4y-3}$

$= 14 \times \dfrac{4y-3}{42-28y}$

$= \dfrac{56y - 42}{42 - 28y}$

$\div 14 = \dfrac{4y-3}{3-2y}$ $\quad p = 4\ q = -3$ $\quad r = 3\ s = -2$

$a = \dfrac{4y-3}{3-2y}$

(Total for Question 19 is 3 marks)

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20 The diagram shows four identical circles drawn inside a square.

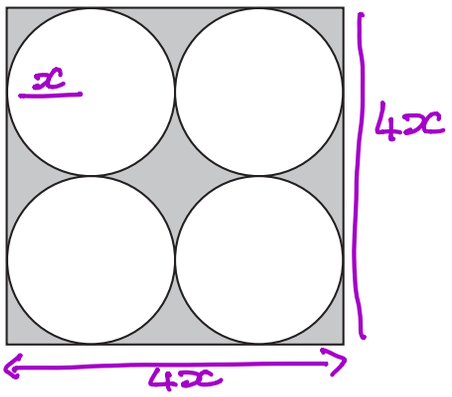


Diagram **NOT** accurately drawn

Each circle touches two other circles and two sides of the square.

The region inside the square that is outside the circles, shown shaded in the diagram, has a total area of 40 cm^2

Work out the perimeter of the square.
Give your answer correct to 3 significant figures.

Let radius = x

$40 = (4x \times 4x) - 4 \times \pi \times x^2$

$= 16x^2 - 4\pi x^2$

$= x^2(16 - 4\pi)$

$x^2 = \dfrac{40}{16 - 4\pi}$ $\therefore x = \sqrt{11.649\ldots}$

$= 3.413\ldots$

so Perimeter $= 4 \times 4x = 16x$

$= 16 \times 3.413\ldots$

$= 54.610\ldots$

3.s.f. 54.6

54 cm

(Total for Question 20 is 4 marks)

21

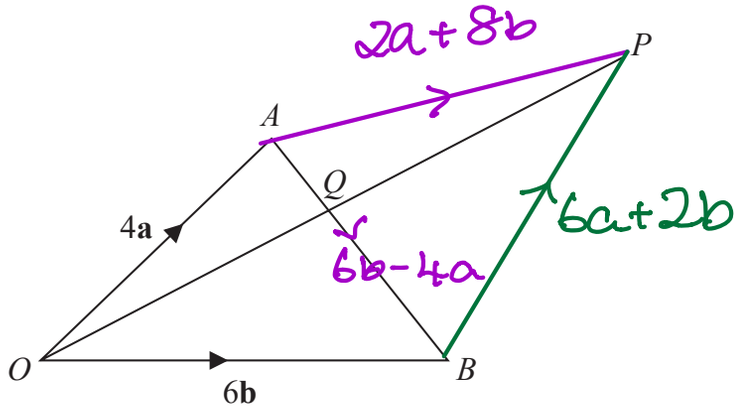


Diagram **NOT** accurately drawn

OAB is a triangle.
Q is the point on *AB* such that *OQP* is a straight line.

$\overrightarrow{OA} = 4\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$ $\overrightarrow{AP} = 2\mathbf{a} + 8\mathbf{b}$

Using a vector method, find the ratio $AQ : QB$

$\overrightarrow{OP} = 6a + 8p$ $\overrightarrow{AB} = 6b - 4a$

$BP = +4a - 6b + 2a + 8b$

$= 6a + 2b$

$\overrightarrow{OQ} = 4a + k(6b - 4a)$

$= 4a + 6kb - 4ka$

$= (4 - 4k)a + 6kb$

$\overrightarrow{QP} = k(-6b + 4a) + 2a + 8b$

$= -6kb + 4ka + 2a + 8b$

$= (2 + 4k)a + (8 - 6k)b$

$$\frac{4 - 4k}{2 + 4k} = \frac{6k}{8 - 6k}$$

$(4 - 4k)(8 - 6k) = 6k(2 + 4k)$

$32 - 24k - 32k + 24k^2 = 12k - 24k^2$

$68k = 32$

$k = 8/17$ $17 - 8 = 9$

$AQ : QB =$ 8 : 9

(Total for Question 21 is 5 marks)

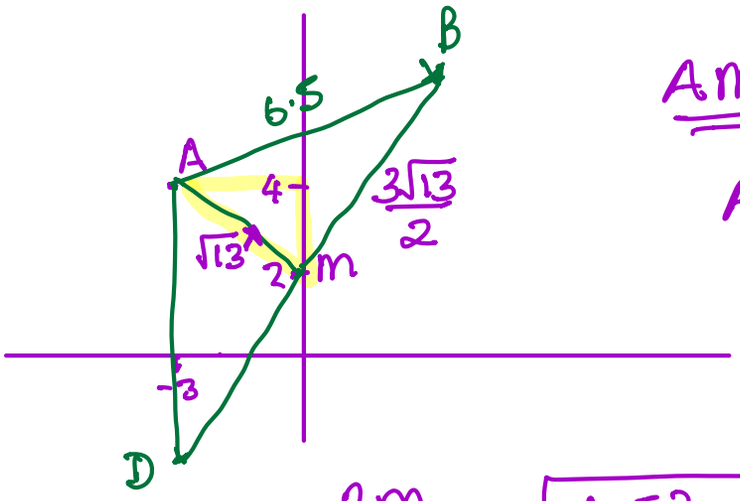
22 $ABCD$ is a kite, with diagonals AC and BD, drawn on a centimetre square grid, with a scale of 1 cm for 1 unit on each axis.

A is the point with coordinates $(-3, 4)$

The diagonals of the kite intersect at the point M with coordinates $(0, 2)$

Given that $AB = AD = 6.5$ cm and the x coordinate of B is positive,

find the coordinates of the points B and D.



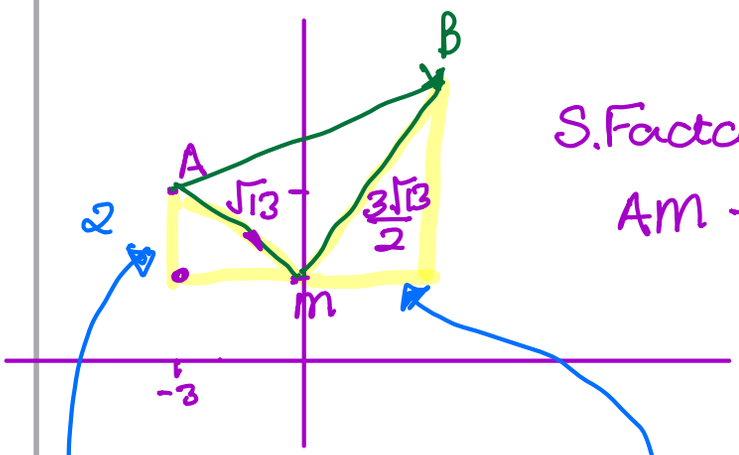
AM

$AM = \sqrt{3^2 + 2^2}$

$= \sqrt{13}$

$BM = \sqrt{6.5^2 - \sqrt{13}^2}$

$= \frac{3\sqrt{13}}{2}$



S.Factor.

AM → MB $\quad \frac{3\sqrt{13}}{2} \div \sqrt{13}$

$= 1.5$

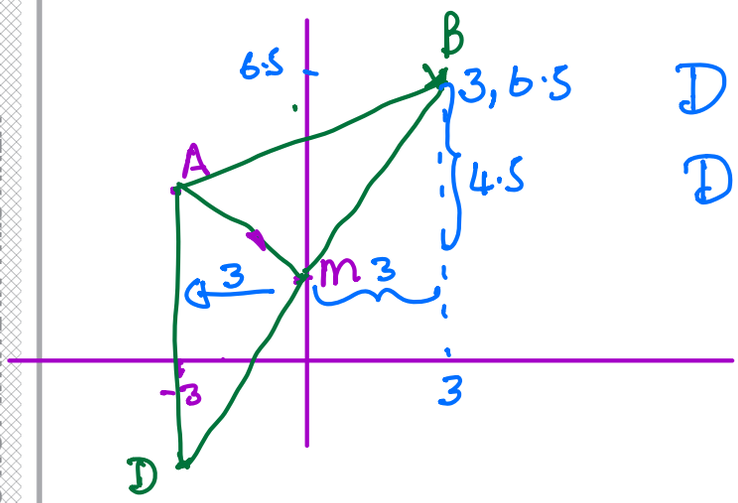
using this $2 \times 1.5 = 3$ so B x coord = 3

and $3 \times 1.5 = 4.5$ so B y coord $= 2 + 4.5$

$= 6.5$

$\therefore B = (3, 6.5)$

and



D x coord = -3

D y coord = 2 - 4.5

= -2.5

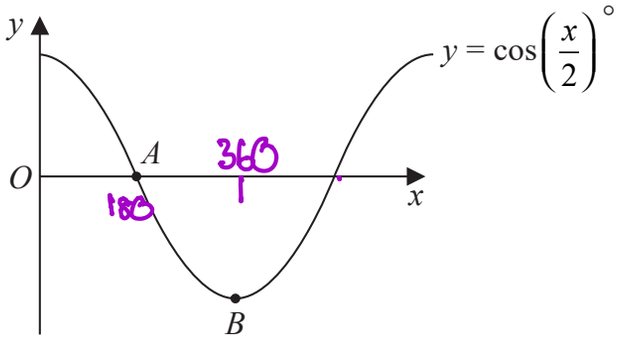
D = (-3, -2.5)

(3 , 6.5)

(-3 , -2.5)

(Total for Question 22 is 7 marks)

23 The diagram shows a sketch of the graph of $y = \cos\left(\frac{x}{2}\right)^\circ$



(i) Find the coordinates of the point A

(180 , 0)

(1)

(ii) Find the coordinates of the point B

(360 , -1)

(1)

(Total for Question 23 is 2 marks)

24

$$\frac{18 \times \left(\sqrt{27}\right)^{4n+6}}{6 \times 9^{2n+8}} = 3^x$$

Express x in terms of n
Show your working clearly and simplify your expression.

$18 = 2 \times 3^2$

$\sqrt{27} = \sqrt{3^3} = 3^{3/2}$

$6 = 2 \times 3$

$9^{2n+8} = (3^2)^{2n+8} = 3^{4n+16}$

$$\frac{2 \times 3^x \times (3^{3/2})^{4n+6}}{2 \times 3 \times 3^{4n+16}}$$

$$\Rightarrow \frac{3^1 \times 3^{6n+9}}{3^{4n+16}} \Rightarrow \frac{3^{6n+10}}{3^{4n+16}} = 3^x$$

$6n + 10 - (4n + 16) = x$

$6n + 10 - 4n - 16 = x$

so $2n - 6 = x$

$x =$ $2n - 6$

(Total for Question 24 is 3 marks)

TOTAL FOR PAPER IS 100 MARKS

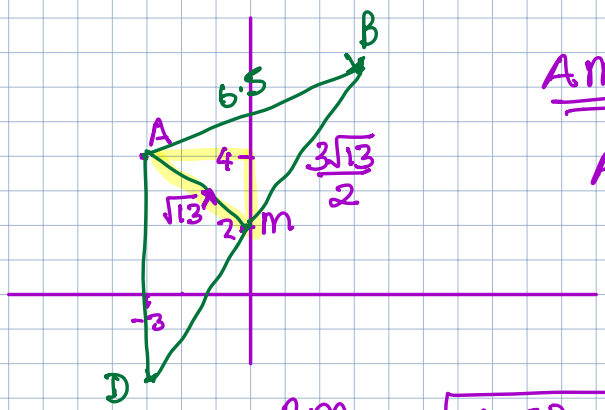
22 *ABCD* is a kite, with diagonals *AC* and *BD*, drawn on a centimetre square grid, with a scale of 1 cm for 1 unit on each axis.

A is the point with coordinates (−3, 4)

The diagonals of the kite intersect at the point *M* with coordinates (0, 2)

Given that $AB = AD = 6.5$ cm and the x coordinate of *B* is positive,

find the coordinates of the points *B* and *D*.



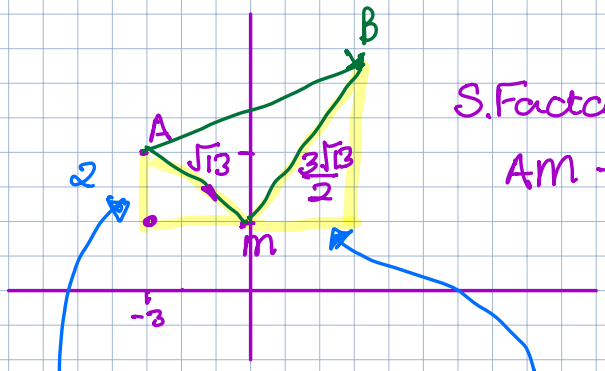
AM

$AM = \sqrt{3^2 + 2^2}$

$= \sqrt{13}$

$BM = \sqrt{6.5^2 - \sqrt{13}^2}$

$= \frac{3\sqrt{13}}{2}$



S.Factor.

AM → MB $\quad \frac{3\sqrt{13}}{2} \div \sqrt{13}$

$= 1.5$

using this $2 \times 1.5 = 3$ so B x coord = 3

and $3 \times 1.5 = 4.5$ so B y coord = $2 + 4.5$

$= 6.5$

$\therefore B = (3, 6.5)$

and