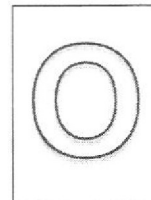




CANBERRA SECONDARY SCHOOL



## 2021 Preliminary Examination

### Secondary Four Express/Five Normal Academic

#### MATHEMATICS

4048/02

23 Aug 2021

2 hours 30 minutes

1100h – 1330h

Name: \_\_\_\_\_ (      ) Class: \_\_\_\_\_

#### READ THESE INSTRUCTIONS FIRST

Write your full name, class and index number on all work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

If working is needed for any question it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For  $\pi$ , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$ .

The number of marks is given in brackets [   ] at the end of each question or part question.

The total number of marks for this paper is 100.

FOR MARKER'S USE		
	Marks Awarded	Max Marks
Total		100

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This question paper consists of 23 printed pages including the cover page.

***Mathematical Formulae***

Compound interest

$$\text{Total amount} = P \left( 1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved Surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector Area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left( \frac{\sum fx}{\sum f} \right)^2}$$

1 (a) Simplify  $\frac{16a^4b^2}{5} \div \frac{8a^3}{25ab^3}$ .

Answer ..... [2]

- (b) (i) Express  $-4x + x^2 - 6$  in the form  $a + (x + b)^2$ , where  $a$  and  $b$  are integers.

Answer ..... [2]

- (ii) Write down the coordinates of the minimum point of the graph of  $y = -4x + x^2 - 6$ .

Answer ( ..... , ..... ) [1]

(c)  $l = \frac{1}{2}(m^2 - n)$

(i) Evaluate  $l$  when  $m = 4$  and  $n = -5$ .

Answer  $l =$  ..... [1]

(ii) Express  $n$  in terms of  $l$  and  $m$ .

Answer ..... [2]

(d) Solve  $\frac{x+1}{2x+3} + \frac{3x}{4x^2-9} = 2$ .

Answer  $x =$  ..... or ..... [4]



- 2 (a) A children indoor playground can accommodate 160 people in a session. Ticket price for an accompanying adult and a child is \$9 and \$32.50 respectively.

- (i) On a particular weekend afternoon, the playground is 60% full. 75% of the patrons are children.

Calculate the total amount collected from the sales of tickets.

Answer \$ \_\_\_\_\_ [3]

- (ii) On that same particular weekend evening, \$3900 was collected from the sales of tickets for children.

Calculate the percentage increase in the number of children who patronized the playground on the weekend evening compared to the afternoon.

Answer \_\_\_\_\_ % [3]

- (b) Arielle plans to invest \$25 000 over a period of 2 years.  
Plan *A* offers simple interest of 6.2% per annum.  
Plan *B* offers 6% per annum interest compounded quarterly.

Determine which plan offers a better return for her.  
Justify your answer.

*Answer*

[5]

- 3 (a) Students in a class were asked how many siblings they have.  
The results are shown in the table.

Number of sibling	0	1	2	3	4
Number of students	5	18	10	$x$	2

- (i) The modal number of siblings is 1.  
Calculate the greatest possible number of students in the class.

Answer ..... [2]

- (ii) The median number of siblings is 2.  
Calculate the smallest possible value of  $x$ .

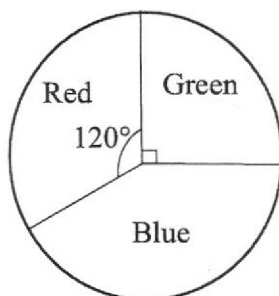
Answer  $x =$  ..... [1]

- (iii) The mean number of siblings is 1.525.  
Calculate the value of  $x$ .

Answer  $x =$  ..... [2]

- (b) A dart board comprises of 3 colours as shown below.

**[Turn Over**



A pouch contains six 10 cents coins, three 20 cents coins and one 50 cents coin.

Tim throws a dart first then picks a coin from the pouch.

- (i) Draw a tree diagram to show the probabilities of the possible outcomes.

*Answer*

[2]

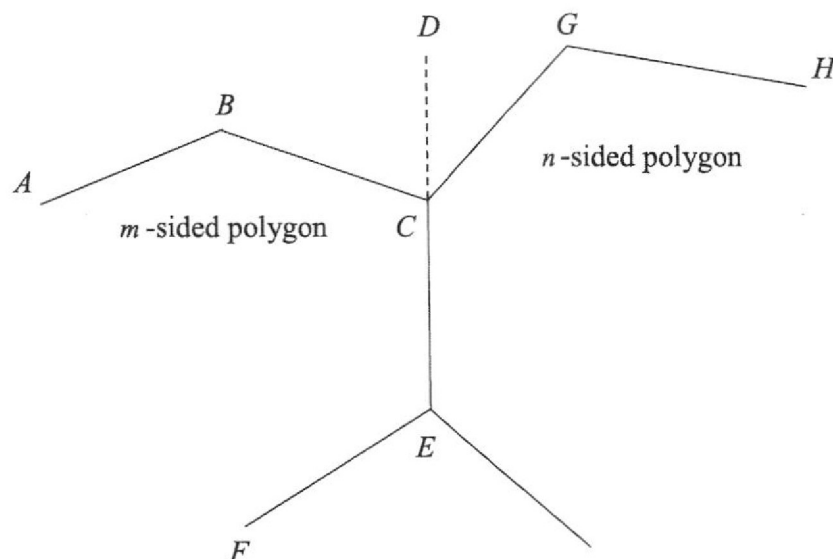
- (ii) Calculate the probability that the dart hits the red region and a 20 cent coin is picked.

*Answer* ..... [2]

- (iii) State one assumption made.

*Answer* .....  
.....  
..... [1]

- 4 (a) A regular  $m$ -sided polygon and a regular  $n$ -sided polygon are joined together.  
Part of the polygons are shown below.  
 $\angle BCD : \angle DCG = 5 : 3$



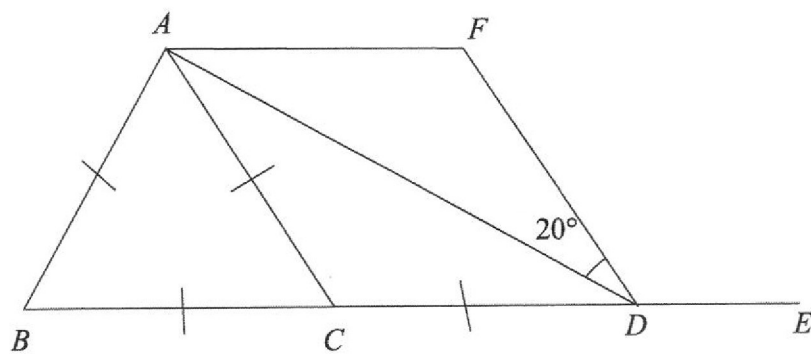
Mike made some calculations and claimed that  $m = 6$  and  $n = 10$ .

Determine if Mike's claim is accurate.  
Justify your answer.

*Answer*

[4]

(b)



Triangle  $ABC$  is an equilateral triangle.

$AC = CD$ .

$\angle ADF = 20^\circ$

$AD$  bisects  $\angle CAF$ .

- (i) Show that  $AF$  is parallel to  $CD$ .  
State your reasons.

*Answer*

[2]

Calculate

- (ii) reflex  $\angle BAF$ ,

*Answer* \_\_\_\_\_  $^\circ$  [1]

- (iii)  $\angle FDE$ .

*Answer* \_\_\_\_\_  $^\circ$  [1]

- 5 (a) Complete the table of values for  $y = 2x^3 - x^2 - 10x$ .

$x$	-2	-1.5	-1	-0.5	0	1	1.5	2
$y$	0	6	7	4.5	0	-9	-10.5	

[1]

- (b) On the grid opposite, draw the graph of  $y = 2x^3 - x^2 - 10x$  for  $-2 \leq x \leq 2$ . [3]

- (c) The equation  $2x^3 - x^2 - 5x = -8$  only has one solution.

- (i) Explain how this can be seen from your graph.

*Answer*

[3]

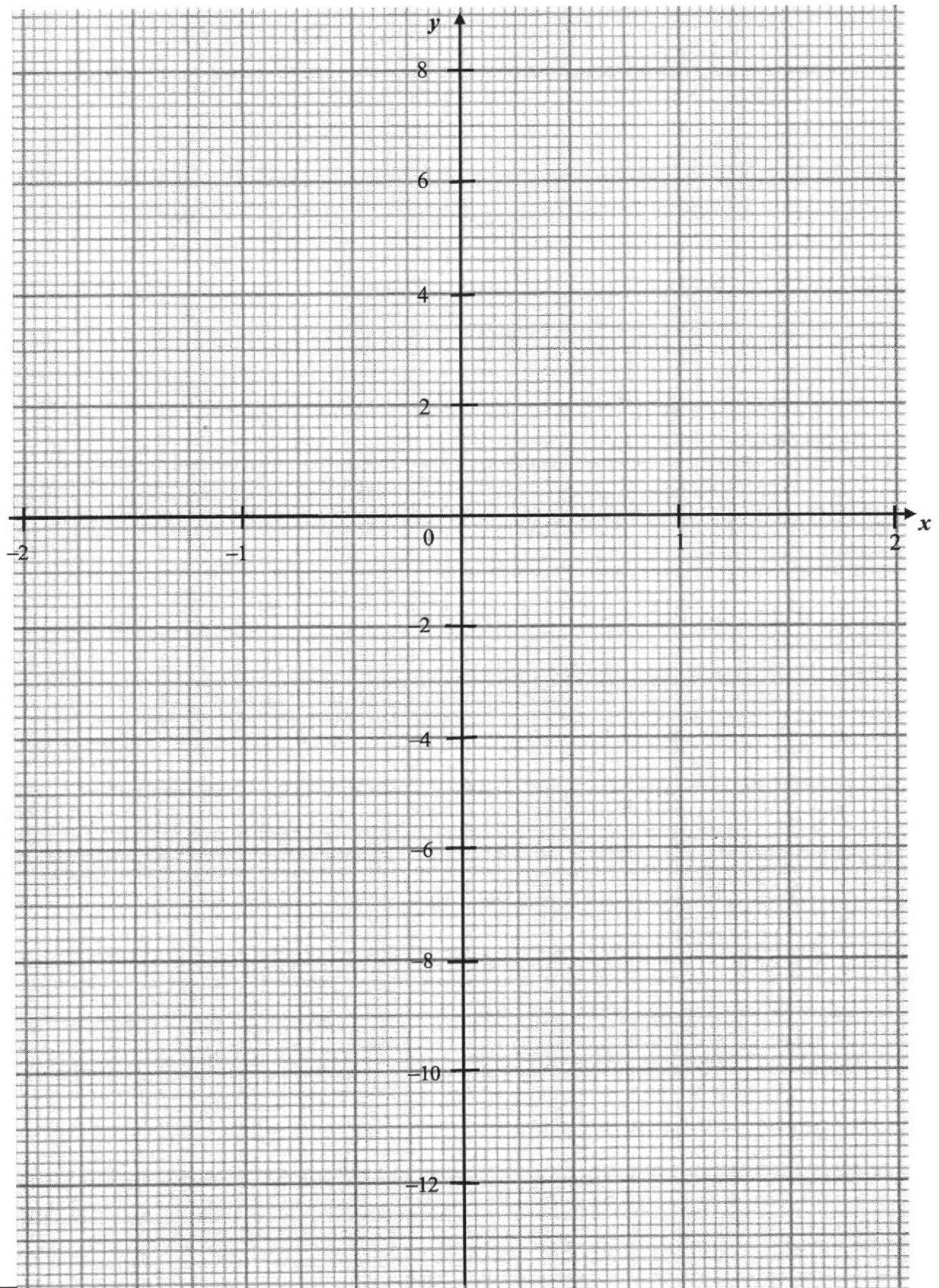
- (ii) Use your graph to find the solution of the equation  $2x^3 - x^2 - 5x = -8$ .

*Answer* \_\_\_\_\_ [1]

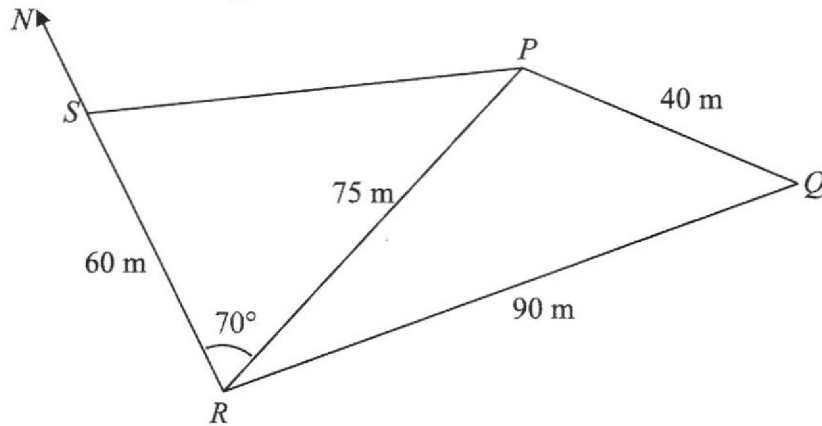
- (d) Use your graph to find the  $x$ -coordinate of the maximum point.

*Answer* \_\_\_\_\_ [1]





- 6 The diagram represents a flat plot of land  $PQRS$ .  
 $PQ = 40$  m,  $PR = 75$  m,  $QR = 90$  m,  $SR = 60$  m and  $\angle PRS = 70^\circ$ . [Turn Over  
 $S$  is due north of  $R$  and  $Q$  is due east of  $R$ .



- (a) Find  
 (i) the area of the land  $PQRS$ ,

Answer \_\_\_\_\_  $\text{m}^2$  [2]

- (ii) the length of  $PS$ ,

Answer \_\_\_\_\_ m [3]

- (iii) the angle  $PSR$ ,

Answer \_\_\_\_\_  $^{\circ}$  [2]

- (iv) the shortest distance from  $S$  to  $PR$ .

Answer \_\_\_\_\_ m [1]

- (b)  $T$  is the top of a vertical tower at  $S$ .  
The angle of elevation of  $T$  from  $R$  is  $10^{\circ}$ .

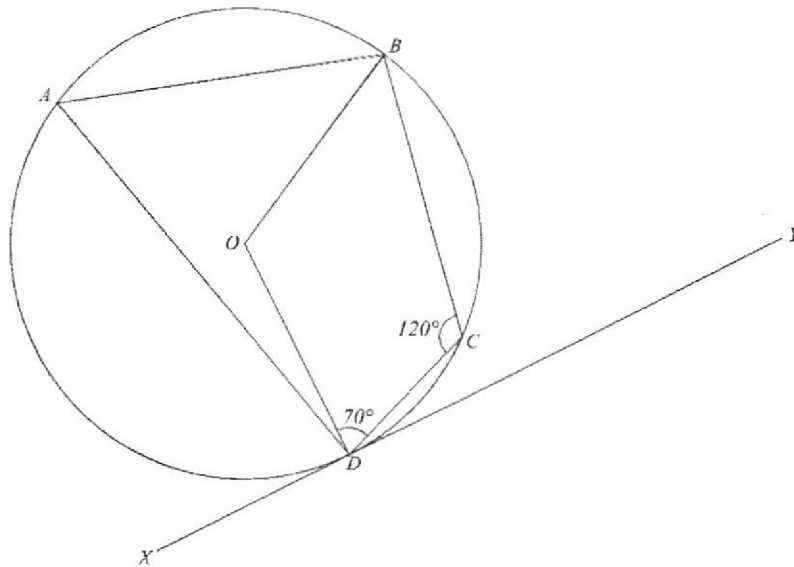
- (i) Find the height of the tower.

Answer \_\_\_\_\_ m [1]

- (ii) Hence, find the greatest angle of elevation of  $T$  viewed from  $PR$ .

Answer \_\_\_\_\_  $^{\circ}$  [1]

- 7 (a) A circle with centre  $O$  has a tangent  $XY$  at  $D$ .  
 $\angle ODC = 70^\circ$ ,  $\angle BCD = 120^\circ$  and  $\angle ODA = 15^\circ$ .



Find

- (i)  $\angle CDY$ ,

Answer \_\_\_\_\_  $^\circ$  [1]

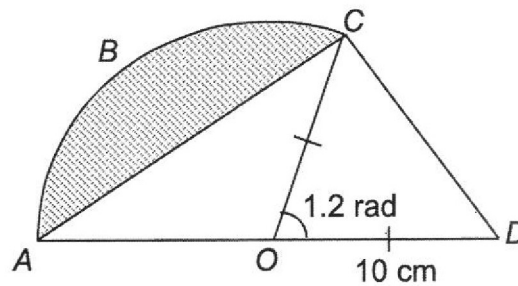
- (ii)  $\angle DAB$ ,

Answer \_\_\_\_\_  $^\circ$  [1]

- (iii)  $\angle OBA$ .

Answer \_\_\_\_\_  $^\circ$  [3]

- (b) The diagram shows a sector  $OAC$  of a circle, centre  $O$  and an isosceles triangle  $OCD$ .  
 $OC = OD = 10$  cm and  $\angle COD = 1.2$  radians.



Find

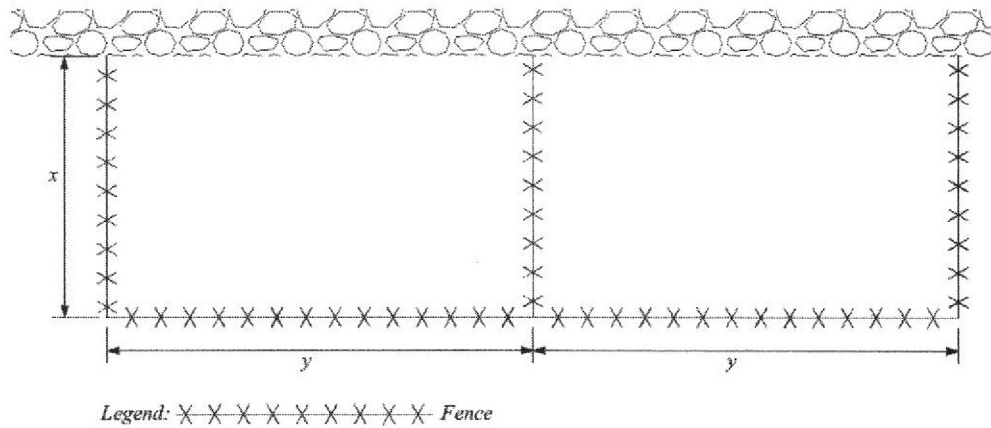
- (i) the area of the shaded segment  $ABC$ ,

Answer \_\_\_\_\_  $\text{cm}^2$  [3]

- (ii) the length  $CD$ .

Answer \_\_\_\_\_  $\text{cm}$  [2]

- 8 Old MacDonald has a farm with a rock wall around it.  
The figure shows a portion of his farm where he plans to build two enclosures.



The total length of the fence is 180 m.

- (a) Show that  $y = 90 - \frac{3}{2}x$ .

Answer

[1]

- (b)  $A$  is the total areas of the 2 enclosures.

Form a quadratic equation for  $A$  in terms of  $x$ .

Answer

[2]

- (c) If  $A = 2100 \text{ m}^2$ , solve for  $x$ .  
Leave your answer in 2 decimal places.

*Answer*  $x =$  \_\_\_\_\_ or \_\_\_\_\_ [3]

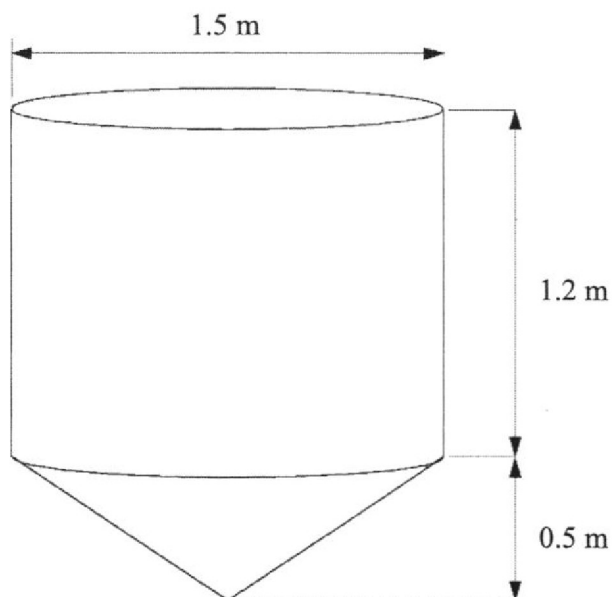
- (d) Using your answers in part (c), find the coordinates of the turning point of the quadratic equation of area,  $A$ .

*Answer* ( \_\_\_\_\_ , \_\_\_\_\_ ) [2]

- (e) Explain if the answer found in part (d) represents a maximum or minimum area.

*Answer* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

- 9 An industrial mixer is made up of an **open** cylinder connected to a cone. The height of the cylinder and the cone is 1.2 m and 0.5 m respectively. The diameter of the mixer is 1.5 m.



- (a) Find the capacity of the mixer in litres,

Answer \_\_\_\_\_ litres [3]



- (b) Water is poured into the mixer.

Find the height of the water level, in centimetres, given that the volume is

- (i) 500 litres,

Answer ..... cm [3]

- (ii) 150 litres.

Answer ..... cm [2]

- (c) The outside of the mixer is to be painted bright yellow.  
1 can of paint can cover  $4.5 \text{ m}^2$ .

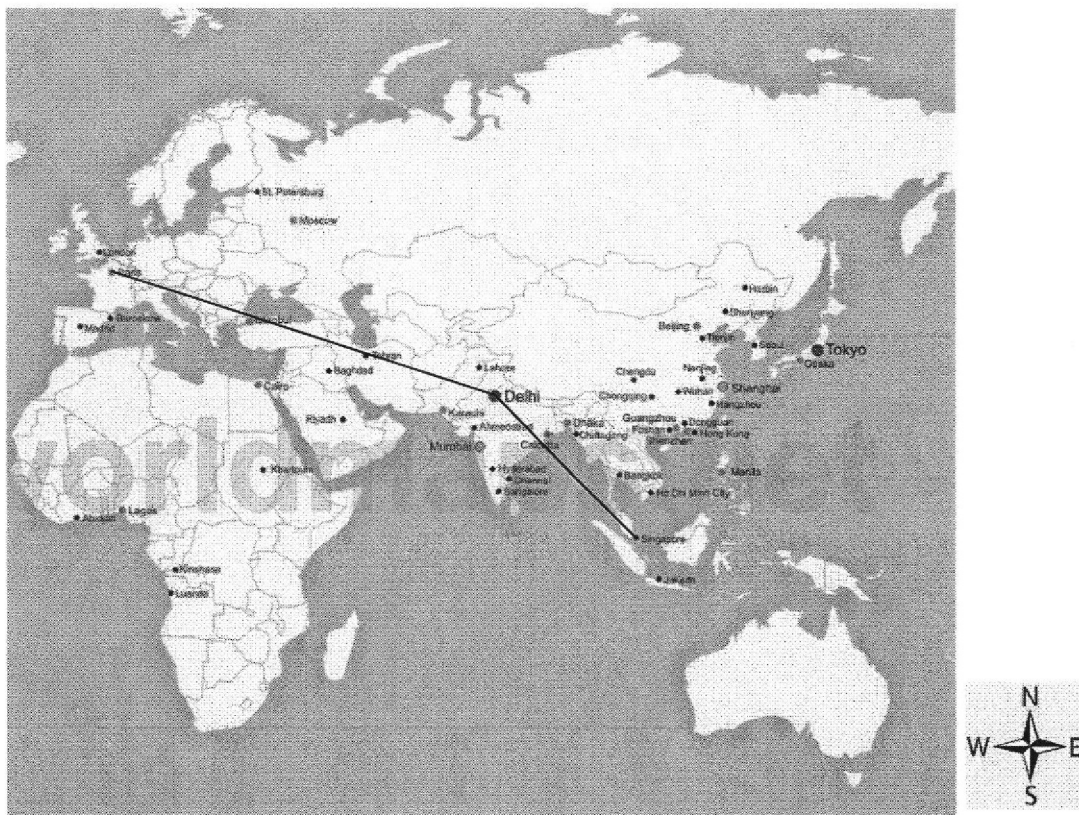
How many cans are needed to paint 6 such mixers?

Answer ..... cans [3]

**[Turn Over]**

- 10 John is planning a trip from Singapore to Paris.  
His flight will stop over in Delhi before continuing its journey to Paris.

Answer the following questions using the information from the map below.



Map is drawn to scale.

- (a) What is the bearing of Paris from Delhi?

*Answer* ◦ [1]

- (b)** The distance from Singapore to Delhi is 4150 km.

What is the distance from Delhi to Paris?

*Answer* km [2]

The table below shows the Greenwich Meridian Time (GMT) for several locations in the world.

Location	GMT
Brisbane, Australia	+10:00
Delhi, India	+05:30
Greenwich, England	00:00
Los Angeles, United States	-07:00
Paris, France	+02:00
Singapore, Singapore	+08:00
Toronto, Canada	-04:00

Note: Brisbane is 10 hours ahead of Greenwich and Los Angeles is 7 hours behind Greenwich.

John departed from Singapore at 11:15 pm on a Saturday.  
His flight will stop over at Delhi for 2 hours before continuing to Paris.  
The average speed of an airplane is 850km/h.

(c) On what day and at what time will John arrive in Paris?

*Answer*

[6]

**End of Paper**