

NEITHER ELECTRONIC CALCULATORS NOR MATHEMATICAL TABLES MAY BE USED IN THIS PAPER

1. Evaluate

(a) $3\frac{1}{6} \times \frac{4}{9} \div 2\frac{2}{3}$

(b) $\left(\frac{16}{25}\right)^{-\frac{1}{2}} - 3\frac{2}{3}$

Answer (a) _____ [1]

(b) _____ [2]

2. (a)(i) Write down the remainder when 365 is divided by 7.

(ii) There are 365 days in the year 1997.

The first day of the year was a Sunday.

On what day of the week will 1998 begin?

(b) Mary, Betty, Alice and Karen meet for breakfast every time when they do their marketing on the same day. Mary visit the market once every 4 days, Betty every 5 days, Alice every 6 days and Karen every 12 days. If they are meeting for breakfast at the market today, how many days later will they meet again?

Answer (a)(i) _____ [1]

(ii) _____ [1]

(b) _____ [2]

3. (a) Given that $2.198^3 = 10.62$, find 21.98^3 .
- (b) Given that $11 \times 237 = 2607$, find the value of $11 \times 0.237 + \frac{2607}{2370}$.

Answer (a) _____ [2]

(b) _____ [2]

4. Mrs Lim buys x apples at \$0.50 each and $(x - 7)$ mangoes at \$1.20 each. She wishes to spend less than \$20.
- (a) Form an inequality in x .
- (b) Solve the inequality and hence, find the largest possible integer value of x .

Answer (a) _____ [1]

(b) _____ [2]

5. (a) Given that $f = \frac{1}{2p} \sqrt{\frac{m}{T}}$, make T the subject.
(b) Factorise completely $48c^2 - 27d^2$

Answer: (a) _____ [2]

(b) _____ [2]

6. Given that y varies inversely as the square root of $x + 2$ and that $y = 3$ when $x = -1$.
(a) Express y in terms of x .
(b) Find the value of y when $x = 7$.

Answer (a) _____ [2]

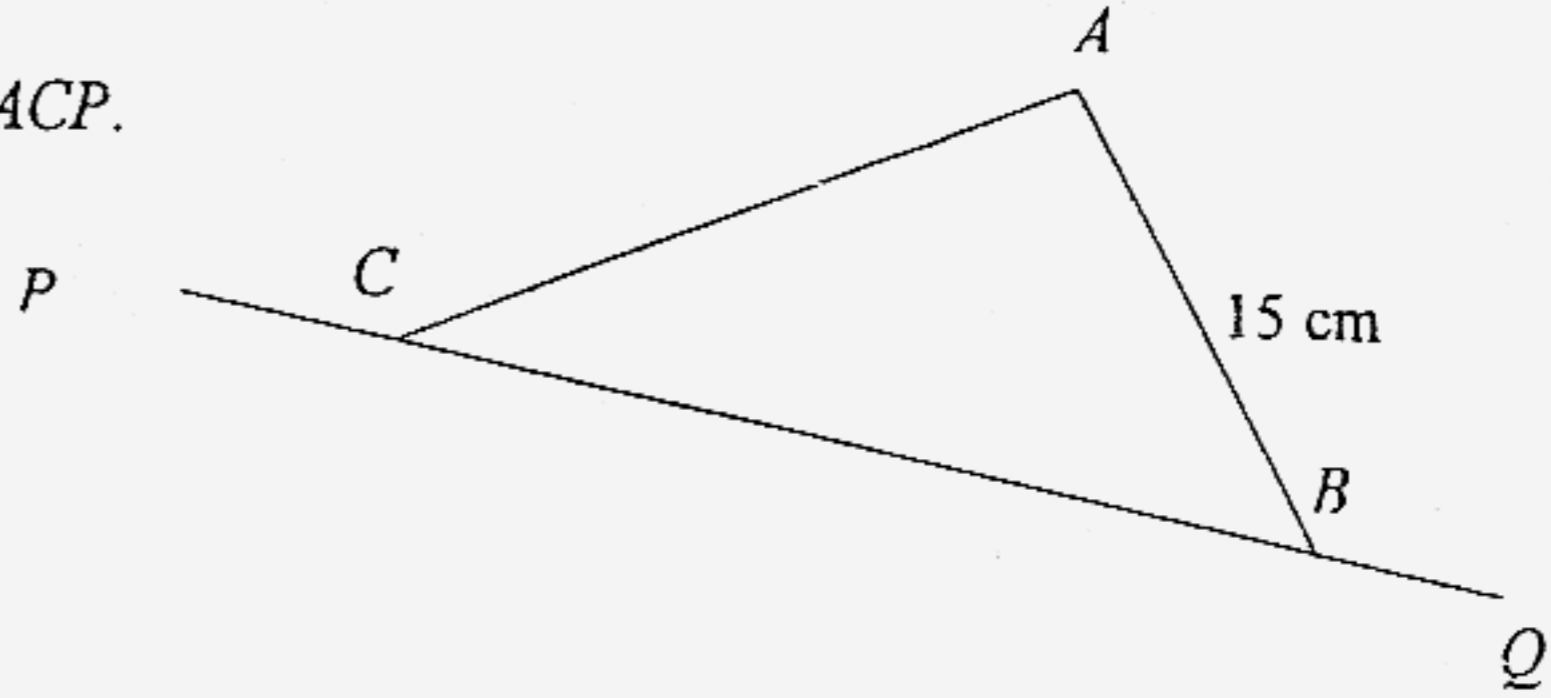
(b) _____ [1]

7. In the diagram, $PCBQ$ is a straight line.

$AB = 15 \text{ cm}$, $\sin \angle ABC = \frac{1}{2}$ and $\sin \angle ACB = \frac{1}{3}$.

(a) Write down the value of $\sin \angle ACP$.

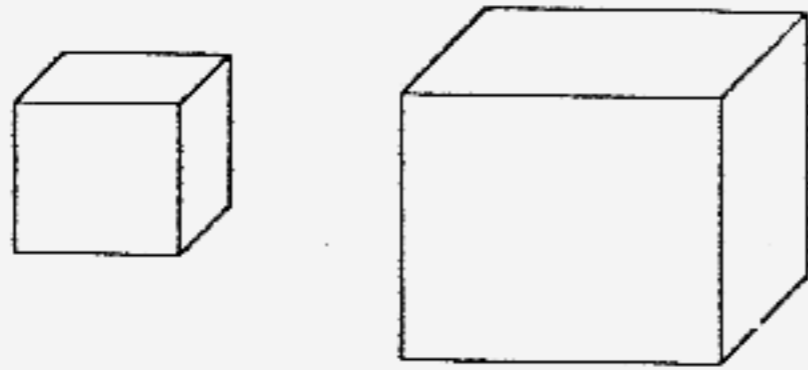
(b) Calculate AC .



Answer (a) _____ [1]

(b) _____ [2]

8.



The ratio of the areas of the bases of two geometrically similar cuboids is 4 : 25.

(a) The area of the top of the bigger cuboid is 137.5 cm^2 .
What is the area of the top of the smaller cuboid?

(b) Write down the ratio of the heights of the two cuboids.

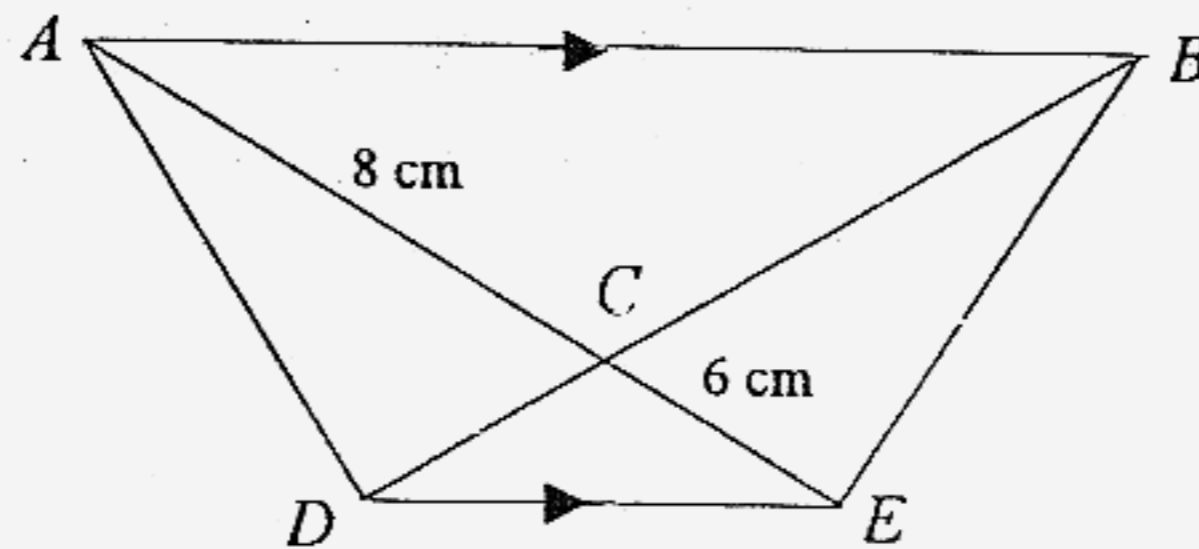
(c) Both cuboids are filled with tar.
Given that the mass of tar in the larger cuboid is 750 kg, find the mass of tar in the smaller cuboid.

Answer (a) _____ [1]

(b) _____ [1]

(c) _____ [2]

9. In the diagram, $ABED$ is a quadrilateral where AB is parallel to DE . AE and BD meet at C where $EC = 6$ cm and $CA = 8$ cm.

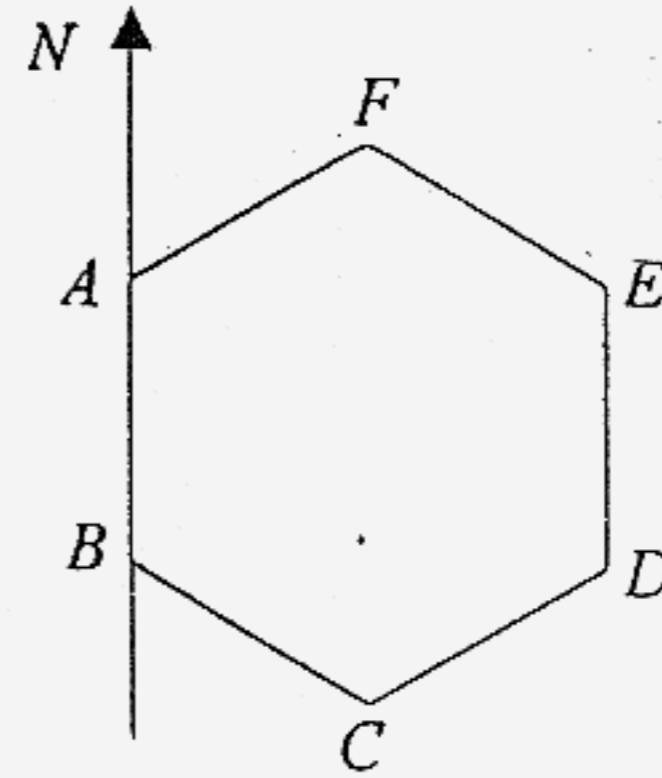


- (a) Name a pair of similar triangles and show that they are similar.
- (b) Find the value of $\frac{AB}{ED}$.
- (c) Calculate the area of $\triangle EDC$ if the area of $\triangle ABC$ is 20 cm^2 .
- (d) Calculate the area of $\triangle DEB$ if the area of $\triangle ABE$ is 35 cm^2 .

Answer : (a) _____ [2]
 (b) _____ [1]
 (c) _____ [1]
 (d) _____ [2]

10. The diagram shows a regular hexagon $ABCDEF$ where A is due North of B .
Find

- (a) angle AFE ,
(b) the bearing of F from A ,
(c) the bearing of B from D



Answer (a) _____ [2]

(b) _____ [1]

(c) _____ [1]

11. The following are the temperatures of three cities on a December night.

| City | London | Sydney | Harbin |
|-------------|----------------------|----------------------|-----------------------|
| Temperature | -6°C | 24°C | -18°C |

- (a) Find the difference in the temperatures between Harbin and Sydney.
(b) If the temperature of Hong Kong is mid-way between London and Sydney, find the temperature of Hong Kong.

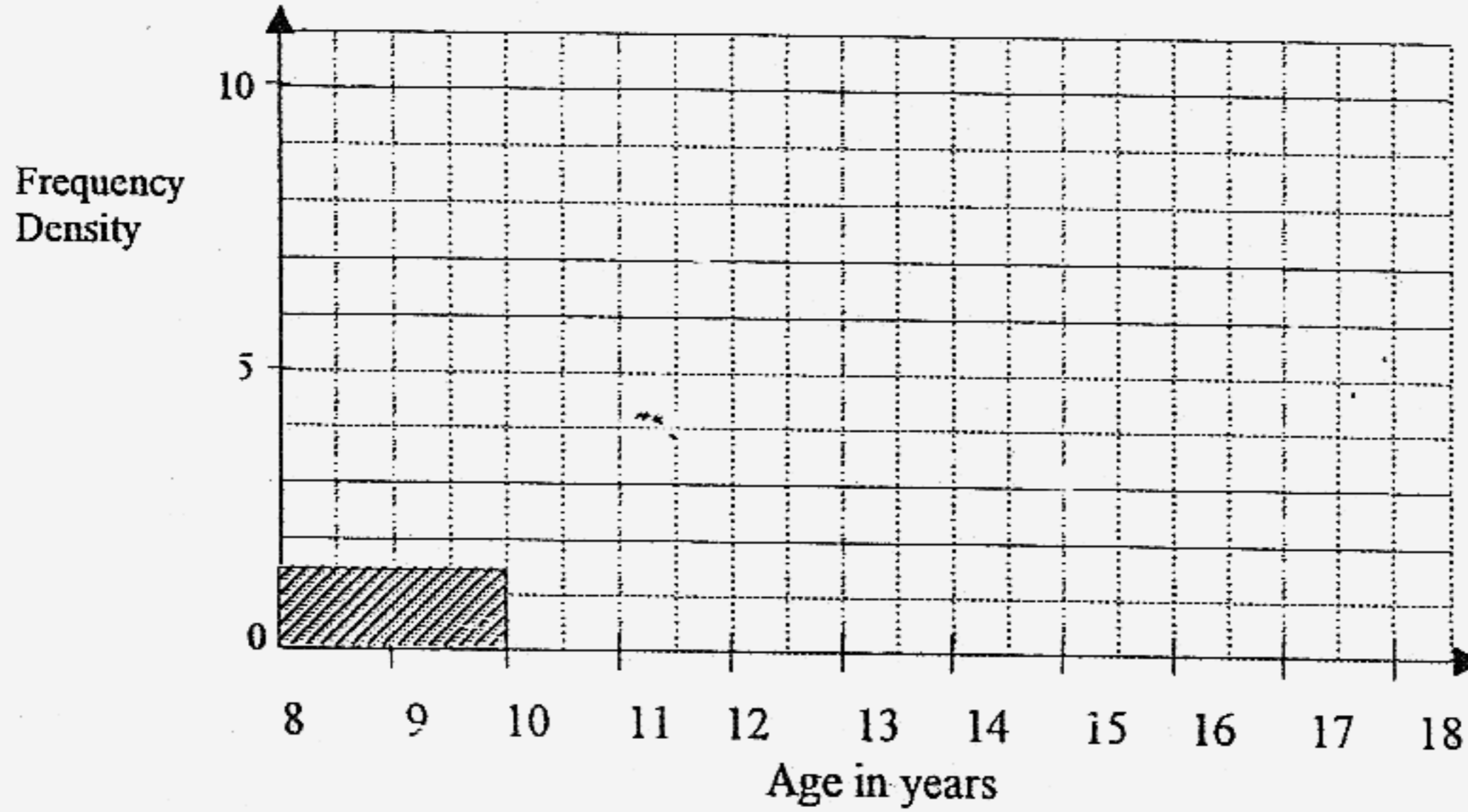
Answer (a) _____ [1]

(b) _____ [1]

12. Thirty-five students sat for a Music examination.
The age distribution of the students is given below.

| Age group | 8 – 10 | 10 – 12 | 12 – 16 | 16 – 17 |
|--------------------|--------|---------|---------|---------|
| Number of students | 3 | 10 | 12 | 10 |

A histogram is constructed from the data given in the table above.
Complete the histogram.



- (a) State the modal class
(b) Estimate the mean age.

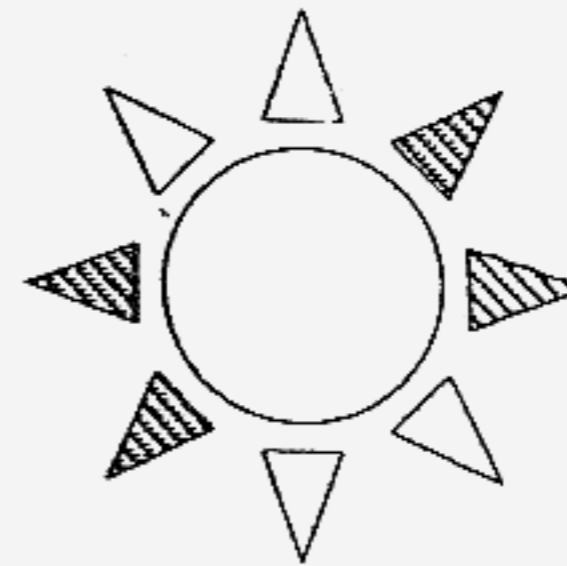
[3]

Answer (a) _____ [1]

(b) _____ [2]

13. Describe completely the symmetry of Figure A

Figure A



Answer :

[2]

14. A map is drawn using the scale of 4 cm to represent 1km. Calculate
- the scale of the map in the form 1: n,
 - the actual distance in kilometres represented by 22 cm on the map,
 - the area on the map, in square centimetres, which represent an actual area of 6.25km^2 .

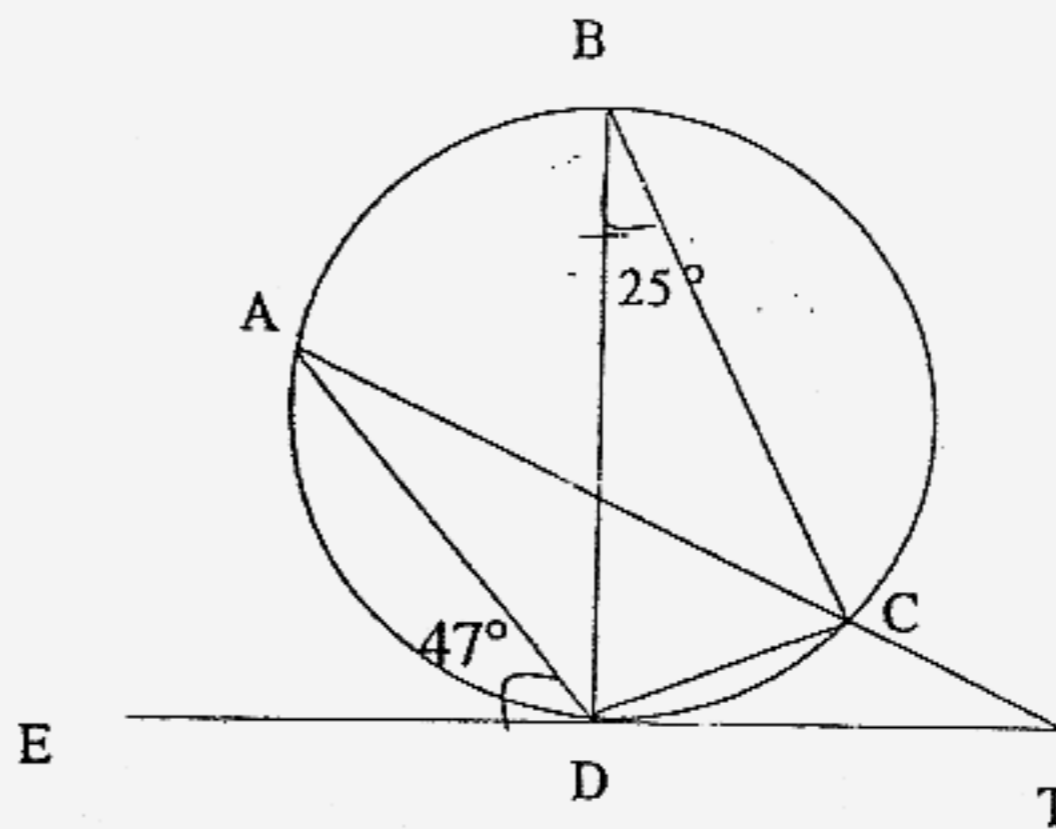
Answer: (a) _____ [2]

(b) _____ [1]

(c) _____ [2]

15. In the diagram, BD is the diameter of the circle. TDE is the tangent to the circle at the point D . ACT is a straight line. Given that $\angle ADE = 47^\circ$ and $\angle CBD = 25^\circ$, calculate, stating your reasons clearly,

- $\angle DAC$,
- $\angle CDT$,
- $\angle CTD$.
- $\angle BCA$.



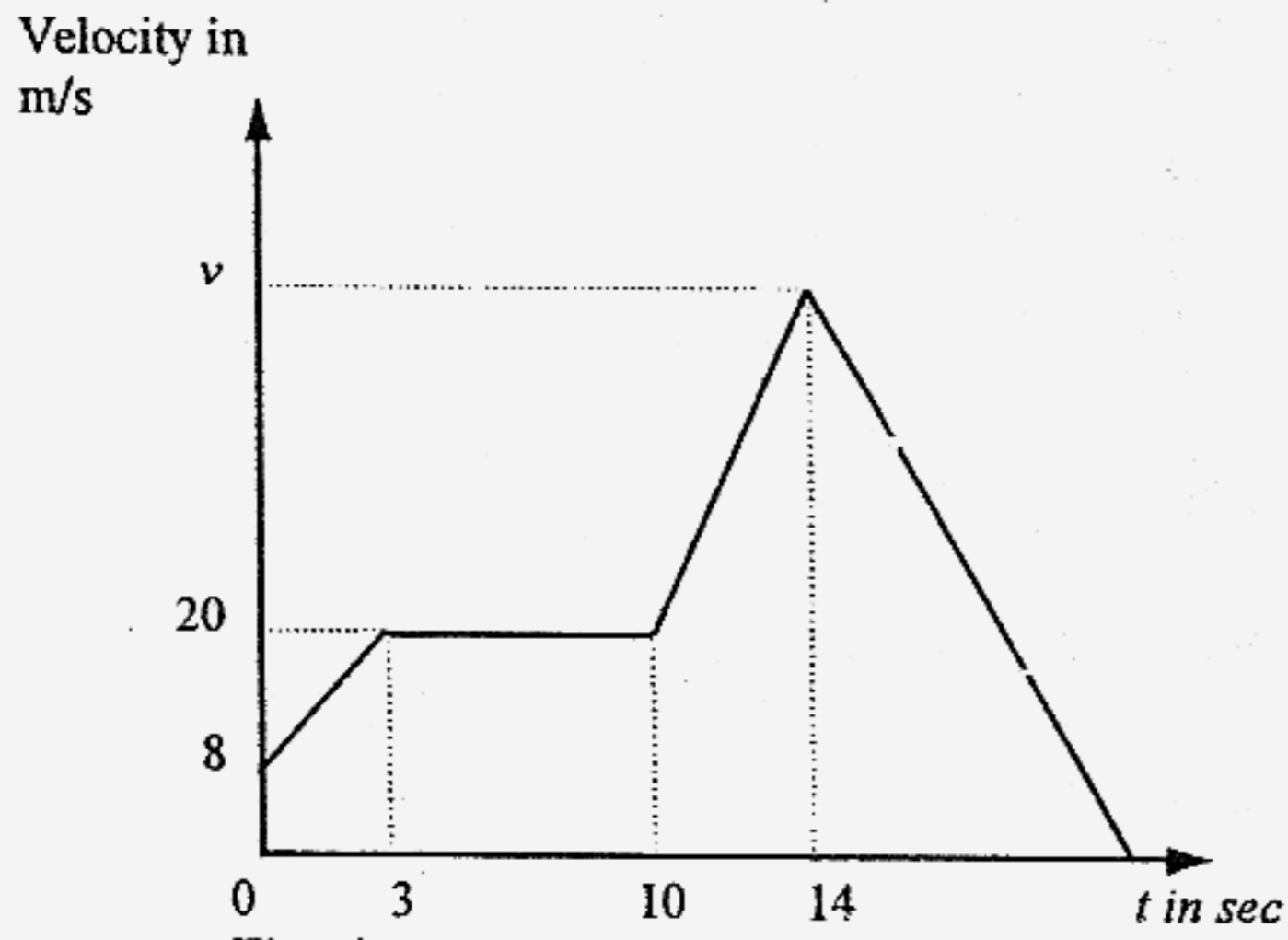
Answer (a) _____ [2]

(b) _____ [2]

(c) _____ [2]

(d) _____ [2]

17. The diagram shows the velocity-time graph of a body over a period of t seconds.



Calculate

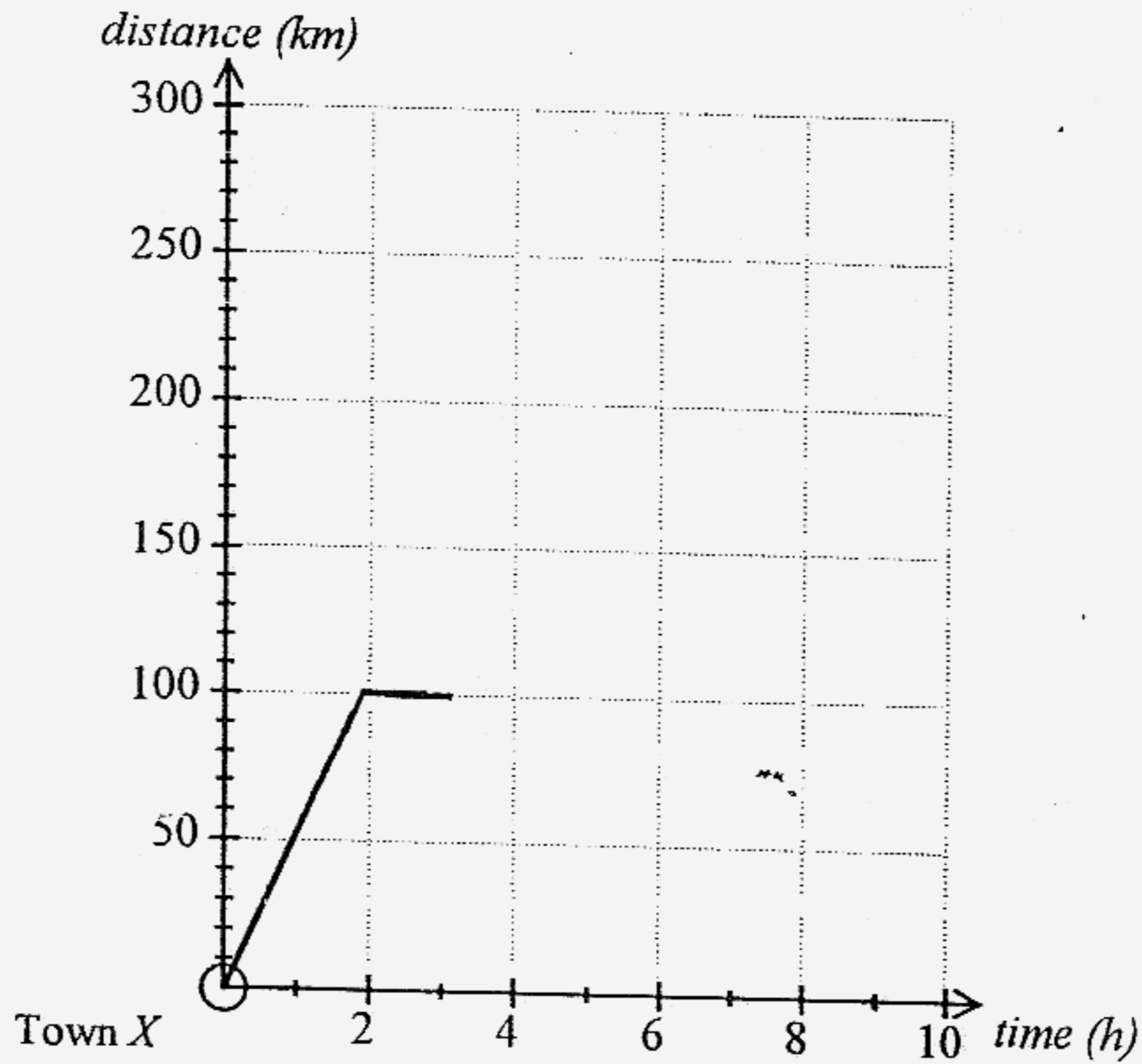
- (a) its acceleration during the first 3 seconds
 (b) the value of v if the total distance moved in the first 14 seconds is 310 m
 (c) the value of t , given that the retardation is $5\frac{1}{2}$ m/s²

Answer (a) _____ [2]

(b) _____ [2]

(c) _____ [2]

18. A cyclist completes his journey in 7 hours travelling from Town X to Town Y. The graph below is a distance-time graph showing the journey of a cyclist for the first 3 hours.



- (a) Calculate the speed of the cyclist in the first 2 hours.
Give your answer in km/h.
- (b) If for the last 4 hours, the cyclist travels at a constant speed of 40 km/h, calculate the distance covered in the 4 hours and complete the graph.
- (c) Sketch on the same graph, the journey by a motorist who travels at a constant speed of 65 km/h from Town Y to Town X. Assume that the motorist starts at Town Y at 0 h.

[2]

Answer (a) _____ [1]

(b) _____ [2]

END OF PAPER

Section A [88 marks]

Answer ALL the questions in this section

1. Mr Ng wishes to buy a new car which is priced in the showroom at \$85 000.
- (a) If he pays cash, he will be given a discount.
Calculate the percentage discount if he only needs to pay \$79 050. [1]
- (b) Mr Ng trades in his old car for \$42 350 and borrows the remaining amount from a finance company which charges simple interest at the rate of 3% per annum. If Mr Ng wishes to pay the loan in 4 years calculate
- (i) the total interest he has to pay for the loan at the end of 4 years. [2]
(ii) the amount he has to pay each month to the finance company. [2]
(Give your answer to the nearest cents)
2. (a) Solve the equation $(x+2)(x-3)=14$. [2]
(b) Express as single fraction [3]
- $$\frac{3}{x-1} - \frac{2}{5x+4}$$
- (c) Simplify $\frac{y^2+5y+6}{y^2-4}$ [2]
(d) Given that $2+gw=h-3kw$, express w in terms of g , h and k . [3]
(e) A fruit seller bought 153 pears and apples altogether. He discovered $\frac{1}{3}$ of pears and 10 apples were rotten. The remaining number of pears and apples were in the ratio 3:1. How many pears were rotten? [3]
3. The distance between two towns, A and B, is 250 km. A driver travelled from A to B at an average speed of x km/h.
- (a) Express in terms of x , the time (in hours) that the driver took to complete the journey from A to B. [1]
(b) On the return journey, he travelled 5 km/h faster.
Express in terms of x , the time (in hours) he took for the return journey. [1]
(c) His return journey took him 25 minutes less. Form an equation in x and show that it reduces to $x^2+5x-3000=0$ [3]
(d) Solve the equation $x^2+5x-3000=0$, giving both answers correct to 2 decimal places. [3]
(e) Hence, find the time, correct to the nearest minute for the return journey [2]

4. In this question take π to be 3.142

Figure 1 shows a sheet of aluminium. The aluminium sheet is in the shape of a sector of a circle centre O , radius 12cm. Given that OA and OB are radii of the circle and reflex $\angle AOB = 240^\circ$.

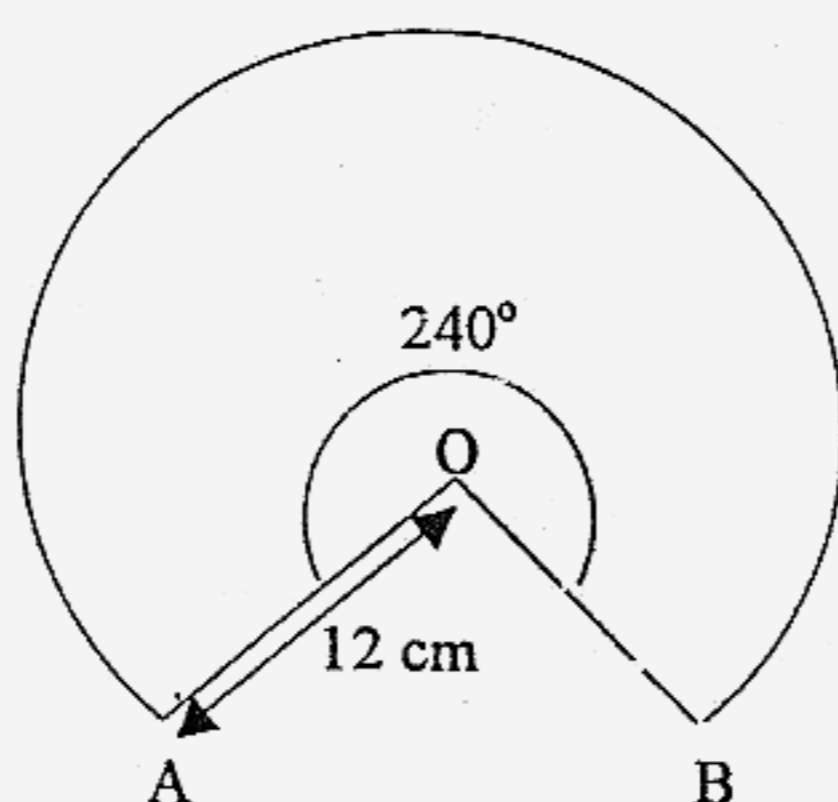


Figure 1

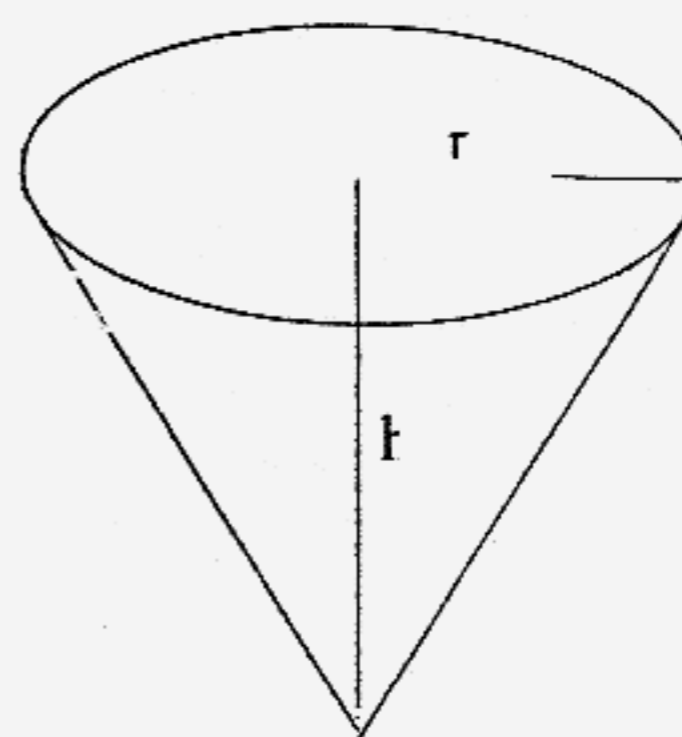
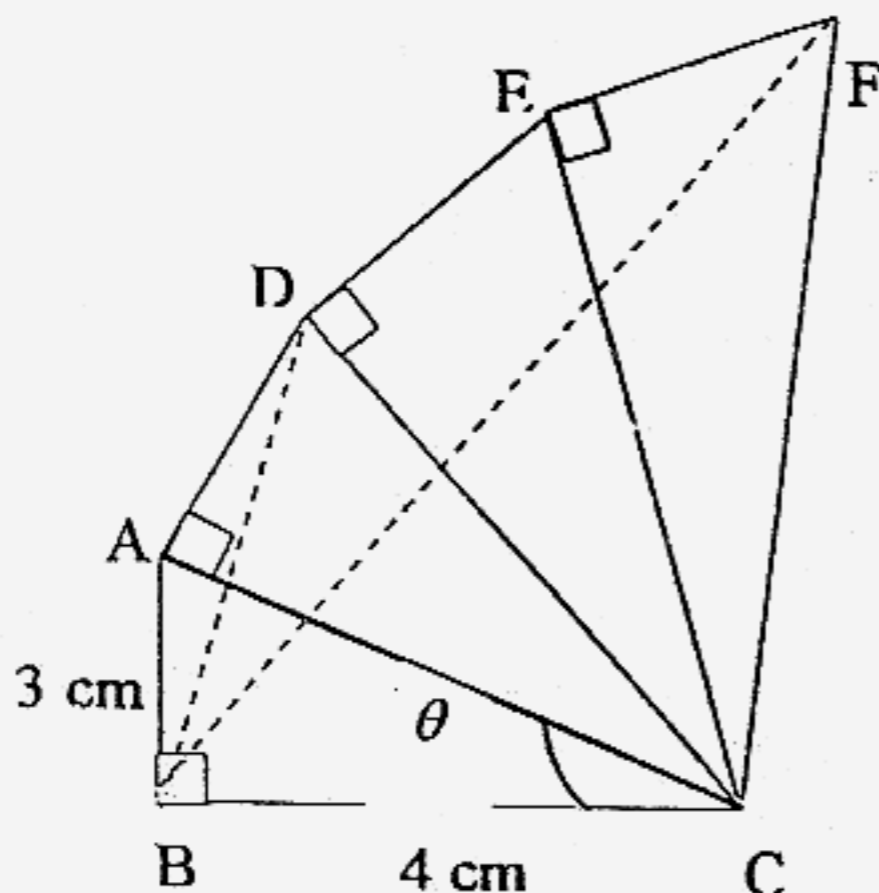


Figure 2

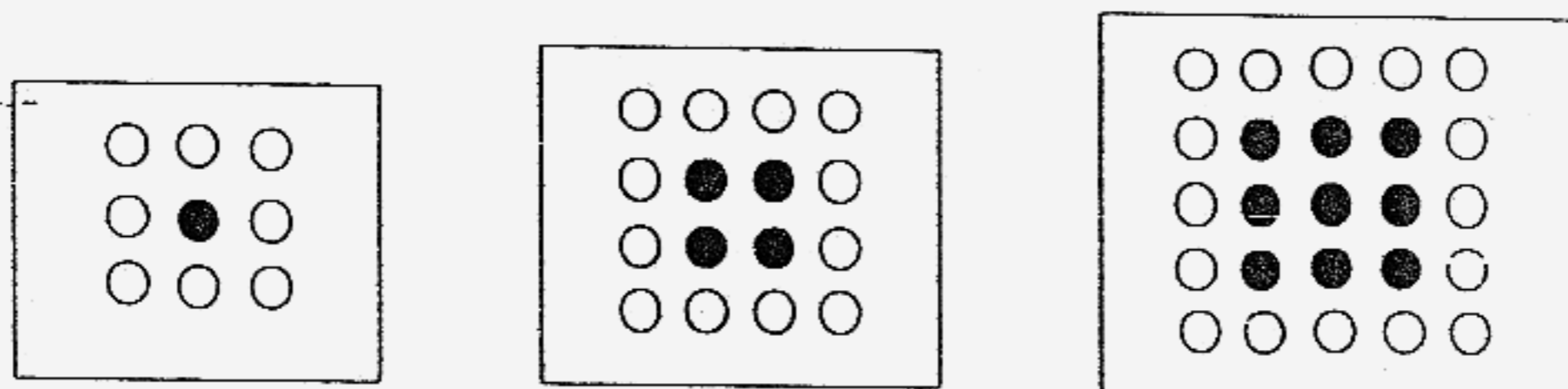
- (a) Calculate the perimeter of the aluminium sheet. [2]
- (b) Figure 2 shows a cone formed by welding together OA and OB . If r is the radius of the base and h is the height of the cone, calculate
- (i) the value of r [2]
- (ii) the value of h [2]
- (c) The cone in figure 2 is now filled with 294cm^3 of water. Metal bearings in the shape of spheres of radius 2mm are dropped into the water until it overflows. Find the maximum number of ball bearings that can be dropped into the cone before the water overflows. [3]

$$\left[\text{Volume of cone} = \frac{1}{3}\pi r^2 h, \text{ Volume of sphere} = \frac{4}{3}\pi r^3 \right]$$

5. In the given figure $\angle ABC = \angle DAC = \angle EDC = \angle FEC = 90^\circ$.
 $\angle BCA = \angle ACD = \angle DCE = \angle ECF = \theta$, $AB = 3$ cm and $BC = 4$ cm.



- (i) Find the length AC. [1]
 (ii) Find the angle θ . [1]
 (iii) Given that $CD = 6.25$ cm, find the length CF. [2]
 (iv) Find the ratio of area of $\triangle BCD$ to area of $\triangle BCF$, giving your answers to 2 decimal places. [2]
6. The points $A(2, 3)$ and $B(a, 7)$ lies on the line l of gradient -3 .
- (a) Find the value of a [2]
 (b) Find the equation of the line l [2]
 (c) If C is a point on the line produced such that B is the mid point of A and C ,
 (i) find the coordinates of C . [2]
 (ii) calculate the distance AC . [2]
 (d) If the line l is parallel to the line $kx + 3y = 4$, find k . [2]
7. Peter used white and black magnetic buttons to make a series of designs. The first three designs are shown below:



Design 1

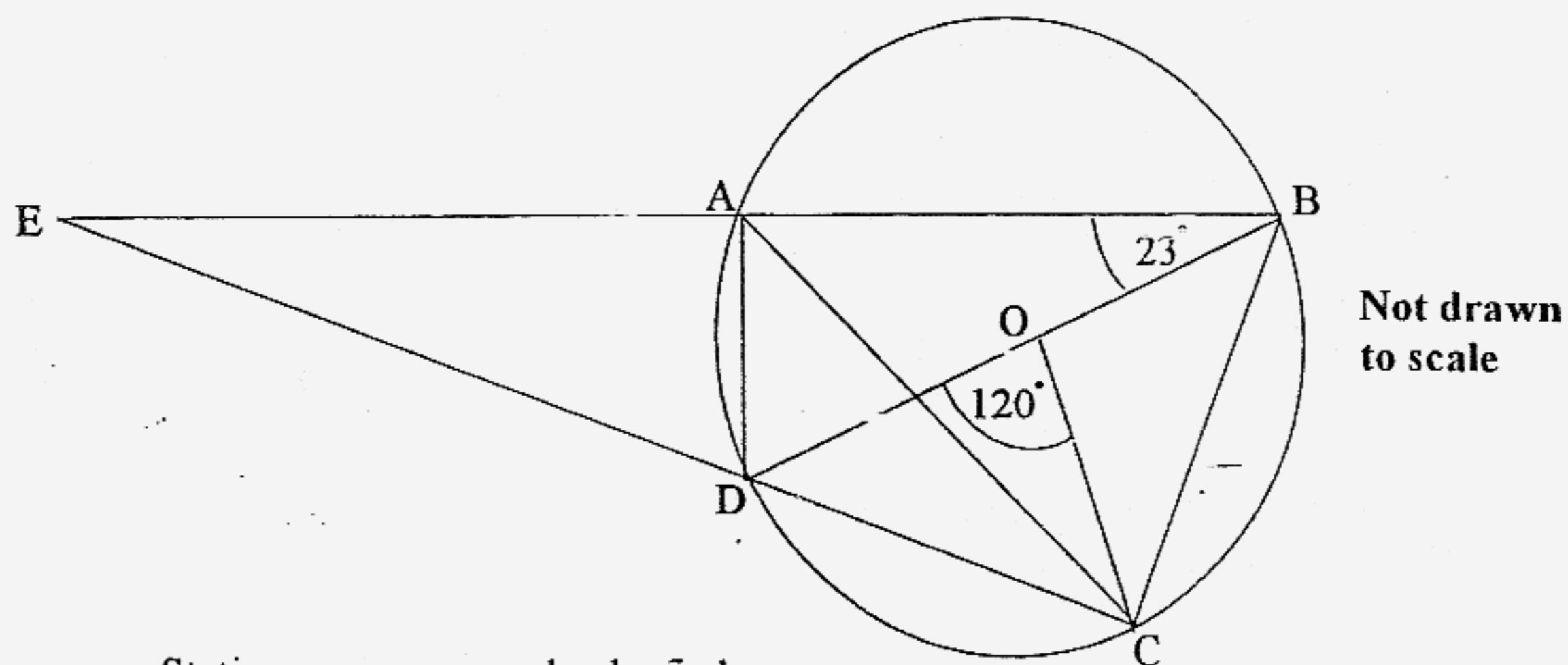
Design 2

Design 3

Each time he made a design, he count the number of white and black buttons used. The results obtained from the first three designs are recorded in the table below.

| Design No. (N) | Number of black buttons (B) | Number of white buttons (W) |
|-------------------|--------------------------------|--------------------------------|
| 1 | 1 | 8 |
| 2 | 4 | 12 |
| 3 | 9 | 16 |
| 4 | x | y |

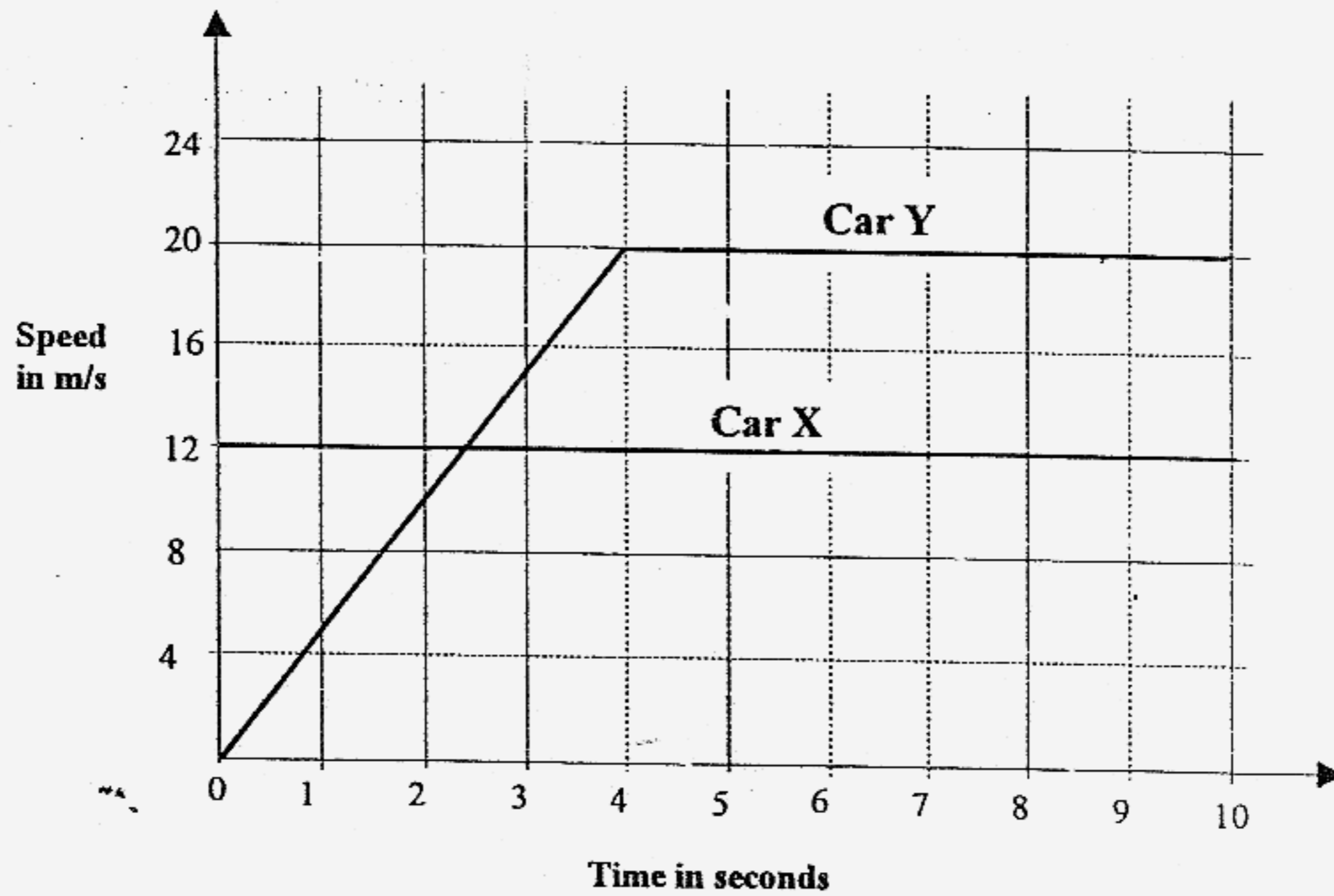
- (a) Write down the values of x and y . [2]
 (b) Write a formula connecting N and W . [2]
 (c) Hence, or otherwise, determine which design uses 96 white buttons [2]
 (d) Give a reason why W can never be equal to 502. [1]
8. BD is a diameter of the circle, centre O . C and A are two points on the circle.
 BA and CD , when produced, meet at E . $\hat{D}OC = 120^\circ$ and $\hat{A}BD = 23^\circ$



Stating your reasons clearly, find

- (a) $\hat{O}BC$ [1]
 (b) $\hat{D}CA$ [1]
 (c) $\hat{A}DB$ [2]
 (d) $\hat{A}ED$ [2]

9.



The diagram shows the speed-time graph of two cars X and Y for the first 10 seconds of their motion.

Car X travels at a constant speed of 12m/s throughout the 10 seconds.

Car Y starts from rest, attain a speed of 20m/s after 4 seconds and then travels at constant speed of 20m/s.

(a) Calculate

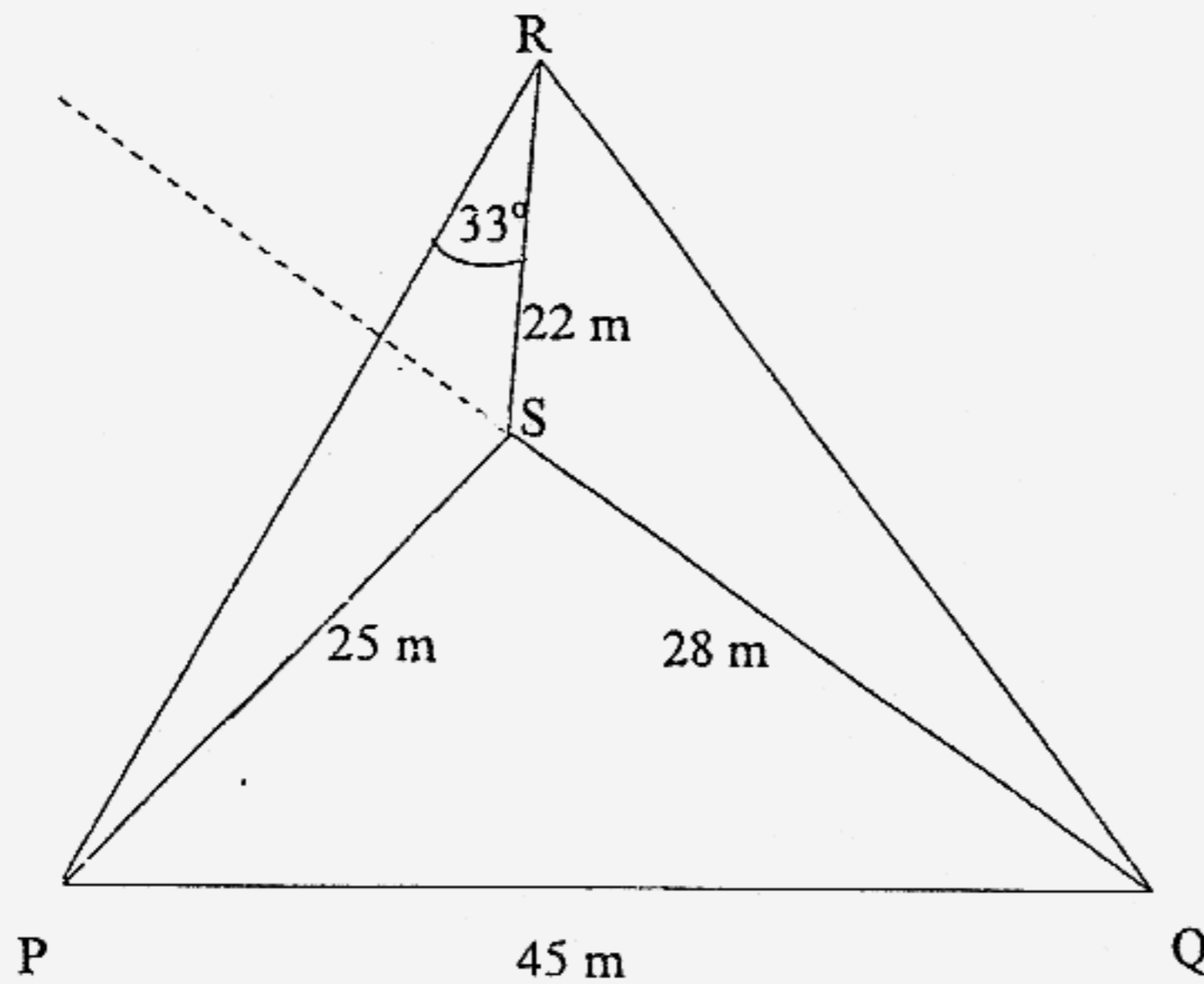
- (i) the distance travelled by car X during the first 4 seconds of its motion. [1]
- (ii) the average speed of car Y for the first 10 seconds of its motion. [2]
- (iii) the time when both cars have travelled the same distance. [3]

(b) After 10 seconds, both cars slow down at the same rate until they come to rest.

Given that car X comes to a rest after a further of 6 seconds, calculate

- (i) the deceleration of car X. [1]
- (ii) the time taken for car Y to come to rest. [2]

10. The diagram shows four points P, Q, R, S, on a horizontal ground. It is given that $PQ = 45$ m, $PS = 25$ m, $QS = 28$ m.



- (a) Calculate \hat{PSQ} . [3]
- (b) Given also that $RS = 22$ m and that $\hat{RPS} = 33^\circ$, calculate \hat{PSR} . [3]
- (c) The line QS is produced beyond S. Calculate the shortest distance from R to this extended line. [3]
- (d) S is the foot of a vertical mast, ST.
The angle of elevation of the top of the mast, T, from P is 40° .
Calculate the angle of elevation of T from Q [4]

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Section B [12 marks]

Answer ONE question in this section.

11. Answer the whole of this question on a sheet of graph paper.

The following table gives corresponding values of x and y which are connected by the equation $y = x + \frac{12}{x} - 5$.

| | | | | | | | | | |
|-----|---|-----|---|---|---|-----|---|-----|-----|
| x | 1 | 1.5 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| y | 8 | p | 3 | 2 | 2 | q | 3 | 3.7 | 4.5 |

- (a) Calculate the value of p and of q . [1]
- (b) Using a scale of 2 cm to 1 unit on both the x and y axes, draw the graph of $y = x + \frac{12}{x} - 5$ for $1 \leq x \leq 8$. [3]
- (c) By drawing a tangent, find the approximate gradient of the curve at the point $x = 6$. [2]
- (d) Use your graph to find
- (i) the minimum value of $x + \frac{12}{x} - 5$, [1]
- (ii) the solution of the equation $x + \frac{12}{x} - 5 = 5$ by drawing a suitable straight line, [1]
- (e) On the same axes used in part (b), draw the graph of $y = 7 - x$ for values from $x = 1$ to $x = 8$ [1]
- (i) Write down the x coordinates of the points at which the two graphs intersect. [1]
- (ii) The x coordinates of the points where the line $y = 7 - x$ intersects the curve are the solutions of the equation $x^2 + ax + b = 0$. Find the value of a and the value of b . [2]

12. Answer the whole of this question on a sheet of graph paper.

An open rectangular tank has a square base of side x metres.
The volume of the tank is 30 m^3 .

- (a) (i) Find an expression in terms of x , for the height of the tank.

[1]

- (ii) Hence show that the total external surface area of the tank, A square metres is given by

$$A = x^2 + \frac{120}{x} \quad [1]$$

- (b) The table below shows some values of x and the corresponding values of A , correct to 1 decimal place, where $A = x^2 + \frac{120}{x}$.

| | | | | | | | | |
|-----|----|------|----|----|----|----|------|-----|
| x | 2 | 2.5 | 3 | 4 | 5 | 6 | 7 | 8 |
| A | 64 | 54.3 | 49 | 46 | 49 | 56 | 66.1 | r |

- (i) Find the value of r .

[1]

- (ii) Using a scale of 2 cm to 1 m, draw a horizontal x -axis for $2 \leq x \leq 8$.

Using a scale of 2 cm to 10 m^2 , draw a vertical A -axis for $40 \leq A \leq 90$.

On your axes, plot the points given in the table and join them with a smooth curve.

[3]

- (c) By drawing a suitable tangent, find the gradient of the curve $A = x^2 + \frac{120}{x}$

at $x = 6$.

[2]

- (d) Using your graph, find the values of x for which the surface area is 60 m^2 .

[2]

- (e) Using your graph, find the dimensions of the tank which has the least possible surface area.

[2]

END OF PAPER 2

Paper 1

1. (a) $\frac{19}{36}$ (b) $-2\frac{5}{12}$
2. (a)(i) 1 (ii) Monday (b) 60 days
3. (a) 10620 (b) 3.707
4. (a) $\frac{1}{2}x + 1.2(x - 7) < 20$ (b) 16
5. (a) $T = \frac{m}{4p^2f^2}$ (b) $3(4c - 3d)(4c + 3d)$
6. (a) $y = \frac{3}{\sqrt{x+2}}$ (b) $y = 1$
7. (a) $\frac{1}{3}$ (b) 22.5 cm
8. (a) 22 (b) 2:5 (c) 48 kg
9. (a) $\triangle ABC : \triangle EDC$ (b) $\frac{4}{3}$ (c) $11\frac{1}{4}$ (d) $26\frac{1}{4}$
10. (a) 120 (b) 060 (c) 270
11. (a) 42 (b) 9
12. (a) 16 - 17 (b) $13\frac{3}{7}$
13. Line symmetry about L_1 and L_2 ; Rotational symmetry about O of order 2.
14. (a) 1 : 25 000 (b) 5.5 km (c) 100
15. (a) 25 (b) 25 (c) 22 (d) 43
16. (c) $m = 14, n = 9$ d(i) 2 (ii) 2
17. (a) (i) 4 (ii) 4 (iii) 22 s
18. (a) 50 km/h (b) 160 km

EOY 2006 E Maths Paper 2 ANSWERS

$$1(a) \text{ Percentage discount} = \frac{5950}{8500} \times 100 = 7\%$$

$$(b) (i) \text{ Total interest} = \$42650 \times \frac{3}{100} \times 4 = \$5118$$

$$(b)(ii) \text{ Amount paid each month} = \frac{47768}{4 \times 12} = \$995.1667 \approx \$995.17$$

$$2(a) x = -4 \text{ or } x = 5$$

$$(b) \frac{13x+14}{(x-1)(5x+4)}$$

$$(c) \frac{y+3}{y-2}$$

$$(d) w = \frac{h-2}{g+3k}$$

$$(e) 39$$

$$3(a) \frac{250}{x} \text{ hours}$$

$$(b) \frac{250}{x+5} \text{ hours}$$

$$(c) \frac{250}{x} - \frac{250}{x+5} = \frac{5}{12}$$

$$x^2 + 5x - 3000 = 0(\text{shown})$$

$$(d) x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-3000)}}{2(1)}$$

$$= 52.33 \text{ km/h or } -57.33 \text{ km/h}$$

$$(e) T \approx 262 \text{ mins}$$

4. (a) $50.272 + 24 = 74.272 \approx 74.3$ cm

(b)(i) $r = 8$ cm

(ii) $h = \sqrt{(12)^2 - (8)^2}$
 $= 8.9443 \approx 8.94$ cm

(c) Maximum number of ball bearings $= \frac{305.53}{0.033515} = 9116.21 \approx 9116$

5.(i) $AC = \sqrt{3^2 + 4^2} = 5$ cm

(ii) $\theta = 36.8699 \approx 36.9^\circ$ (1 d.p)

(iii) $EC = 7.8125$

$CF = 9.7656 \approx 9.77$ cm

(iv) $\frac{\text{area of BCD}}{\text{area of BCF}} = \frac{\frac{1}{2}(4)(6.25)\sin 2\theta}{\frac{1}{2}(4)(9.7656)\sin 4\theta}$
 $= 1.14$ (2 d.p)

6(a) $-3 = \frac{7-3}{a-2}$

$a = \frac{2}{3}$

(b) $y = -3x + 9$

(c)(i) $C = (-\frac{2}{3}, 11)$

(ii) 8.43 units

(d) $k = 9$

7(a) $x = 16$ (B1)

$y = 20$ (B1)

(b) $W = 4N + 4$ (A2)

(c) $96 = 4N + 4$ (M1)

$$N = \frac{96 - 4}{4} = 23 \text{ (A1)}$$

(d) If $w = 502$

$$502 = 4N + 4$$

$$4N = 498$$

$$N = 124.5 \text{ (M1)}$$

The design No. must be an integer

8(a)(i) $\hat{O}BC = 60^\circ$ (angle at centre = 2x angle at circumf)

(ii) $\hat{D}CA = 23^\circ$ (angle in the same segment)

(iii) $\hat{A}DB = 180^\circ - 90^\circ - 23^\circ = 67^\circ$

(angle in a semicircle, sum of angle in triangle)

(iv) $\hat{E}DB = 180^\circ - 30^\circ = 150^\circ$

$$\hat{A}ED = 180^\circ - 150^\circ - 23^\circ = 7^\circ \text{ (sum of angle in triangle)}$$

9(a)(i) Distance = $12 \times 4 = 48m$

(ii) Average speed = $\frac{160}{10} = 16m/s$

(iii) $t = 5s$

(b) (i) deceleration = $\frac{12}{6} = 2m/s^2$

(ii) $2 = \frac{20}{t}$

$$t = 10s$$

$$10(a) \cos \hat{P} \hat{S} \hat{Q} = \frac{25^2 + 28^2 - 45^2}{2(25)(28)}$$

$$= \frac{-11}{25}$$

$$\hat{P} \hat{S} \hat{Q} = 116.1^\circ$$

$$10(b) \hat{P} \hat{S} \hat{R} = 18.36 \approx 118.4 (1 \text{ d.p.})$$

(c) Let RX be the shortest distance

$$\hat{R} \hat{S} \hat{Q} = 360^\circ - 116.1^\circ - 118.4^\circ$$

$$= 125.5^\circ (\angle \text{ at a pt})$$

$$\hat{X} \hat{S} \hat{R} = 180^\circ - 125.5^\circ$$

$$= 54.5^\circ (\angle \text{ on a str. line})$$

$$\text{In triangle RXS, } \sin 54.5^\circ = \frac{RX}{22}$$

$$RX = 22 \times \sin 54.5^\circ$$

$$= 17.9105$$

$$\approx 17.9 \text{ m}$$

$$(d) \tan 40^\circ = \frac{TS}{25}$$

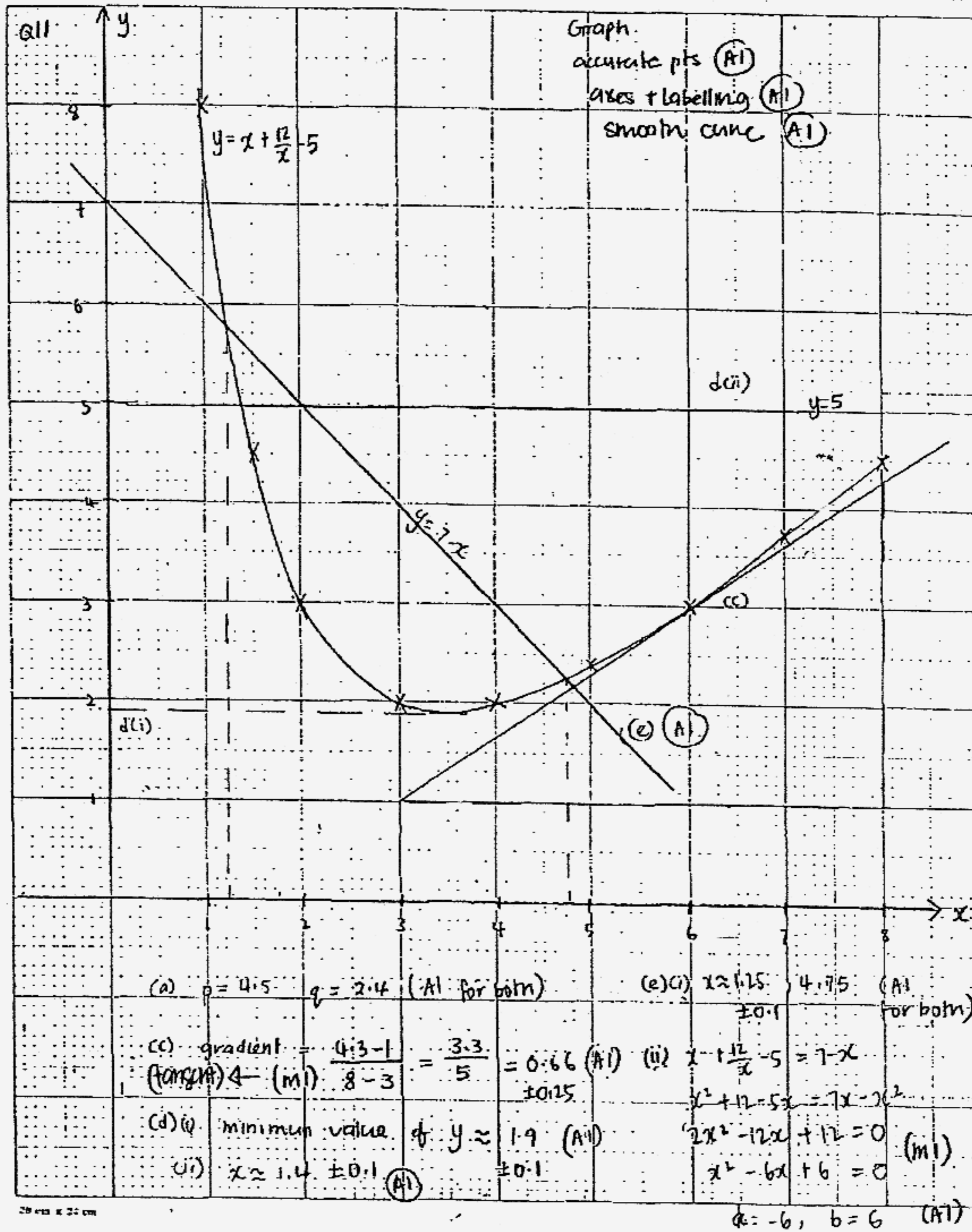
$$TS = 25 \tan 40^\circ$$

$$= 20.98 \text{ m}$$

$$\tan \hat{T} \hat{Q} \hat{S} = \frac{20.98}{28}$$

$$\hat{T} \hat{Q} \hat{S} = 36.84^\circ$$

The angle of elevation of T from Q is 36.8°



Graph (3) — accurate pts (A1)
 axes + labelling (A1)
 smooth curve (A1)

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