

Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Solve  $3(2 - 4x) = 5 - 8x$

Show clear algebraic working.

$$3(2 - 4x) = 6 - 12x$$

$$\begin{array}{rcl} 6 - 12x & = & 5 - 8x \\ +12x & & +12x \end{array}$$

$$\begin{array}{rcl} 6 & = & 5 + 4x \\ -5 & & -5 \end{array}$$

$$1 = 4x$$

$$\begin{array}{rcl} \text{SO } 4x & = & 1 \\ x & = & \frac{1}{4} \end{array}$$

$$x = \frac{1}{4} \text{ or } 0.25.$$

(Total for Question 1 is 3 marks)

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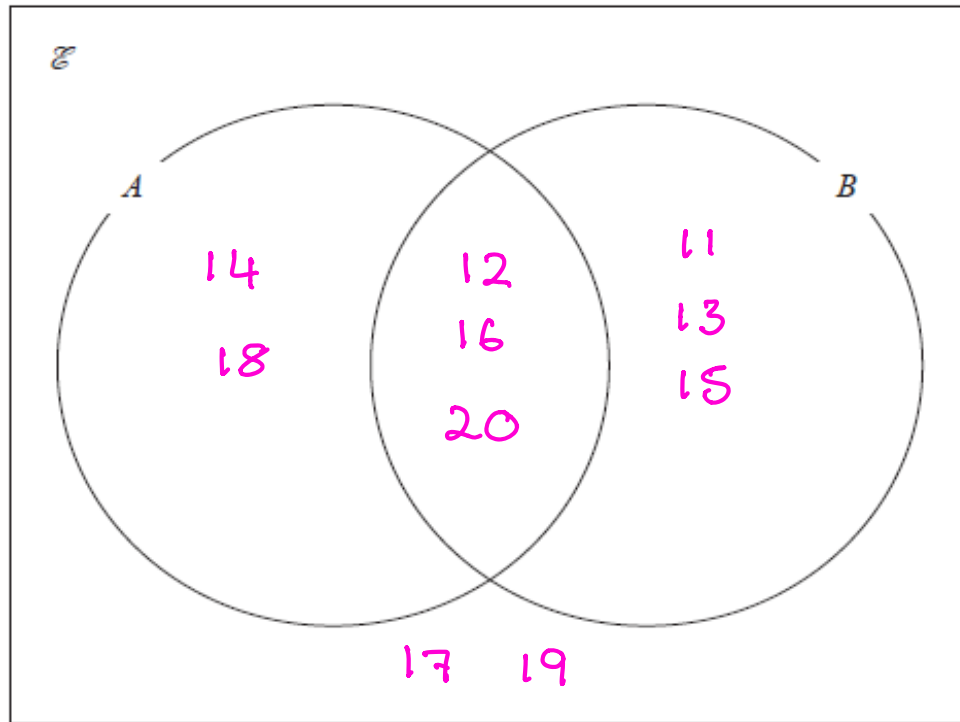
2  $\mathcal{E} = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

$A = \{\text{even numbers}\}$  12 14 16 18 20

$A \cap B = \{12, 16, 20\}$

$(A \cup B)' = \{17, 19\}$  not A or B

Complete the Venn diagram for the sets  $\mathcal{E}$ ,  $A$  and  $B$



(Total for Question 2 is 3 marks)

3 Solve the simultaneous equations

$$5x + 4y = -2 \quad \times 2$$

$$2x - y = 4.4 \quad \times 5$$

Show clear algebraic working.

$$\begin{array}{r}
 10x + 8y = -4 \\
 10x - 5y = 22 \\
 \hline
 - \quad \quad \quad \times \quad 13y = -26 \\
 \quad \quad \quad \quad \quad y = -2
 \end{array}$$

$$\begin{array}{r}
 4.4 \\
 \times 5 \\
 \hline
 22.0 \\
 \underline{\quad} \\
 2
 \end{array}$$

subs. into  $2x - y = 4.4$

$$2x - -2 = 4.4$$

$$2x + 2 = 4.4$$

$$2x = 2.4$$

$$x = 1.2$$

$$x = \underline{1.2}$$

$$y = \underline{-2}$$

(Total for Question 3 is 3 marks)

4  $3^{\frac{1}{2}} \times 3^{\frac{2}{5}} = 3^m$

(a) Work out the value of  $m$

$$3^{\frac{1}{2} + \frac{2}{5}} = 3^{\frac{5}{10} + \frac{4}{10}}$$
$$= 3^{\frac{9}{10}}$$

$m = \frac{9}{10}$ .....

(1)

$5^{-10} \div 5^{-4} = 5^n$

(b) Work out the value of  $n$

$$5^{-10 - (-4)}$$
$$= 5^{-10 + 4}$$
$$= 5^{-6}$$

$n = -6$ .....

(1)

(Total for Question 4 is 2 marks)

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- 5 Here are 9 cards. Each card has either a number <sup>2</sup> on it or a letter <sup>7</sup> on it.

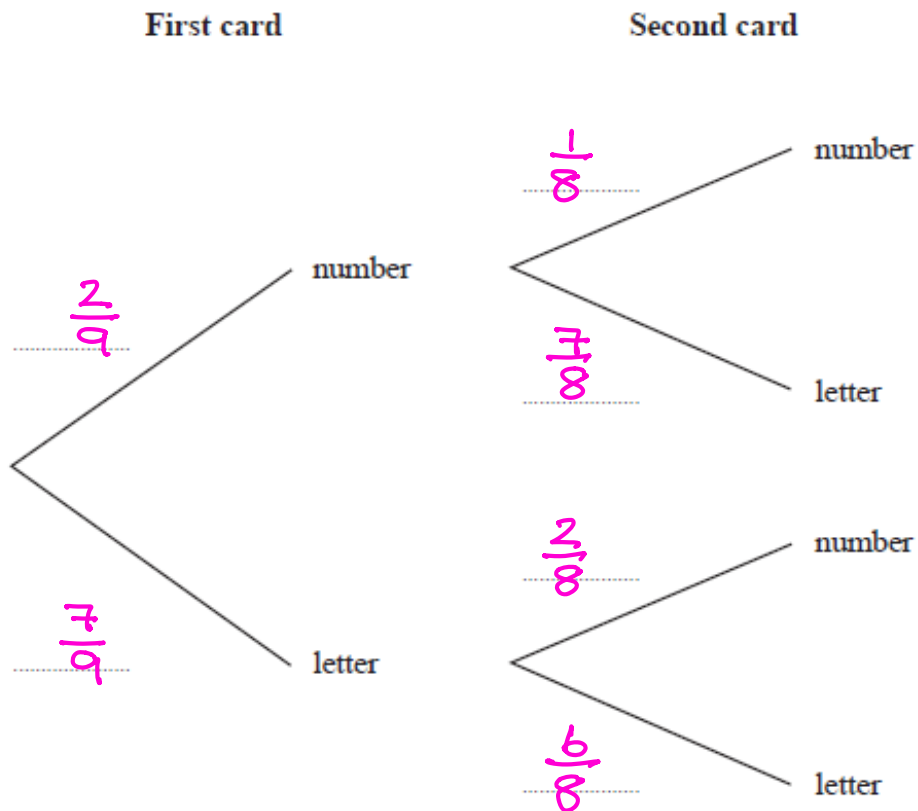


Tomas is playing a game.

Tomas takes at random one of the cards and keeps it.

Tomas then takes at random another card and keeps it.

- (a) Complete the probability tree diagram.



(2)

(b) Work out the probability that each of the two cards has a number on it.

$$P(N, N) = \frac{2}{9} \times \frac{1}{8} = \frac{2}{72}$$

$\frac{2}{72}$  or equivalent

(2)

(c) Work out the probability that there will be one card with a number on it and one card with a letter on it.

$$P(N, L) + P(L, N)$$

$$\frac{2}{9} \times \frac{7}{8} + \frac{7}{9} \times \frac{2}{8}$$

$$= \frac{14}{72} + \frac{14}{72}$$

$$= \frac{28}{72}$$

$\frac{28}{72}$  or equivalent

(3)

(Total for Question 5 is 7 marks)

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6 Show that  $3\frac{5}{7} \div 1\frac{5}{8} = 2\frac{2}{7}$

$$3\frac{5}{7} = \frac{26}{7} \quad 1\frac{5}{8} = \frac{13}{8}$$

$$\begin{aligned} \frac{26}{7} \div \frac{13}{8} &= \frac{26}{7} \times \frac{8}{13} \\ &= \frac{16}{7} \end{aligned}$$

$$\frac{16}{7} = 2\frac{2}{7} \text{ as required.}$$

(Total for Question 6 is 3 marks)

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7 (a) Write down the value of  $(m + 2)^0$  where  $m$  is a positive integer.

anything to the power of 0 = 1

1

(1)

(b) Simplify  $(3a^2b^4)^3$

$3^3 a^{2 \times 3} b^{4 \times 3}$

$27a^6b^{12}$

(2)

(c) Factorise fully  $14x^2y^4 + 21x^3y^2$

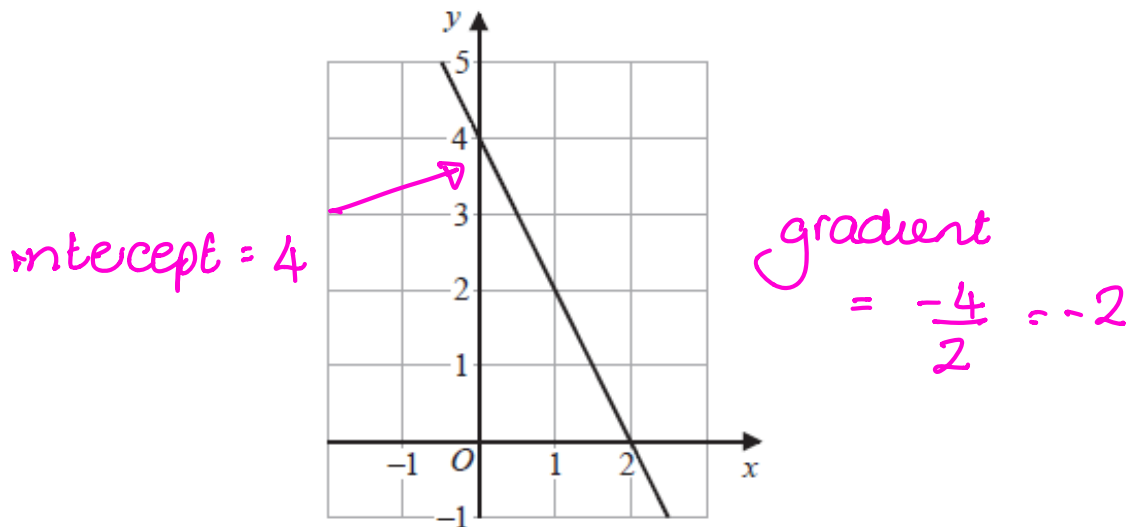
$2 \times 7$   
 $x \times x$   
 $y \times y \times y \times y$

$3 \times 7$   
 $x \times x \times x$   
 $y \times y$

$7x^2y^2(2y^2 + 3x)$

(2)

The diagram shows a straight line drawn on a grid.



(d) Write down an equation of the line.

$y = -2x + 4$

(2)

(Total for Question 7 is 7 marks)



8 The diagram shows an isosceles triangle, with base length 24 cm.

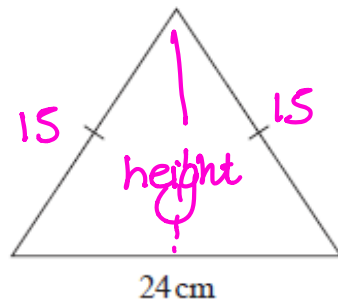
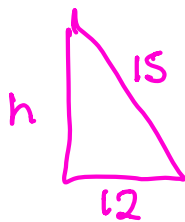


Diagram NOT accurately drawn

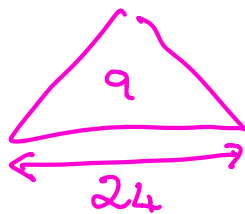
$$54 - 24 = 30$$
$$30 \div 2 = 15$$

The perimeter of the triangle is 54 cm.

Work out the area of the triangle.



$$15^2 - 12^2 = 225 - 144$$
$$= 81$$
$$h = \sqrt{81} = 9$$

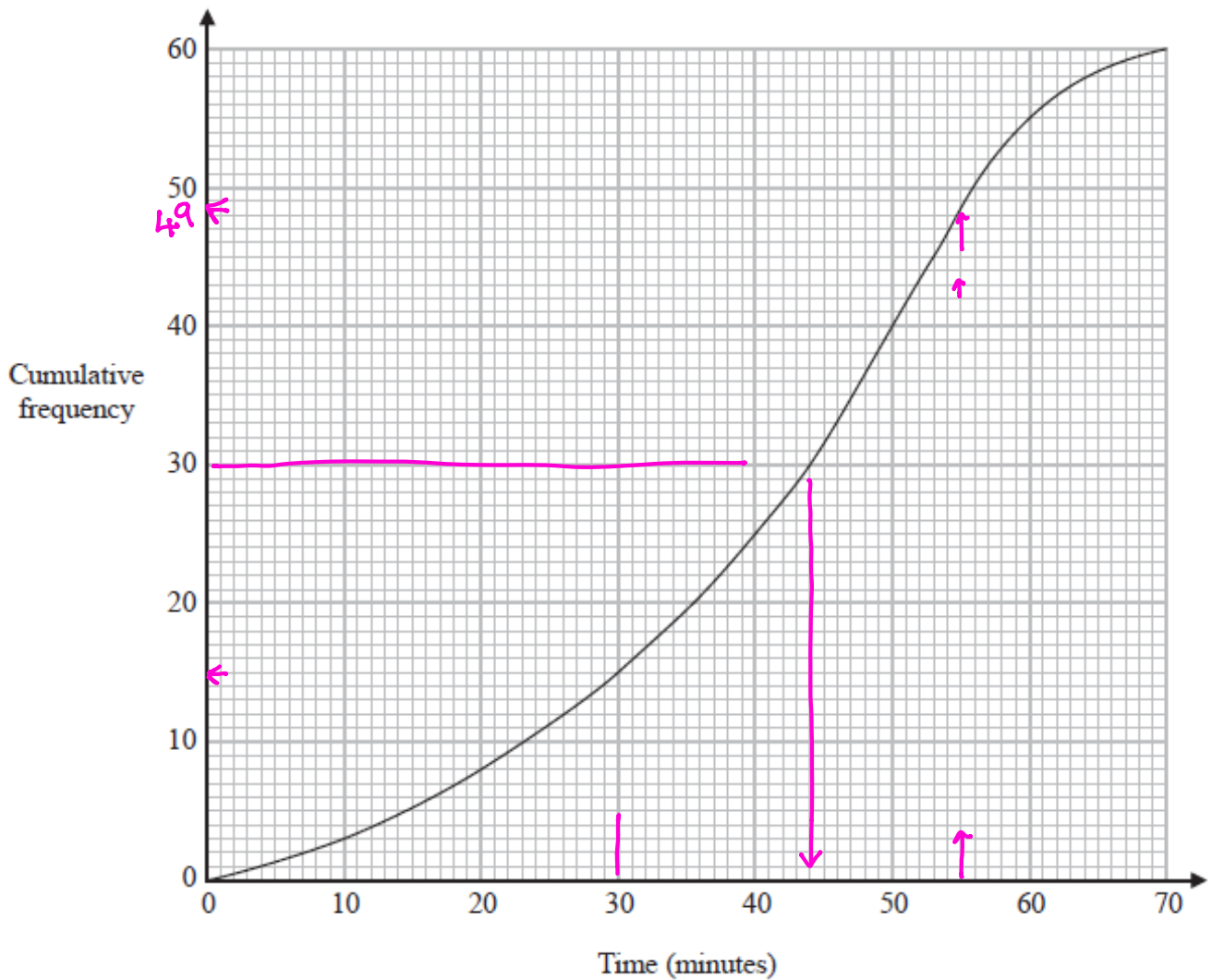


$$\text{Area} = \frac{1}{2} \times 9 \times 24$$
$$= 9 \times 12$$
$$= 108$$

..... 108 ..... cm<sup>2</sup>

(Total for Question 8 is 5 marks)

- 9 The cumulative frequency graph gives information about the time, in minutes, each of 60 people took to shop in a market.



- (a) Use the graph to find an estimate for the median time people took to shop in the market.

..... minutes  
44  
**(1)**

- (b) Use the graph to find an estimate for the number of people who took longer than 55 minutes to shop in the market.

$$60 - 49 = \dots\dots\dots 11$$

$$(60 - 48) = 12 \text{ also accepted} \quad (2)$$

- (c) Use the graph to complete the frequency table to give information about the time, in minutes, each of the 60 people took to shop in the market.

Time taken to shop in the market ( $m$ minutes)	Frequency
$0 < m \leq 10$	3
$10 < m \leq 20$	5
$20 < m \leq 30$	7
$30 < m \leq 40$	10
$40 < m \leq 50$	15
$50 < m \leq 60$	15
$60 < m \leq 70$	5

(2)

(Total for Question 9 is 5 marks)

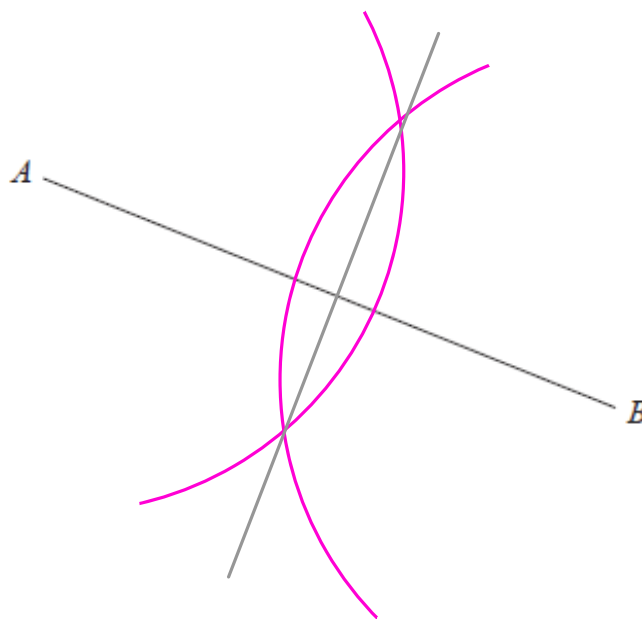
- 10 Expand and simplify  $3x(2x - 5)^2$   
Show clear algebraic working.

$$\begin{aligned}
 & 3x(2x - 5)(2x - 5) \\
 = & 3x(4x^2 - 20x + 25) \\
 = & 12x^3 - 60x^2 + 75x
 \end{aligned}$$

$$\dots\dots\dots 12x^3 - 60x^2 + 75x$$

(Total for Question 10 is 3 marks)

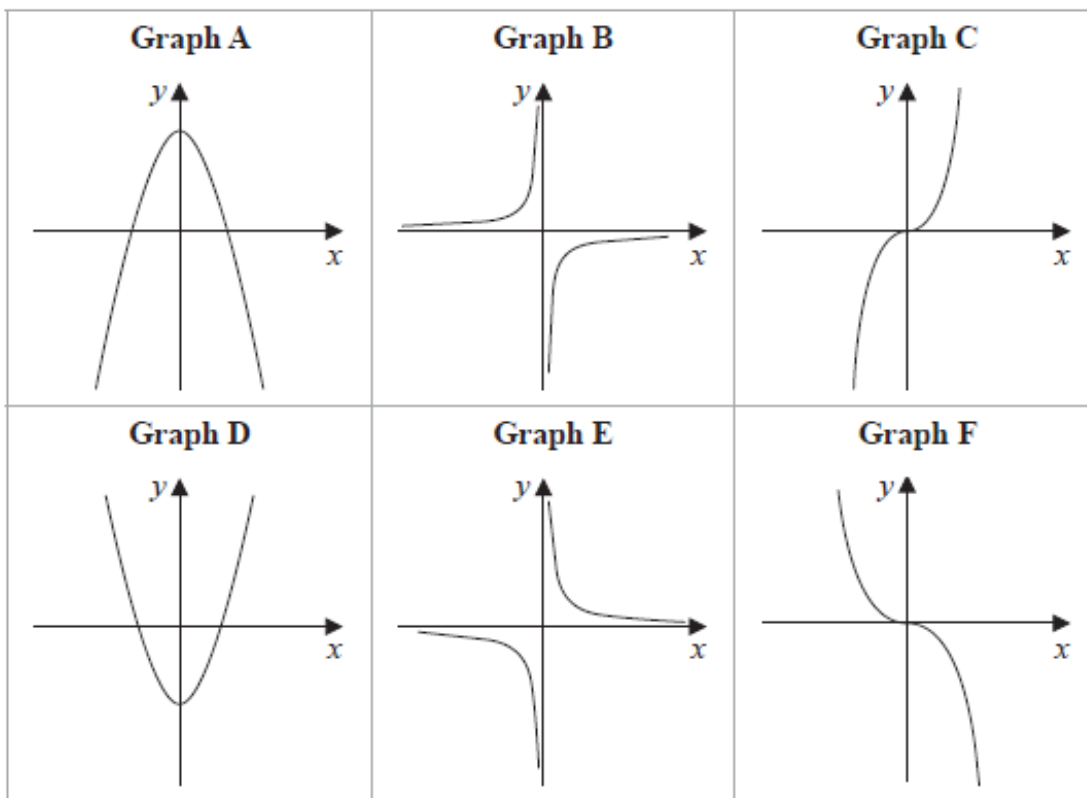
- 11 Use ruler and compasses only to construct the perpendicular bisector of line  $AB$   
You must show all your construction lines.



**(Total for Question 11 is 2 marks)**

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12 Here are six graphs.



Complete the table below with the letter of the graph that could represent each given equation.

Write your answers on the dotted lines.

Equation	Graph
$y = -\frac{2}{x}$	B .....
$y = 5 - x^2$	A .....
$y = -2x^3$	F .....

(Total for Question 12 is 3 marks)

13 Solve the simultaneous equations

$$\begin{aligned}y &= 7 - 2x \\ x^2 + y^2 &= 34\end{aligned}$$

$$\begin{aligned}y^2 &= (7 - 2x)(7 - 2x) \\ &= 49 - 28x + 4x^2\end{aligned}$$

Show clear algebraic working.

$$x^2 + 49 - 28x + 4x^2 = 34$$

$$5x^2 - 28x + 15 = 0$$

$$(5x - 3)(x - 5) = 0$$

$$x = \frac{3}{5} \quad x = 5$$

$$\begin{aligned}y &= 7 - 2\left(\frac{3}{5}\right) & y &= 7 - 2(5) \\ &= 5.8 & &= -3\end{aligned}$$

$$x = 0.6, y = 5.8 \quad x = 5, y = -3$$

(Total for Question 13 is 5 marks)

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14 Use algebra to show that  $0.4\dot{3}\dot{8} = \frac{217}{495}$

$$100x = 43.8383838\dots$$

$$x = 0.4383838\dots$$

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$$99x = 43.4$$

$$x = \frac{43.4}{99}$$

$$\frac{43.4}{99} = \frac{434}{990}$$

$$\frac{434}{990} = \frac{217}{495} \text{ as required.}$$

(Total for Question 14 is 2 marks)

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- 15  $y$  is inversely proportional to  $\sqrt{x}$   
 $y = c^4$  when  $x = c^2$  where  $c$  is a positive constant.

Find a formula for  $y$  in terms of  $x$  and  $c$   
Give your answer in its simplest form.

$$y \propto \frac{1}{\sqrt{x}} \quad y = \frac{k}{\sqrt{x}}$$

$$y = c^4$$
$$x = c^2$$

$$c^4 = \frac{k}{\sqrt{c^2}}$$

$$c^4 = \frac{k}{c}$$

$$k = c^5$$

$$\therefore y = \frac{c^5}{\sqrt{x}}$$

(Total for Question 15 is 3 marks)

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16 Solve the inequality  $6x^2 + 37x \leq 35$

Show clear algebraic working.

$$6x^2 + 37x - 35 \leq 0$$

$$6x(x+7) - 5(x+7) \leq 0$$

$$(6x-5)(x+7) \leq 0$$

$$6x-5 \leq 0$$

$$x \leq -7$$

$$x \leq \frac{5}{6}$$

$$-7 \leq x \leq \frac{5}{6}$$

(Total for Question 16 is 3 marks)

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- 17 Given that  $8\sqrt{m} + \sqrt{49m} - \sqrt{9m} = k\sqrt{m}$   
where  $k$  is an integer and  $m$  is a prime number,

(a) work out the value of  $k$

$$\sqrt{49m} = 7\sqrt{m}$$

$$\sqrt{9m} = 3\sqrt{m}$$

$$8\sqrt{m} + 7\sqrt{m} - 3\sqrt{m} \\ = 12\sqrt{m}$$

$$k = \dots\dots\dots 12 \dots\dots\dots (1)$$

- (b) Show that  $\frac{5 - \sqrt{18}}{1 - \sqrt{2}}$  can be written in the form  $a + b\sqrt{2}$  where  $a$  and  $b$  are integers.

Show each stage of your working clearly.

$$\frac{5 - \sqrt{18}}{1 - \sqrt{2}} \times \frac{(1 + \sqrt{2})}{(1 + \sqrt{2})}$$

$$= \frac{5 + 5\sqrt{2} - \sqrt{18} - \sqrt{36}}{1 - 2}$$

$$= \frac{5 - 6 + 5\sqrt{2} - 3\sqrt{2}}{-1} = \frac{-1 + 2\sqrt{2}}{-1}$$

$$= 1 - 2\sqrt{2}$$

$\sqrt{18} = \sqrt{2 \times 9} = 3\sqrt{2}$

$a = 1 \quad b = -2$

(3)

(Total for Question 17 is 4 marks)

18 The function  $f$  is such that  $f(x) = \frac{k}{x}$  where  $x \neq 0$  and  $k$  is an integer.

(a) Express the inverse function  $f^{-1}$  in the form  $f^{-1}(x) = \dots$

$$y = \frac{k}{x}$$

$$x = \frac{k}{y}$$

$$f^{-1}(x) = \frac{k}{x} \dots \dots \dots (1)$$

The function  $g$  is such that  $g(x) = 2 - 3x^4$  where  $x \neq 0$

The function  $h$  is such that  $h(x) = \frac{3x}{2-x}$  where  $x \neq 2$

(b) (i) Find  $g(-2)$

$$2 - 3(-2)^4$$

$$= 2 - 3(16) = 2 - 48 \dots \dots \dots -46 \dots \dots \dots (1)$$

(ii) Express the composite function  $hg$  in the form  $hg(x) = \dots$   
Give your answer in its simplest form.

$$hg(x) = \frac{3(2-3x^4)}{2-(2-3x^4)} = \frac{2-9x^4}{3x^4}$$

$$= \frac{2-3x^4}{x^4}$$

$$hg(x) = \frac{2-3x^4}{x^4} \dots \dots \dots (2)$$

(Total for Question 18 is 4 marks)

- 19  $A, B, C$  and  $D$  are points on a circle, centre  $O$   
 $EBF$  is the tangent to the circle at  $B$

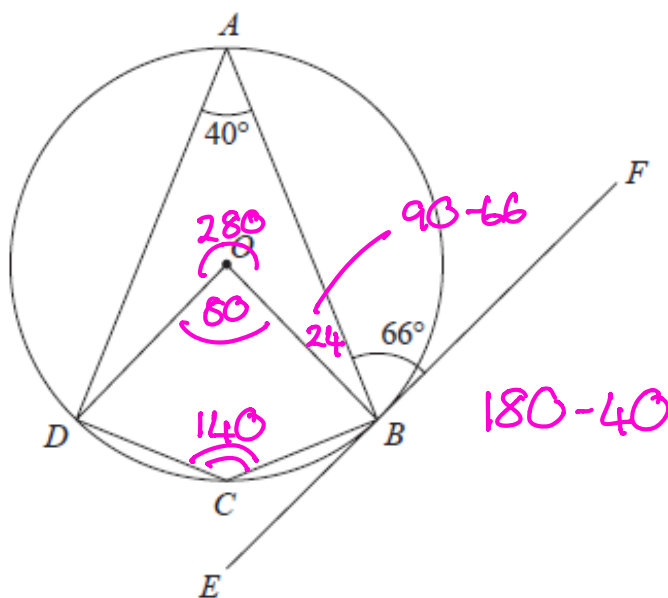


Diagram NOT accurately drawn

- (a) (i) Work out the size of angle  $DCB$

.....  
 140 .....°  
 (1)

- (ii) Give a reason for your answer to (a)(i)

.....  
 opposite angles in a cyclic quadrilateral  
 adds up to 180°  
 .....  
 (1)

- (b) Work out the size of angle  $ADO$

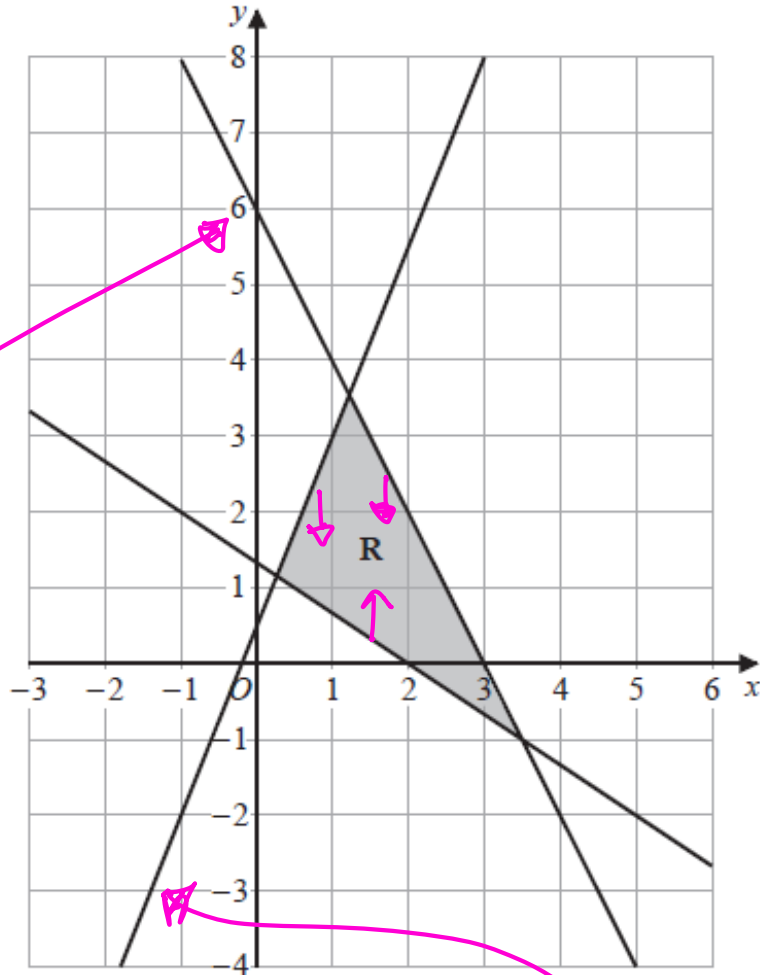
$$360 - (40 + 280 + 24)$$

$$= 360 - 344$$

$$= 16$$

.....  
 16 .....°  
 (3)

(Total for Question 19 is 5 marks)



The region **R**, shown shaded in the diagram, is bounded by the straight lines with equations

$$2x + y = 6$$

$$2y = 5x + 1$$

$$3y + 2x = 4$$

$$y = 6 - 2x$$

$$y = \frac{5}{2}x + \frac{1}{2}$$

Write down the three inequalities that define **R**

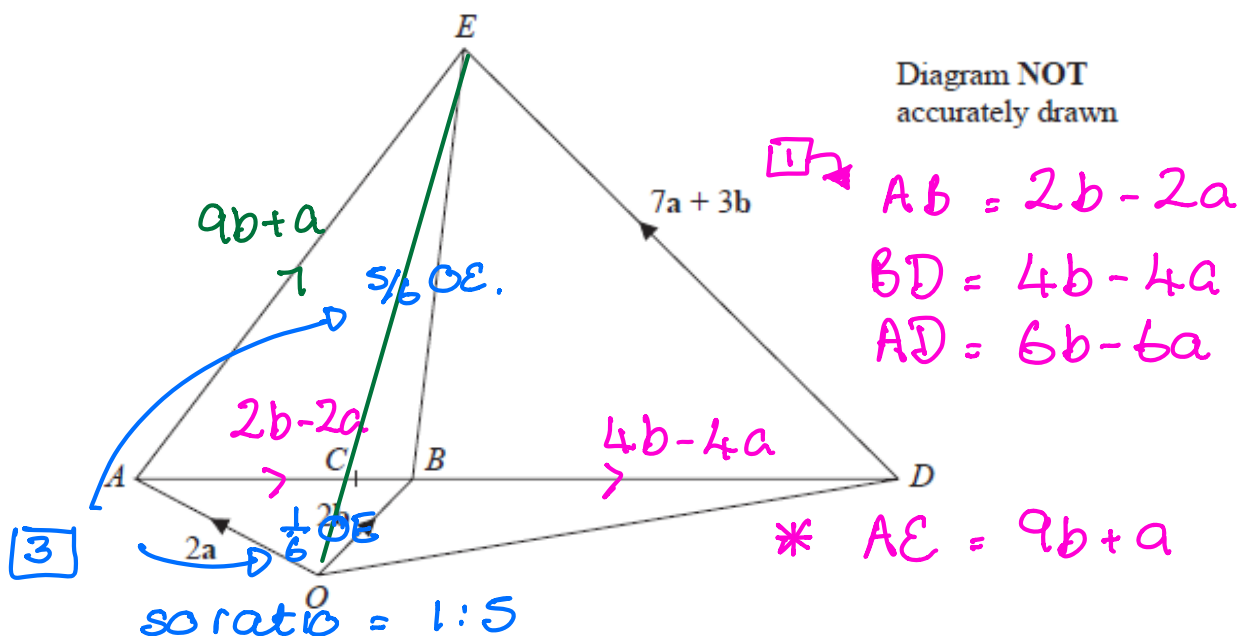
$$2x + y \leq 6$$

$$2y \leq 5x + 1$$

$$3y + 2x \geq 4$$

(Total for Question 20 is 3 marks)

21  $OAED$  is a quadrilateral.



$$\vec{OA} = 2a \quad \vec{OB} = 2b \quad \vec{DE} = 7a + 3b$$

$$AB : BD = 1 : 2$$

The point  $C$  on  $AB$  is such that  $OCE$  is a straight line.

Use a vector method to find the ratio of  $OC : CE$

$$\vec{OE} = 2b + 4b - 4a + 7a + 3b = 9b + 3a$$

and  $\vec{AE} = \lambda \vec{AD} + \mu \vec{OE}$

$$a + 9b = \lambda(6b - 6a) + \mu(9b + 3a)$$

$$a + 9b = 6\lambda b - 6\lambda a + 9\mu b + 3\mu a$$

$$= (6\lambda + 9\mu)b + (3\mu - 6\lambda)a$$

$$9\mu + 6\lambda = 9$$

$$3\mu - 6\lambda = 1$$

$$12\mu = 10$$

$$\mu = 10/12 = 5/6$$

$$3\left(\frac{5}{6}\right) - 6\lambda = 1$$

$$\lambda = \frac{2.5 - 1}{6} = \frac{1.5}{6} = \frac{1}{4}$$

$$1:5$$

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS