

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 (a) Expand and simplify $3(2y - 5) + 7(y + 2)$

$$3 \times 2y = 6y$$

$$3 \times -5 = -15$$

$$7 \times y = 7y$$

$$7 \times 2 = 14$$

$$6y - 15 + 7y + 14$$

$$= 6y + 7y - 15 + 14$$

$$13y - 1$$

(2)

- (b) Factorise fully $6x^2 + 15x$

$$\begin{array}{l} 1, 6 \\ 2, 3 \\ \hline \end{array}$$

$$\begin{array}{l} 1, 15 \\ 3, 5 \\ \hline \end{array}$$

$$3x(2x + 5)$$

(2)

- (c) Make g the subject of the formula $f = 3g + 11$

$$\begin{array}{l} f \\ -11 \end{array} = \begin{array}{l} 3g + 11 \\ -11 \end{array}$$

$$\frac{f - 11}{3} = \frac{3g}{3}$$

$$g = \frac{f - 11}{3}$$

$$g = \frac{f - 11}{3}$$

(2)

(Total for Question 1 is 6 marks)



2 Karen is organising a party for a charity.

She spends

£100 on food

£120 on a hall

£80 on a DJ.

Karen sells 54 tickets for the party.

Each ticket costs £7.50

Work out the percentage profit Karen makes for the charity.

$$\text{Spends } 100 + 120 + 80 = \text{£}300$$

$$\text{Tickets} = 54 \times 7.50 = \text{£}405$$

$$\text{Profit} = 405 - 300 = 105$$

$$\begin{aligned} \% \text{ profit} &= \frac{105}{300} \times 100 \\ &= 35\% \end{aligned}$$

.....35.....%

(Total for Question 2 is 4 marks)



P 6 9 5 3 4 A 0 3 2 0

- 3 Andrew invests £4500 in a savings account for 2 years.
The account pays compound interest at a rate of 3.4% per year.

Calculate how much Andrew has in this savings account at the end of the 2 years.

$$100 + 3.4 = 103.4\% \rightarrow 1.034$$

$$\text{Yr 1} \quad 4500 \times 1.034 = 4653$$

$$\text{Yr 2} \quad 4653 \times 1.034 = 4811.202$$

$$\text{£ } 4811.20$$

(Total for Question 3 is 2 marks)

- 4 Solve $5x - 14 = 52 - x$

$$\begin{array}{r} \checkmark \quad x \quad \checkmark \quad x \\ 5x - 14 = 52 - x \\ +x \quad \quad +x \end{array}$$

$$\begin{array}{r} 6x - 14 = 52 \\ +14 \quad +14 \end{array}$$

$$6x = 66$$

$$x = \frac{66}{6} = 11$$

$$x = 11$$

(Total for Question 4 is 3 marks)



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- 5 Chris, Debbie and Errol share some money in the ratio 3:4:2
Debbie gets £120

Chris then gives some of his share to Debbie and some of his share to Errol.
The money that Chris, Debbie and Errol each have is now in the ratio 2:5:3

How much money did Chris give to Errol?

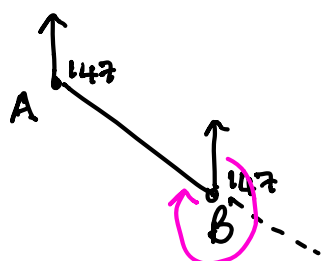
C	D	E	
3	4	2	
↓	↓	↓	
$\times 30$	$\times 30$	$\times 30$	
£90	£120	£60	Total = £270

C	D	E	Total = £270
2	5	3	
$270 \div 10 = 27$			
2×27	5×27	3×27	
= £54	= £135	= £81	
\Downarrow $£81 - 60$ $= £21$			

£ 21

(Total for Question 5 is 4 marks)

- 6 The bearing of port B from port A is 147°
Work out the bearing of port A from port B.



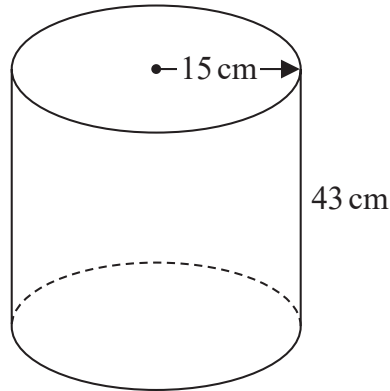
$$147 + 180 = 327$$

327

(Total for Question 6 is 2 marks)



7 The diagram shows an empty tank in the shape of a cylinder.



The cylinder has radius 15 cm and height 43 cm.

Water flows into the tank at a rate of 0.47 litres per minute.

Calculate the number of minutes it will take to completely fill the tank.
Give your answer correct to the nearest minute.

$$\begin{aligned} \text{Volume} &= \pi \times 15^2 \times 43 \\ &= 30394.90892 \text{ cm}^3 \end{aligned}$$

$$1 \text{ Litre} = 1000 \text{ cm}^3 \quad \text{so} \quad 30.394908... \text{ Litres.}$$

$$\begin{aligned} 30.394... \div 0.47 &= 64.6700... \text{ minutes} \\ &65 \text{ to nearest minute.} \end{aligned}$$

65 minutes

(Total for Question 7 is 4 marks)



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8 A number x is written correct to 2 significant figures.

The result is 1.9

Complete the error interval for x .

1.8 ↑ 1.9 ↑ 2.0

..... 1.85 ≤ x < 1.95

(Total for Question 8 is 2 marks)

9 Expand and simplify $(x + 7)(x - 2)(x + 3)$

$x^2 - 2x + 7x - 14 = x^2 + 5x - 14$

$(x + 3)(x^2 + 5x - 14)$

$= x^3 + 5x^2 - 14x + 3x^2 + 15x - 42$

$= x^3 + 8x^2 + x - 42$

..... $x^3 + 8x^2 + x - 42$

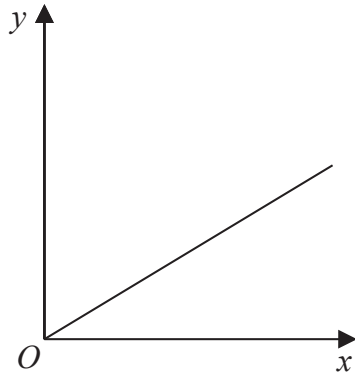
(Total for Question 9 is 3 marks)



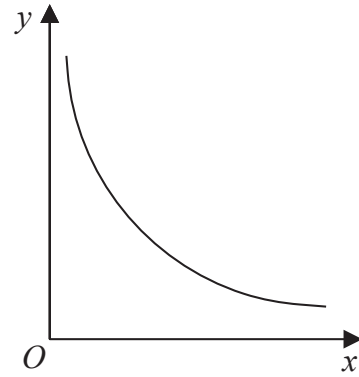
P 6 9 5 3 4 A 0 7 2 0

11

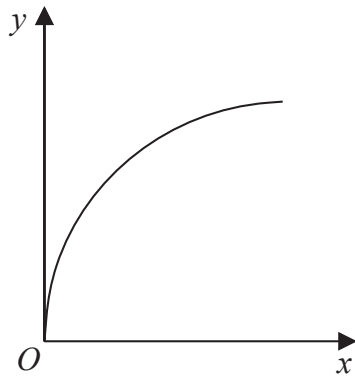
Graph A



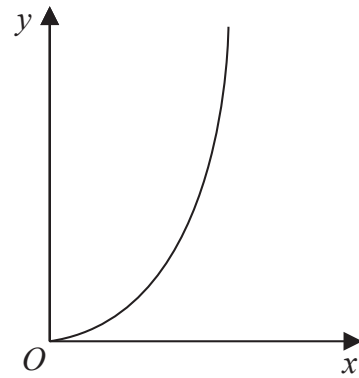
Graph B



Graph C



Graph D



The graphs of y against x represent four different types of proportionality.

Match each type of proportionality in the table to the correct graph.

Type of proportionality	Graph
$y \propto x^2$	D
$y \propto x$	A
$y \propto \frac{1}{x}$	B
$y \propto \sqrt{x}$	C

(Total for Question 11 is 2 marks)

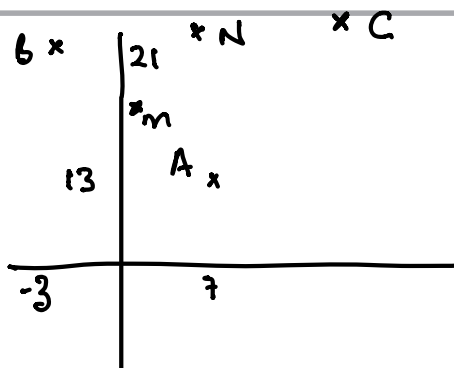


P 6 9 5 3 4 A 0 9 2 0

- 12 A is the point with coordinates $(7, 13)$
 B is the point with coordinates $(-3, 21)$
 C is the point with coordinates $(15, 23)$

M is the midpoint of AB .
 N is the midpoint of BC .

Work out the distance between M and N .
 Give your answer correct to 1 decimal place.



$$\begin{array}{ccc} & m & \\ A & & B \\ (7, 13) & & (-3, 21) \end{array}$$

$$\frac{7-3}{2}, \frac{13+21}{2}$$

$$M = (2, 7)$$

$$\begin{array}{ccc} & n & \\ B & & C \\ (-3, 21) & & (15, 23) \end{array}$$

$$\frac{-3+15}{2}, \frac{21+23}{2}$$

$$N = (6, 22)$$

$$\begin{aligned} MN &= \sqrt{(22-7)^2 + (6-2)^2} \\ &= \sqrt{5^2 + 4^2} = \sqrt{41} \\ &= 6.403... \end{aligned}$$

6.4

(Total for Question 12 is 3 marks)

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13 Prove algebraically that $0.0\dot{7}2\dot{3}$ can be written as $\frac{241}{3330}$

$$\begin{array}{r} 1000x = 72.3723\dots \\ x = 0.0723723\dots \\ \hline \end{array}$$

$$999x = 72.3$$

$$x = \frac{72.3}{999}$$

$$\frac{72.3}{999} = \frac{723}{9990}$$

$$\frac{723}{9990} \div 3 = \frac{241}{3330}$$

(Total for Question 13 is 3 marks)

14 y is proportional to x^2
 $y = 3$ when $x = 0.5$

x is inversely proportional to w
 $x = 2$ when $w = 0.2$

Find the value of y when $w = 2$

$$y \propto x^2$$

$$y = kx^2$$

$$y = 3 \text{ when } x = 0.5$$

$$3 = k \times 0.5^2$$

$$k = \frac{3}{0.5^2} = 12$$

$$\underline{y = 12x^2}$$

$$x \propto \frac{1}{w} \quad x = \frac{k}{w}$$

$$\text{when } x = 2 \quad w = 0.2$$

$$2 = \frac{k}{0.2} \quad \text{so } k = 0.4$$

$$x = \frac{0.4}{w}$$

$$\text{when } w = 2 \quad x = \frac{0.4}{2} = 0.2$$

$$y = 12 \times 0.2^2 = 0.48$$

$$y = 0.48$$

(Total for Question 14 is 5 marks)



- 15 The incomplete table and the incomplete histogram give information about the times taken by some students to run a race.

Freq. density

$$10 \div 4 = 2.5$$

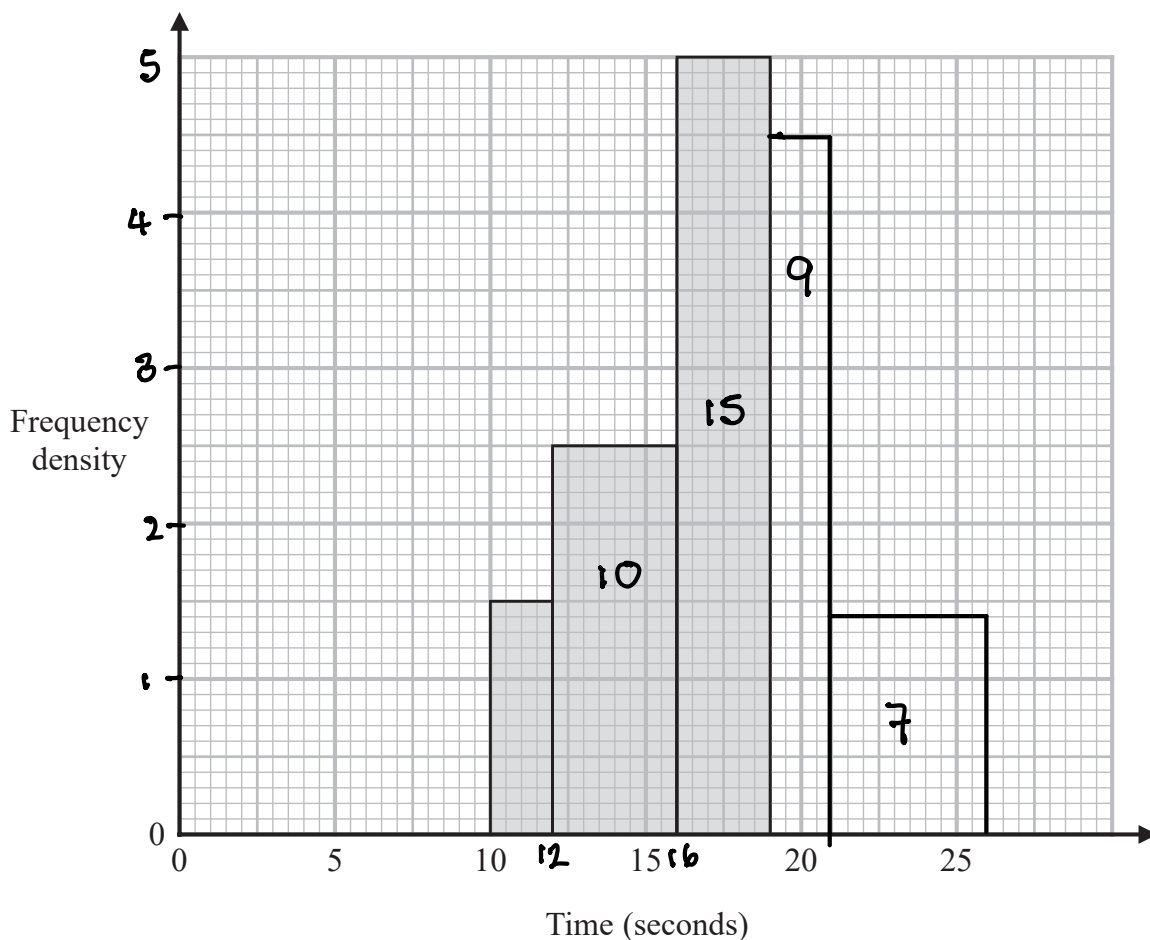
$$15 \div 3 = 5$$

$$9 \div 2 = 4.5$$

$$7 \div 5 = 1.4$$

Time (t seconds)	Frequency
$10 < t \leq 12$	3
$12 < t \leq 16$	10
$16 < t \leq 19$	15
$19 < t \leq 21$	9
$21 < t \leq 26$	7

$$1.5 \times 2 = 3$$



None of these students had a time for the race such that $t \leq 10$ or $t > 26$

- (a) Use the histogram to complete the table.

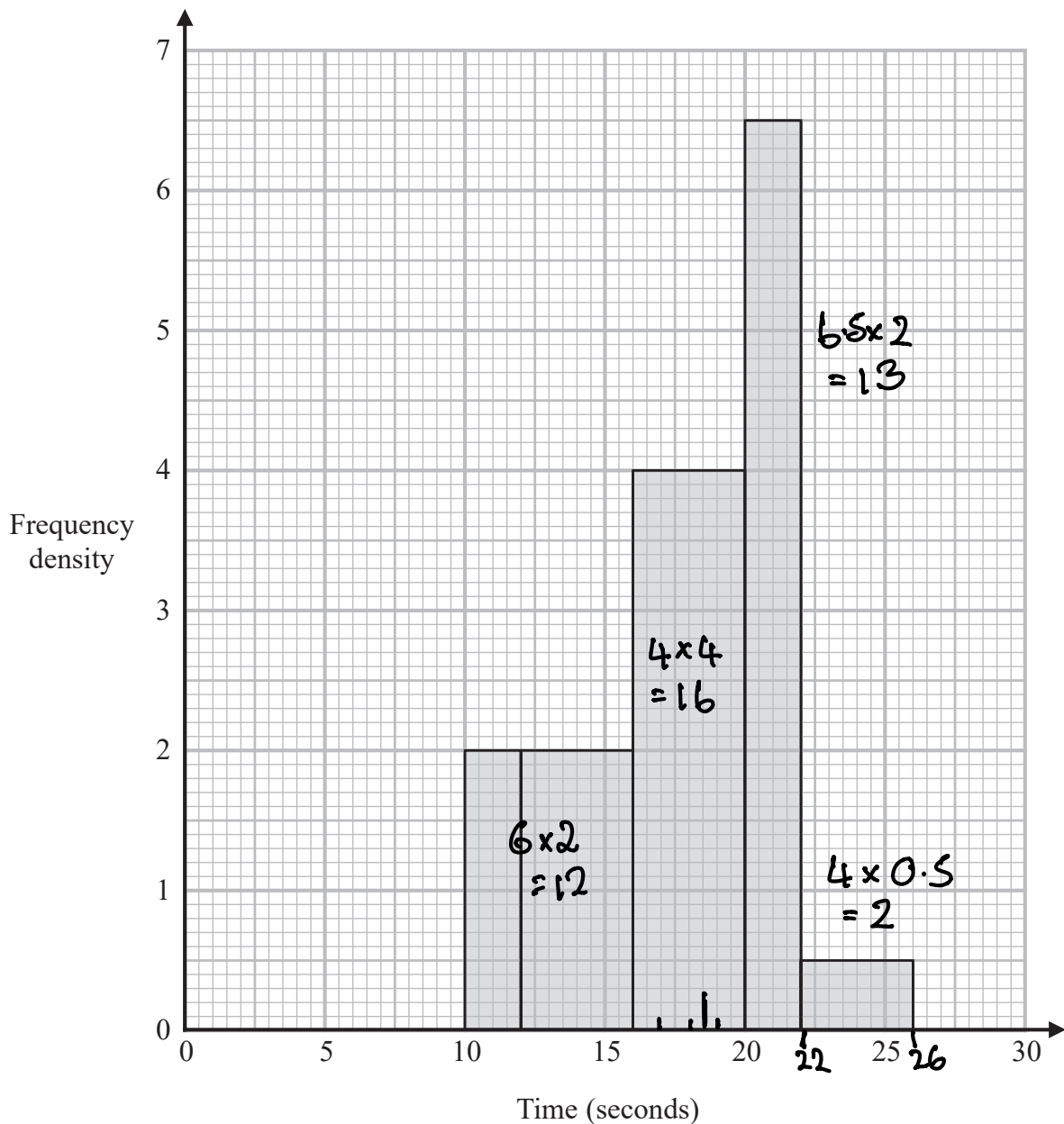
(1)

- (b) Use the table to complete the histogram.

(2)



The histogram below gives information about the times taken by 43 students to run a different race.



(c) Work out an estimate for the median of the times taken by these 43 students to run the race.

$$\text{Total} = 12 + 16 + 13 + 2 = 43$$

$$\text{Median} = \frac{43 + 1}{2} = 22 \text{nd student}$$

$$22 - 12 = 10$$

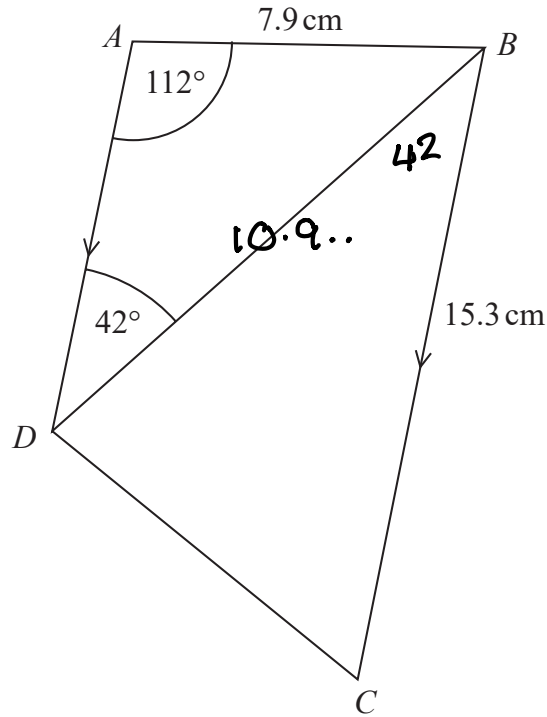
..... 18.5 seconds
(3)

(Total for Question 15 is 6 marks)



P 6 9 5 3 4 A 0 1 3 2 0

16 $ABCD$ is a trapezium.



AD is parallel to BC .

Calculate the area of triangle BCD .
Give your answer correct to 1 decimal place.

$$\frac{BD}{\sin 112} = \frac{7.9}{\sin 42}$$

$$BD = \frac{7.9}{\sin 42} \times \sin 112$$

$$= 10.9\dots$$

$$\text{area } BCD = \frac{1}{2} \times 10.9\dots \times 15.3 \times \sin 42$$

$$= 56.0343\dots$$

$$\text{so } 56.0 \text{ (1dp)}$$

$$\dots\dots\dots 56.0 \dots\dots\dots \text{cm}^2$$

(Total for Question 16 is 4 marks)

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17 (a) Show that the equation $x^3 + 2x - 6 = 0$ has a solution between $x = 1$ and $x = 2$

$$x = 1 \quad 1^3 + 2 \times 1 - 6 = 1 + 2 - 6 = -3$$

$$x = 2 \quad 2^3 + 2 \times 2 - 6 = 8 + 4 - 6 = 6$$

since there is a change in sign a solution must lie between $x = 1$ and $x = 2$ (2)

(b) Show that the equation $x^3 + 2x - 6 = 0$ can be rearranged to give $x = \frac{6}{x^2 + 2}$

$$x^3 + 2x - 6 = 0$$

$$x^3 + 2x = 6$$

$$x(x^2 + 2) = 6$$

$$\text{so } x = \frac{6}{x^2 + 2} \text{ as required.}$$

(1)

(c) Starting with $x_0 = 1.45$

use the iteration formula $x_{n+1} = \frac{6}{x_n^2 + 2}$ twice to find an estimate for the solution of $x^3 + 2x - 6 = 0$

Give your answer correct to 4 decimal places.

$$x_0 = 1.45$$

$$x_1 = \frac{6}{1.45^2 + 2} = 1.46252\dots$$

$$x_2 = \frac{6}{1.462^2 + 2} = 1.44963\dots$$

$$\text{so } 1.4496 \text{ (4dp)}$$

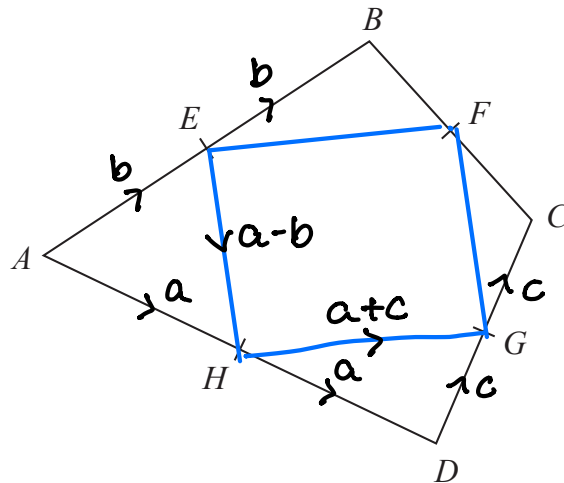
$$1.4496$$

(3)

(Total for Question 17 is 6 marks)



P 6 9 5 3 4 A 0 1 5 2 0



$ABCD$ is a quadrilateral.

E, F, G and H are the midpoints of AB, BC, CD and DA .

$$\vec{AH} = \mathbf{a} \quad \vec{AE} = \mathbf{b} \quad \vec{DG} = \mathbf{c}$$

Prove, using vectors, that $EFGH$ is a parallelogram.

$$\vec{BC} = 2\mathbf{a} + 2\mathbf{c} - 2\mathbf{b} \quad \text{so} \quad \vec{BF} = \vec{FC} \\ = \mathbf{a} + \mathbf{c} - \mathbf{b}$$

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

$$\vec{HC} = \mathbf{a} + \mathbf{c}$$

$$\vec{FC} = \vec{FC} + \vec{CH} \\ = \mathbf{a} + \mathbf{c} - \mathbf{b} - \mathbf{c} \\ = \mathbf{a} - \mathbf{b}$$

$$\vec{EF} = \vec{EB} + \vec{BF} \\ = \mathbf{b} + \mathbf{a} + \mathbf{c} - \mathbf{b} \\ = \mathbf{a} + \mathbf{c}$$

$$\text{so } \vec{EH} = \vec{FC}$$

$$\text{so } \vec{HC} = \vec{EF}$$

$\therefore EFCH$ is a parallelogram

(Total for Question 18 is 4 marks)



19 The functions f and g are such that

$$f(x) = (2x + 3)^2 \quad \text{and} \quad g(x) = 2x - 1$$

(a) Find $gf(-3)$

$$\begin{aligned} f(-3) &= (2 \times -3 + 3)^2 \\ &= (-3)^2 = 9 \end{aligned}$$

$$\begin{aligned} g(9) &= 2 \times 9 - 1 \\ &= 17 \end{aligned}$$

17

(2)

(b) Find $g^{-1}(x)$

$$\begin{aligned} y &= 2x - 1 \\ 2x &= y + 1 \\ x &= \frac{y+1}{2} \\ \therefore g^{-1}(x) &= \frac{x+1}{2} \end{aligned}$$

$$g^{-1}(x) = \frac{x+1}{2}$$

(2)

(Total for Question 19 is 4 marks)



P 6 9 5 3 4 A 0 1 7 2 0

20 Write

$\frac{14}{3x-21} + \left[(x+4) \div \frac{2x^2-6x-56}{2x+3} \right]$ in the form $\frac{ax+b}{cx+d}$ where a, b, c and d are integers.

$$\frac{14}{3x-21} + (x+4) \times \frac{2x+3}{2x^2-6x-56}$$

$$2x^2-6x-56 = (x+4)(2x-14)$$

$$= \frac{14}{3x-21} + \frac{\cancel{(x+4)}(2x+3)}{\cancel{(x+4)}(2x-14)}$$

$$= \frac{14(2x-14) + (2x+3)(3x-21)}{(3x-21)(2x-14)}$$

$$= \frac{28x - 196 + 6x^2 - 42x + 9x - 63}{(3x-21)2(x-7)}$$

$$= \frac{6x^2 - 5x - 259}{2(3x-21)(x-7)}$$

$$= \frac{(6x+37)\cancel{(x-7)}}{2(3x-21)\cancel{(x-7)}}$$

$$= \frac{6x+37}{6x-42}$$

$$\frac{6x+37}{6x-42}$$

(Total for Question 20 is 4 marks)

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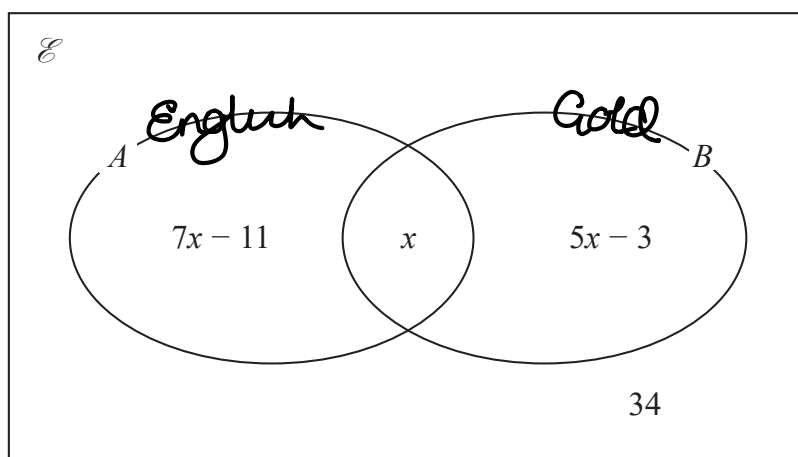
21 Vicky has a collection of medals.

The Venn diagram gives information about the number of medals in her collection where

$$\mathcal{E} = \{\text{all medals}\}$$

$$A = \{\text{English medals}\}$$

$$B = \{\text{gold medals}\}$$



Vicky is going to take at random a medal from her collection.

Given that the medal is gold, the probability that the medal is English is $\frac{2}{11}$

Work out the number of medals in Vicky's collection.

$$\begin{aligned} \mathcal{E} &= 7x - 11 + x + 5x - 3 + 34 \\ &= 13x + 20 \end{aligned}$$

Given that the medal is gold $x + 5x - 3 = 6x - 3$

$$\frac{x}{6x - 3} = \frac{2}{11}$$

$$11x = 2(6x - 3)$$

$$11x = 12x - 6$$

$$x = 6 \quad \text{so medals} = 13 \times 6 + 20$$

98

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS



P 6 9 5 3 4 A 0 1 9 2 0