CANBERRA SECONDARY SCHOOL

O

2021 Preliminary Examination

Secondary Four Express / Five Normal Academic

MATHEMATICS
4048/01

20 August 2021
2 hours
1045 to 1245

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 or tape.

Answer **all** the 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 π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

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 80.

FOR MARKER'S USE		
	Marks Awarded	Max Marks
Total		80

This question paper consists of 22 printed pages including the cover page.

Setter: Mrs Long and Mrs Wee

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

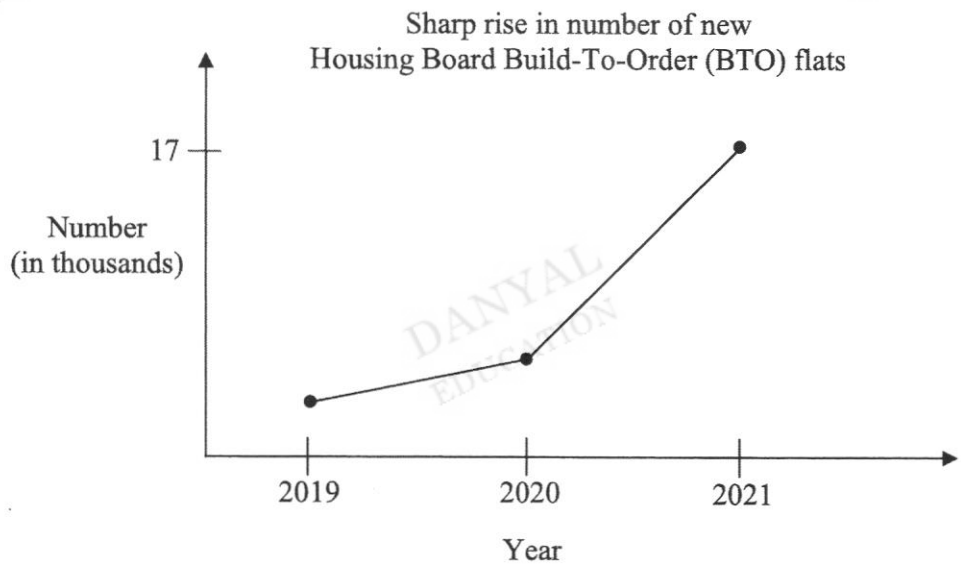
$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

1 Elly's height is 1.61 m and Adela's height is 1.73 m, measured correct to three significant figures.

Find the greatest possible difference in their heights in metres, correct to three significant figures.

Answer ..... m [1]

2



Explain how the line graph above may be misleading.

Answer

.....

.....

..... [1]

3 Simplify $\left(2x^2\right)^3 \div 4\sqrt{x}$, giving your answer in the form of ax^n, where a and n are rational numbers.

Answer ..... [2]

---

4 Given that $9172.05 = \left(9\times10^3\right)+\left(1\times10^2\right)+\left(7\times10\right)+\left(2\times10^a\right)+\left(5\times10^b\right)$, write down the values of a and of b.

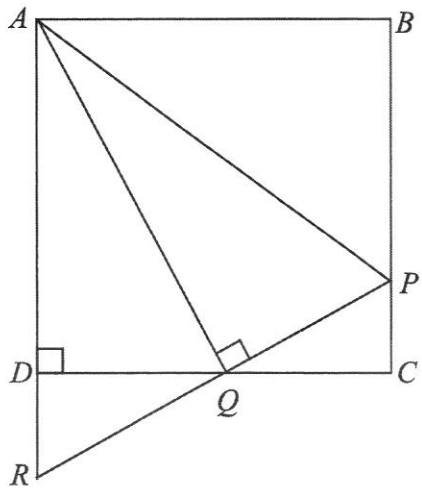
Answer a = ... b = ... [2]

---

5 Write as a single fraction in its simplest form $\frac{3}{1-x^2}-\frac{2}{x+1}$.

Answer ..... [2]

6



ABCD is a square and *AQ* is perpendicular to *PR*.
PQR and *ADR* are straight lines.
$DQ : DC = 1 : 2$.

Show that triangle *DQR* is congruent to triangle *CQP*.
Give a reason for each statement you make.

Answer

[2]

7 Use **factorisation** to solve the equation.

$$2h^2 - 11h - 21 = 0$$

Answer $h =$ ..... or ..... [2]

---

8 A map is drawn to a scale of $1 : n$.
The actual distance between two points X and Y is 2.8 km.
On the map, they are 4 cm apart.

Find the value of n.

Answer $n =$ ..... [2]

9 Solve the inequalities $x \leq \frac{x+4}{3} \leq 2x-1$.

Answer ..... [3]

---

10 The acceleration, a m/s^2, of a particle is inversely proportional to the square of its distance x metres from a fixed point.
The distance of the particle is reduced to $0.5x$.

Find the ratio of the acceleration to the original acceleration.

Answer ..... : ..... [3]

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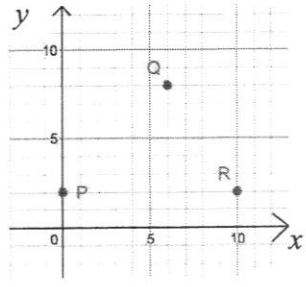
11 $PQSR$ is a parallelogram.
The coordinates of P, Q and R are $(0,2)$, $(6,8)$ and $(10,2)$ respectively.
Find area of the parallelogram $PQSR$.



Answer ..... units^2 [3]

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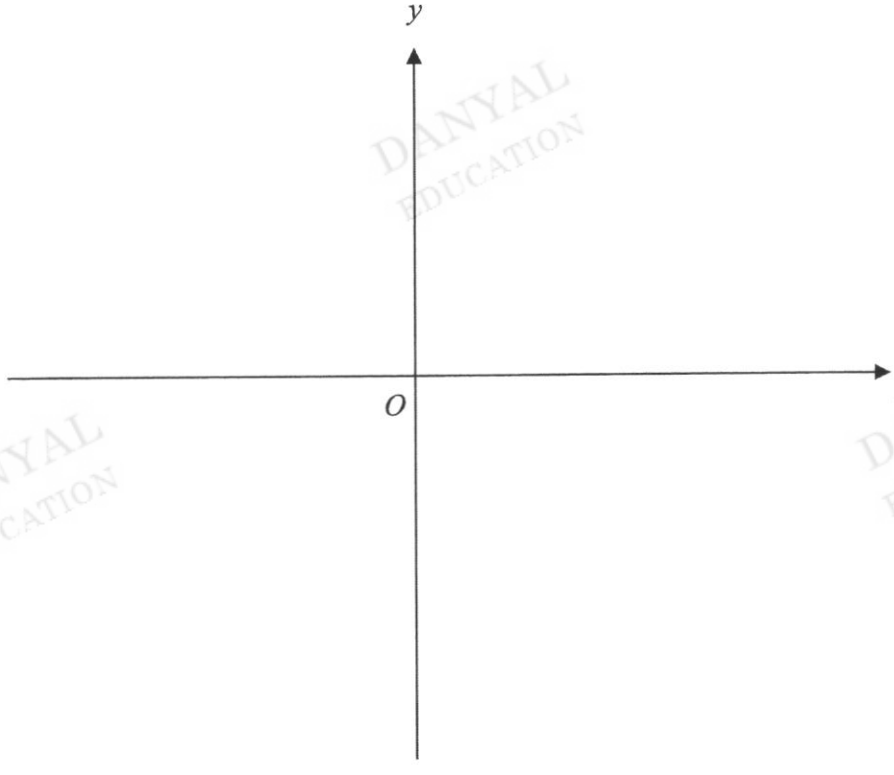
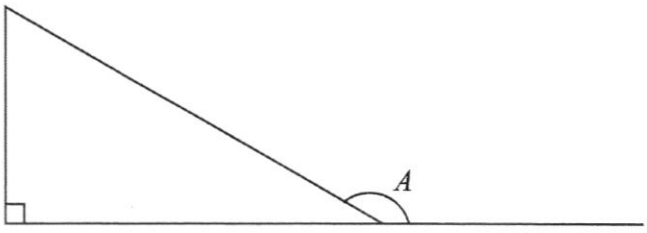
12 Sketch the graph of $y=(x+4)(10-x)$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the maximum point on the curve.



[3]

13 In the diagram, A is an obtuse angle such that $\sin A = \frac{5}{13}$.



Leaving your answer as a fraction, find the value of

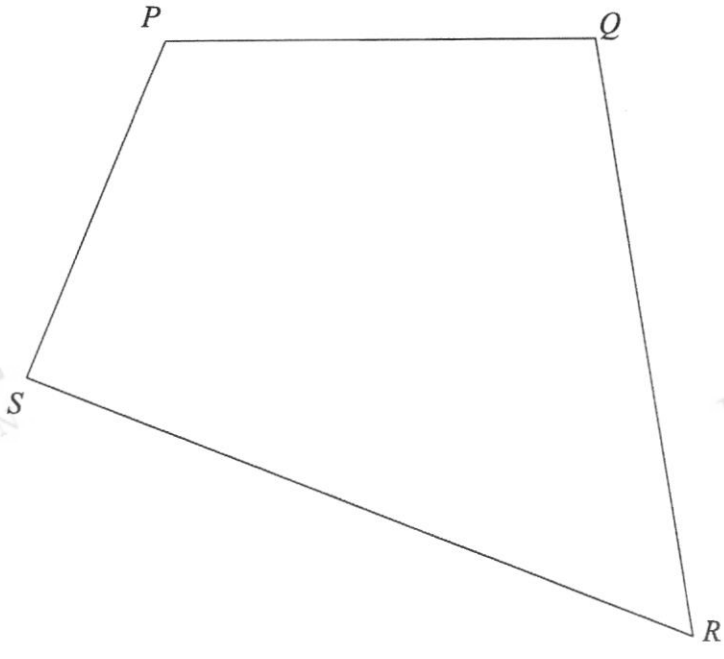
(a) $\sin(180° - A)$,

Answer ..... [1]

(b) $\cos A$.

Answer ..... [2]

14 The diagram shows a quadrilateral $PQRS$.



On the diagram,

(a) construct the perpendicular bisector of SR such that it meets PQ at point Z.
Mark and label Z. [2]

(b) measure and write down the size of angle PZS.

Answer .....° [1]

15 **(a)** Factorise completely $5pr - 2ps - 5qr + 2qs$.

Answer ..... [2]

(b) Given that $p \neq q$, find the value of $\frac{r}{s}$ when $5pr - 2ps - 5qr + 2qs = 0$.

Answer ..... [2]

16 Written as a product of its prime factors,

$$p = 2^1 \times 3^x \times 7^y \text{ and } q = 3 \times 7^2 \times 11$$

(a) Find the smallest value of x and y for which p is a multiple of 21.

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

(b) Explain why $33q$ is a perfect square.

Answer .....

.....

.....

.....

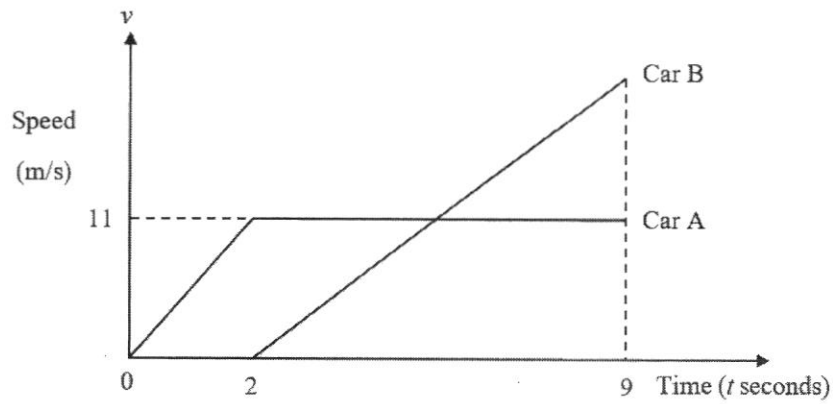
.....

.....

.....

..... [2]

17



The diagram shows the speed-time graph of two cars, A and B.
Car A, starting from rest, accelerates uniformly for 2 seconds until it reaches a speed of 11 m/s.
It then continues to travel at constant speed.
2 seconds later, Car B starts from the same point as Car A.

(a) Find

(i) the acceleration of Car A when $t = 1$,

Answer ..... m/s^2 [1]

(ii) the distance travelled by Car A for the first 2 seconds.

Answer ..... m [1]

(b) Car B accelerates uniformly from rest.
It overtakes Car A when $t = 9$ seconds.
Find v, the speed of Car B when it overtakes Car A.

Answer $v =$ ..... [2]

18 $\varepsilon = \{ \text{integers } x: \ 2 \le x \le 13 \}$
$A = \{ \text{prime numbers} \}$
$B = \{ \text{multiples of } 4 \}$
$C = \{ \text{factors of } 12 \}$

List the elements in

(a) B',

Answer ..... [1]

(b) $A \cap B'$,

Answer ..... [1]

(c) $(A \cup B)'$,

Answer ..... [1]

(d) $B \cap C$.

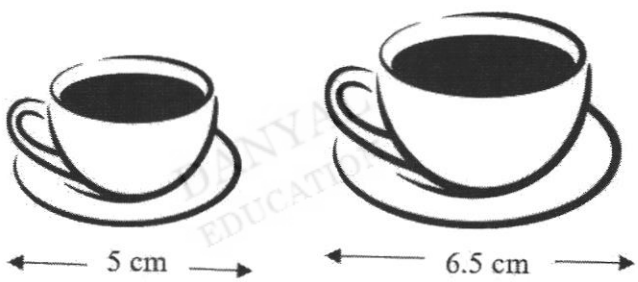
Answer ..... [1]

19 The number of blue, white and black masks Julian has is in the ratio 3 : 4 : 5.
After exchanging 30 black masks for blue ones, the ratio becomes 9 : 10 : 11.

Find the number of blue masks Julian has now.

Answer ..... masks [4]

20



The diagram shows two geometrically similar cup and saucer sets.
The diameter of the smaller saucer is 5 cm.
The diameter of the larger saucer is 6.5 cm.
A coffee shop sells the smaller cup of coffee at $1 and the larger cup at $2.

Calculate which is a better buy.
Explain your answer.

Answer .....

.....

.....

..... [4]

21 The matrix below shows the results of three baseball teams in a series of competition.

$$\mathbf{R} = \begin{array}{c} \begin{matrix} \text{Win} & \text{Draw} & \text{Lose} \end{matrix} \\ \begin{pmatrix} 12 & 5 & 3 \\ 3 & 8 & 7 \\ 9 & 4 & 4 \end{pmatrix} \end{array} \begin{matrix} \\ \text{Gratitude} \\ \text{Respect} \\ \text{Compassion} \end{matrix}$$

(a) A win gains 3 points, a draw 1 point and a loss 0 point.

Represent this information with a 3×1 column matrix **P**.

Answer **P** = ... [1]

(b) Evaluate the matrix **RP**.

Answer **RP** = ... [2]

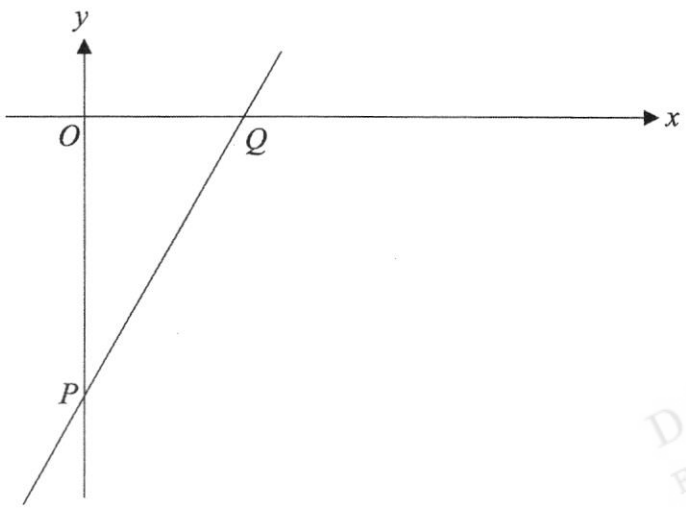
(c) Explain what your answer to **(b)** represents and state the name of the winning baseball team.

Answer .....

.....

..... [1]

22 The diagram shows a sketch of the graph of $y = -10 + 2x$.
The line crosses the axes at P and Q.



(a) Find the coordinates of P and Q.

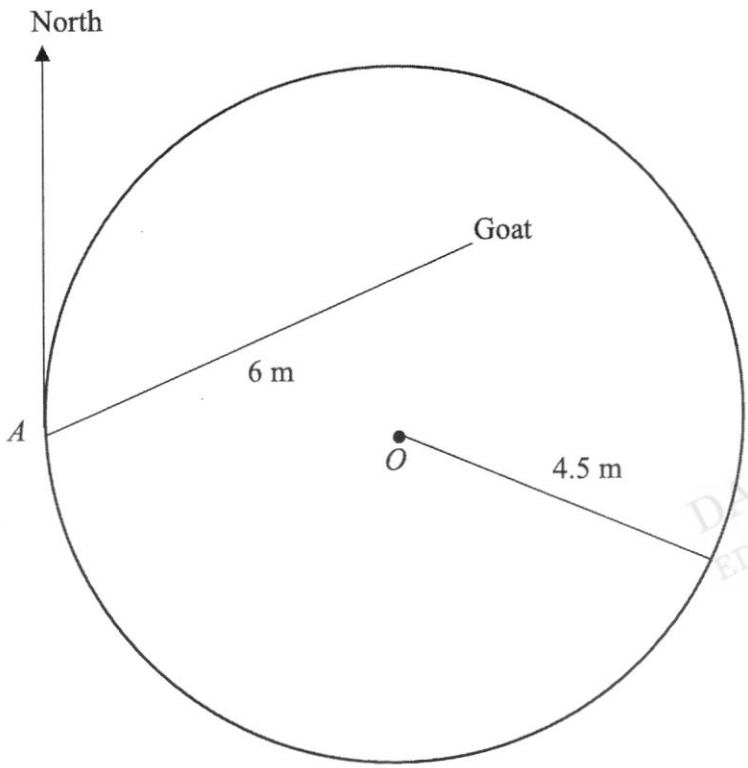
Answer $P($..... , ...$)$

$Q($..... , ...$)$ [2]

(b) Calculate the length of the line joining P to Q.

Answer ..... units [2]

23



The diagram shows a goat tied to a pole at A.
The length of the rope attached to the goat is 6 m.
A is due west of the centre of the circle, O.

(a) **Measure** the bearing of the goat from A.

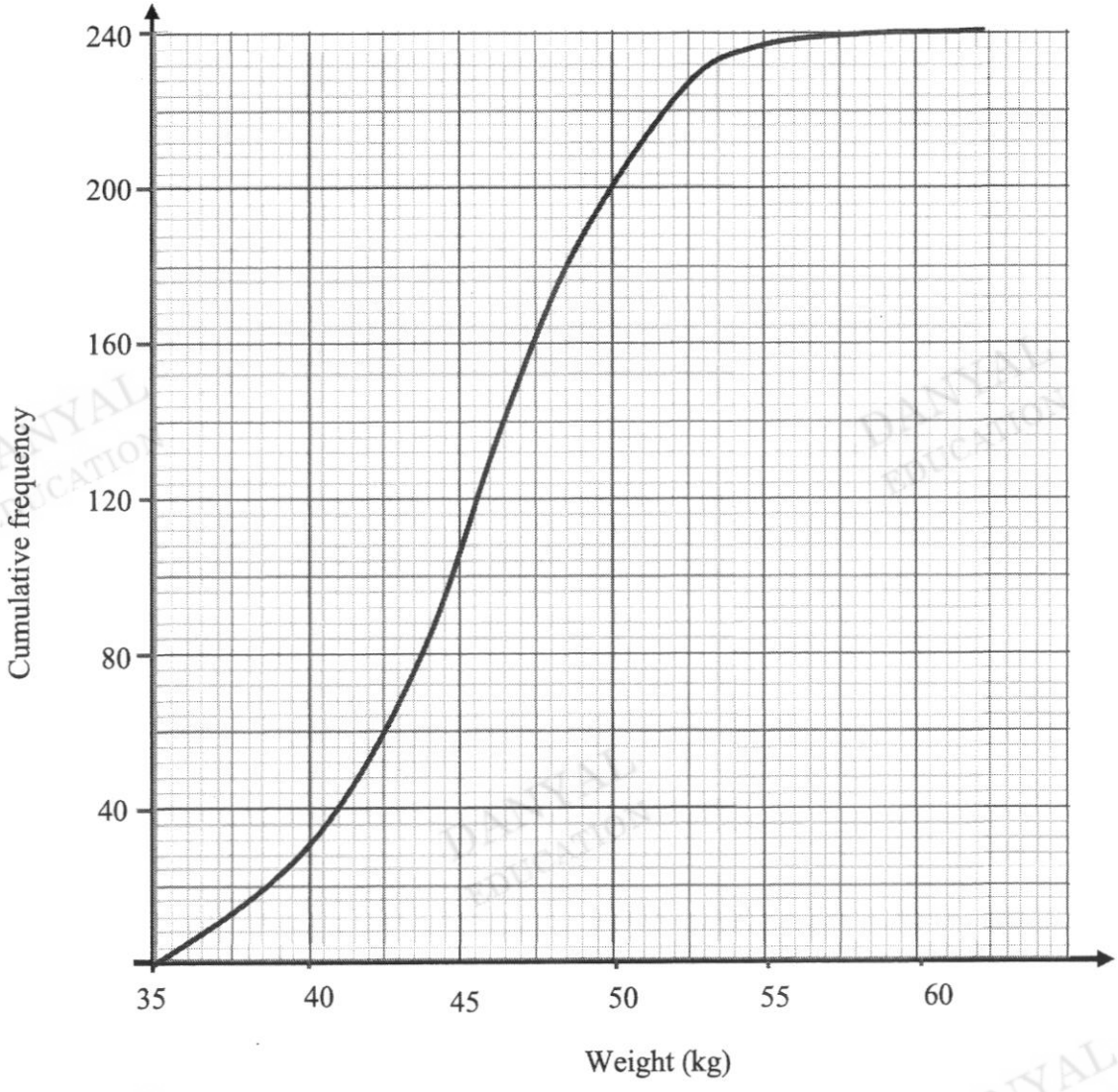
Answer ..... ° [1]

(b) The circle represents a grass patch of radius 4.5 m.

Find the probability that the goat is in the grass patch.

Answer ..... [3]

24 The cumulative frequency graph below shows the weight of 240 students in a school.



Use the graph to find

(a) the number of students with a weight greater than 55 kg,

Answer ..... [1]

(b) the interquartile range,

Answer ..... kg [2]

(c) the median.

Answer ..... kg [1]

It was discovered that the weighing machine used to measure the weight of the students was faulty.

The weight of each of the students was supposed to be 5 kg more than their recorded weights.

(d) Explain how the cumulative frequency curve of the corrected weights will differ from the given curve.

Answer .....

.....

.....

.....

..... [2]

25 The first four terms of a sequence are 5, 9, 13 and 17.

(a) Write down the 8th term of the sequence.

Answer ..... [1]

(b) Find an expression, in terms of n, for the nth term of the sequence.

Answer ..... [2]

(c) One term of the sequence is 205.

Find the value of n for this term.

Answer $n =$ ..... [1]

(d) Explain why 50 is not part of the sequence.

Answer .....

.....

.....

..... [2]

CANBERRA SECONDARY SCHOOL

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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

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Write in dark blue or black pen.
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The total number of marks for this paper is 100.

FOR MARKER'S USE		
	Marks Awarded	Max Marks
Total		100

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

Mathematical Formulae

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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

(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.

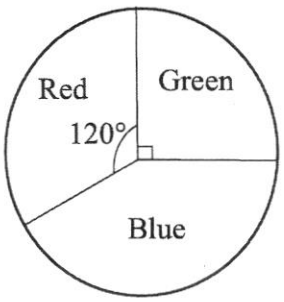
Answer $x =$ _____ [1]

(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]

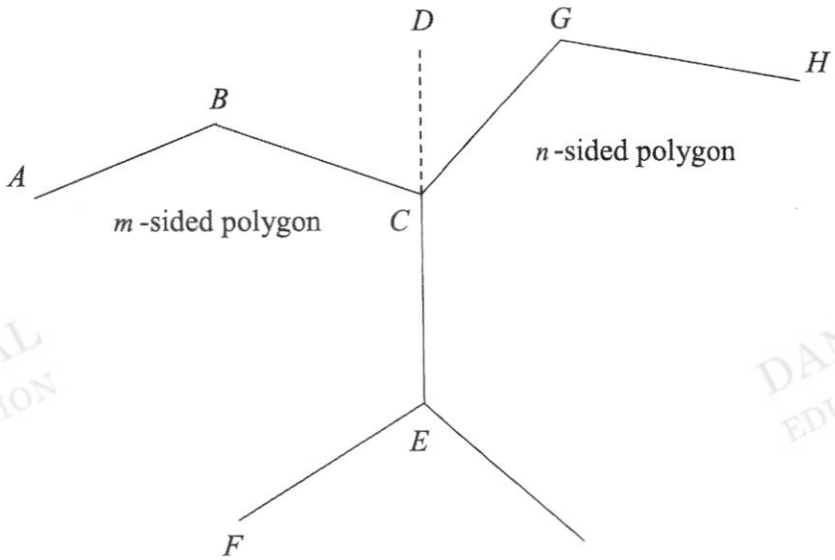
(iii) State one assumption made.

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.
$\angle BCD : \angle DCG = 5:3$



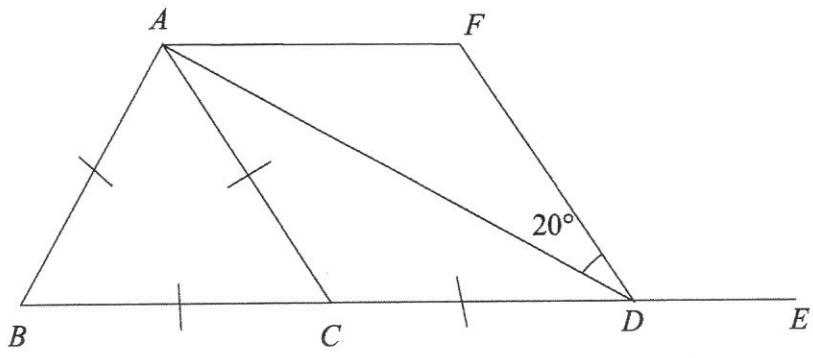
Mike made some calculations and claimed that $m = 6$ and $n = 10$.

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

Answer

[4]

(b)



Triangle ABC is an equilateral triangle.
$AC = CD$.
$\angle ADF = 20°$
AD bisects $\angle CAF$.

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

Answer

[2]

Calculate

(ii) reflex $\angle BAF$,

Answer _____ ° [1]

(iii) $\angle FDE$.

Answer _____ ° [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 $-2 \le x \le 2$. [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

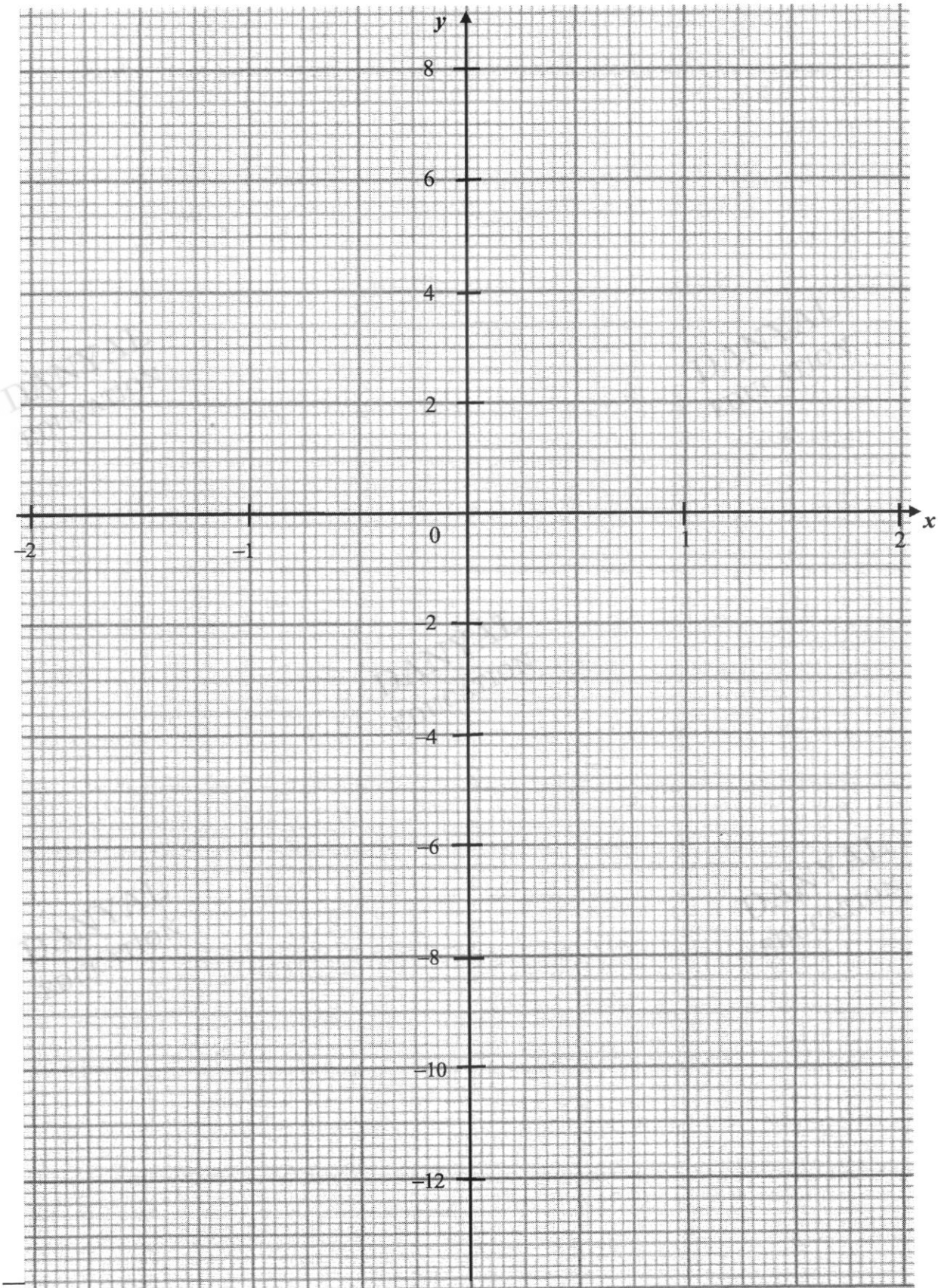
[3]

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

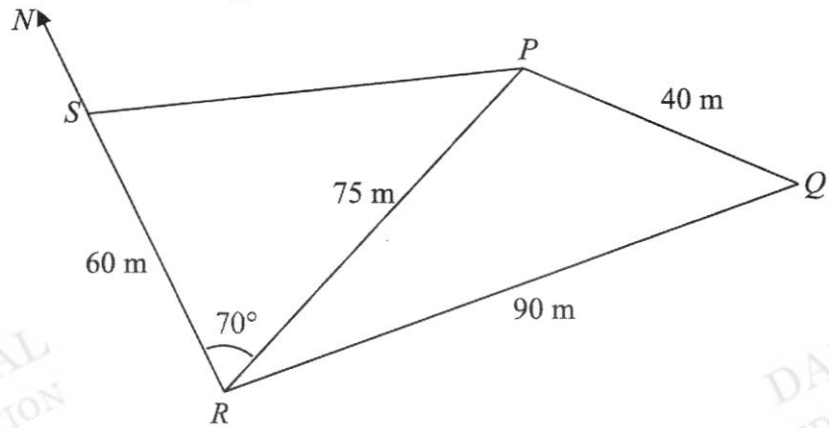
Answer _____ [1]

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

Answer _____ [1]


y
8
6
4
2
0
−2
−1
1
2
x
−2
−4
−6
−8
−10
−12

6 The diagram represents a flat plot of land $PQRS$.
$PQ = 40$ m, $PR = 75$ m, $QR = 90$ m, $SR = 60$ m and $\angle PRS = 70°$. **[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 _____ m^2 [2]

(ii) the length of PS,

Answer _____ m [3]

(iii) the angle PSR,

Answer _____ ° [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 $10°$.

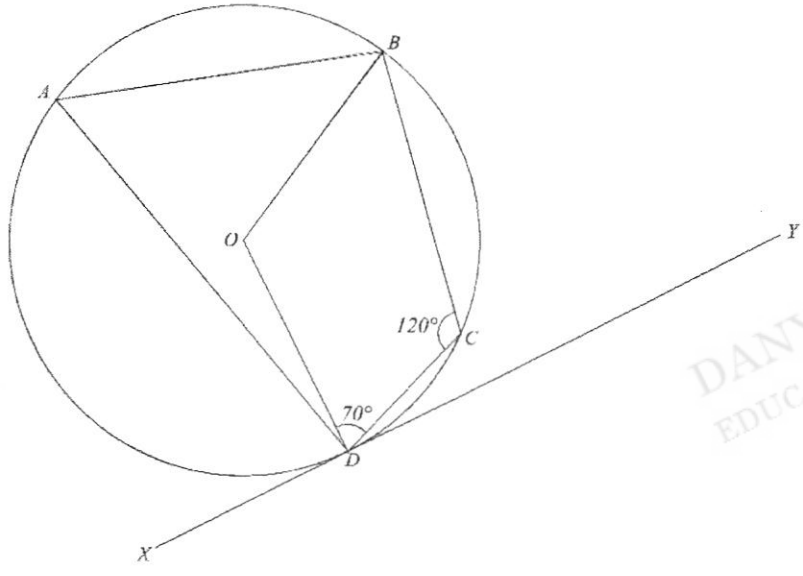
(i) Find the height of the tower.

Answer _____ m [1]

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

Answer _____ ° [1]

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



Find

(i) $\angle CDY$,

Answer _____ ° [1]

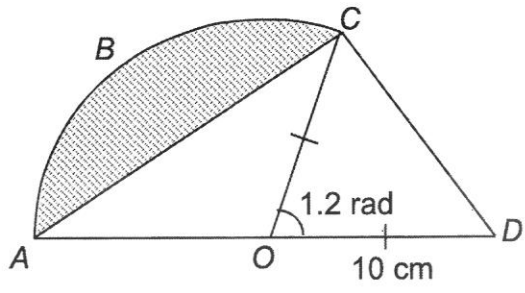
(ii) $\angle DAB$,

Answer _____ ° [1]

(iii) $\angle OBA$.

Answer _____ ° [3]

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



Find

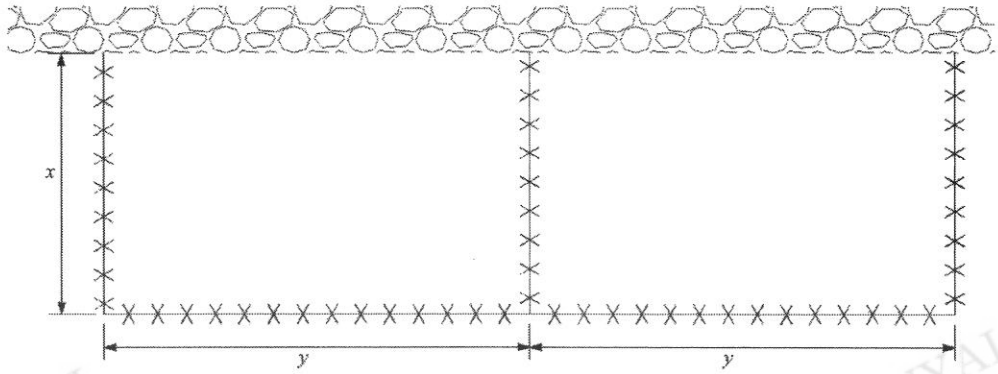
(i) the area of the shaded segment ABC,

Answer _____ cm^2 [3]

(ii) the length CD.

Answer _____ 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]

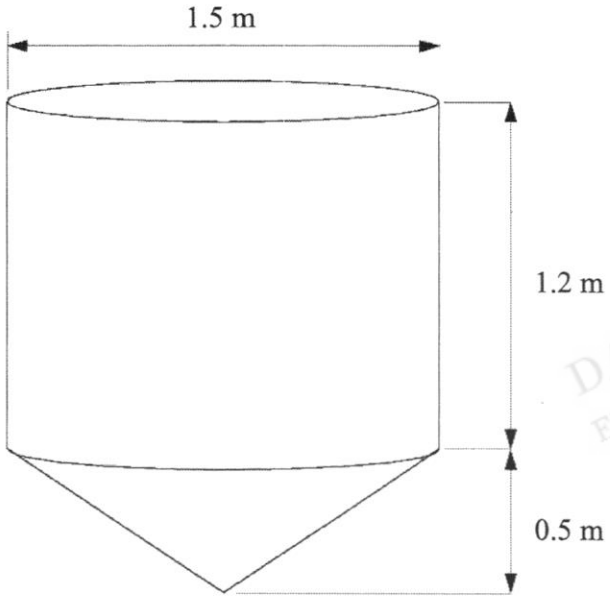
(e) Explain if the answer found in part **(d)** represents a maximum or minimum area.

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]

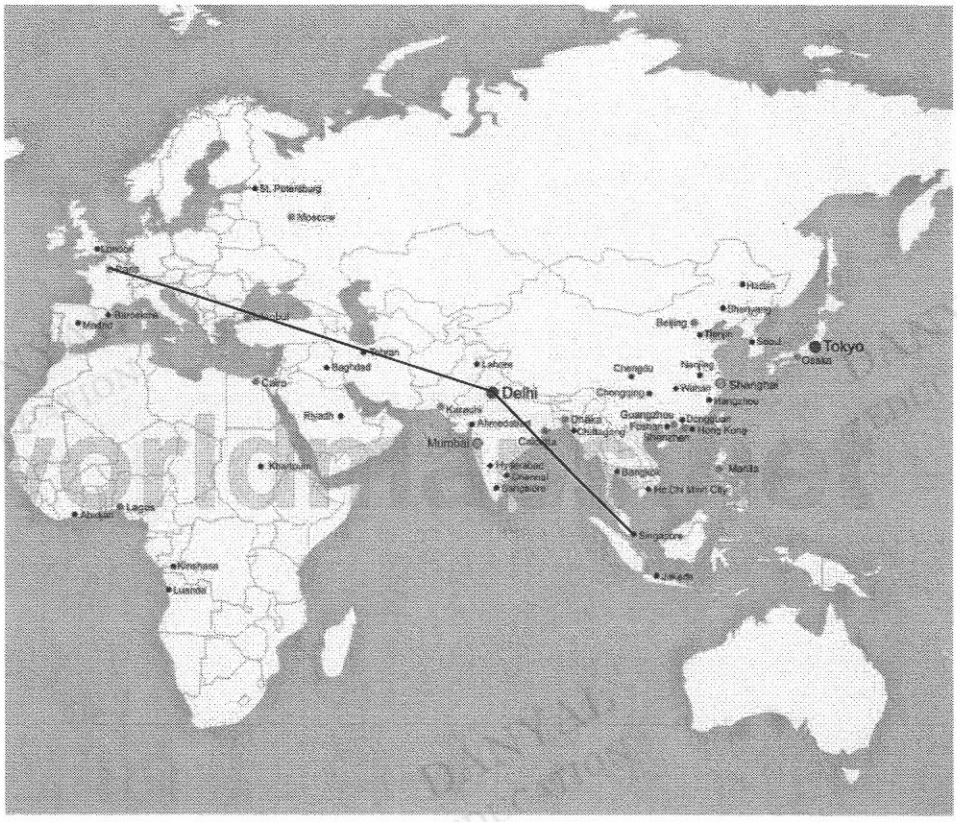
(c) The outside of the mixer is to be painted bright yellow.
1 can of paint can cover 4.5 m^2.

How many cans are needed to paint 6 such mixers?

Answer _____ cans [3]

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 in 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

Answers

1	$1.734 - 1.605 = 0.129$ m OR $1.7349 - 1.6050 = 0.130$ m
2	The title of the line graph is biased as it does not allow reader to make judgement. OR The vertical axis does not start from 0, which exaggerated the differences. (Can accept without the reasoning)
3	$2x^{5\frac{1}{2}}$
4	$a = 0, \quad b = -2$
5	$= \frac{1+2x}{1-x^2}$ or $\frac{1+2x}{(1+x)(1-x)}$
7	$h = -\frac{3}{2}$ or $h = 7$
8	$n = 70\ 000$
9	$1\frac{2}{5} \le x \le 2$
10	$a_{\text{new}} : a_{\text{original}} = 4:1$
11	60 square units
13a	$\sin(180° - A) = \frac{5}{13}$
13b	$\cos A = -\frac{12}{13}$ OR shown adjacent side is 12 units (1 m)
14b	$\angle PZS = 33°$ (accept angle values of $\pm 1°$)
15a	$(p-q)(5r-2s)$
15b	$\frac{r}{s} = \frac{2}{5}$
16a	Smallest $x = 1$, Smallest $y = 1$
16b	Since the indices of the prime factors are multiples of 2, $33q$ is a perfect square.
17ai	5.5 m/s^2
17aii	11 m
17b	$v = 25.1$ or $25\frac{1}{7}$ or $\frac{176}{7}$
18a	{ 2, 3, 5, 6, 7, 9, 10, 11, 13 }
18b	{ 2, 3, 5, 7, 11, 13 }
18c	{ 6, 9, 10 }
18d	{ 4, 12 }
19	There are 180 blue masks.
20	The larger cup is a better buy since it could have been more costly.

21a	$\mathbf{P} = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$
21b	$\mathbf{RP} = \begin{pmatrix} 41 \\ 17 \\ 31 \end{pmatrix}$
21c	Team Gratitude scores 41 points, Team Respect scores 17 points and Team Compassion scores 31 points. **Team Gratitude is the winner.**
22a	$P(0,-10)$ & $Q(5,0)$
22b	$\sqrt{(5)^2+(10)^2} = 11.2$ units
23a	067°
23b	Probability = 0.624 (to 3 sf) or 0.351 (to 3 sf)
24a	2 to 4 students
24b	interquartile range = 6 kg
24c	median = 45.5 kg
24d	The cumulative frequency curve will shift to the **right by 5 kg.**
25a	33
25b	$4n+1$
25c	51
25d	Since n is not an integer, 50 is not a term of the sequence.

Answers

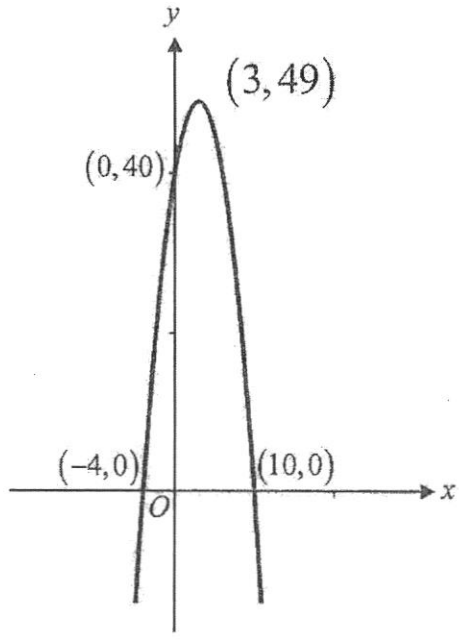
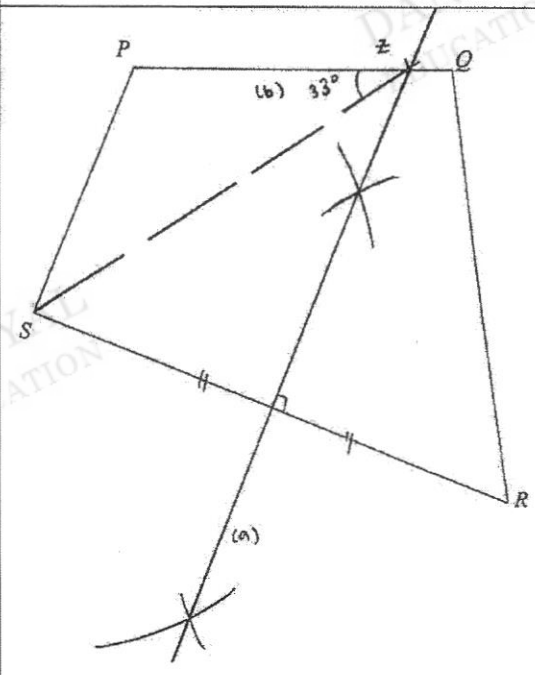
1a	$10a^2b^5$
bi	$(x-2)^2-10$
ii	$(2,-10)$
ci	10.5
ii	$n=m^2-2l$
d	$x=1.76$ or $x=-1.42$
2ai	\$2556
ii	$66\frac{2}{3}\%$
b	Plan B offers better returns with a higher interest.
3ai	$x=17$ $5+18+10+17+2=52$
ii	12
iii	$x=5$
bii	$\frac{1}{10}$
iii	The dart will always hit one of the coloured region.
4a	Mike's claim is accurate.
ii	240°
iii	130°
5a	−8
ci	Plot $y=-5x-8$ Since the line intersects the curve only at one point, there is only one solution for $2x^3-x^2-5x=-8$.
ii	−1.9
d	−1.1
6ai	3270 m^2
ii	78.4m
iii	$\angle PSR=64.0°$
v	56.4 m
bi	10.6 m
ii	10.6°
7ai	20°
ii	60°
iii	45°
bi	50.5 cm^2
ii	11.3 cm
8a	$y=90-\frac{3}{2}x$
b	$A=180x-3x^2$
c	$x=44.14$ m or $x=15.86$ m

8d	x-coordinate of turning point = 30 y-coordinate of turning point = $180(30)-3(30)^2 = 2700\,\text{m}^2$
e	Area is maximum, Because the coefficient of x^2 is negative.
9a	2415 or 2420 litres
bi	61.6 cm
ii	39.9 cm
c	11 cans
10a	Bearing = 360 – 70 = 290°
b	8540 km
c	Time difference between Singapore and Paris = 8 – 2 = 6 hours Singapore 6 hours ahead of Paris Total distance = 4150 + 8540 = 12, 690 km Total time including stop over = $\frac{12690}{850}+2=16.929$ =16 hrs 56 mins Adjustment for time difference = 16 hrs 56 mins – 6 hrs = 10 hrs 56 mins 11:15 pm → 12:00 am Saturday (45 minutes) 12:00 am → 10:00 am Sunday (10 hours) 10:00 am → 10:11 am Sunday (11 minutes) Reach Paris at 10:11 am Sunday

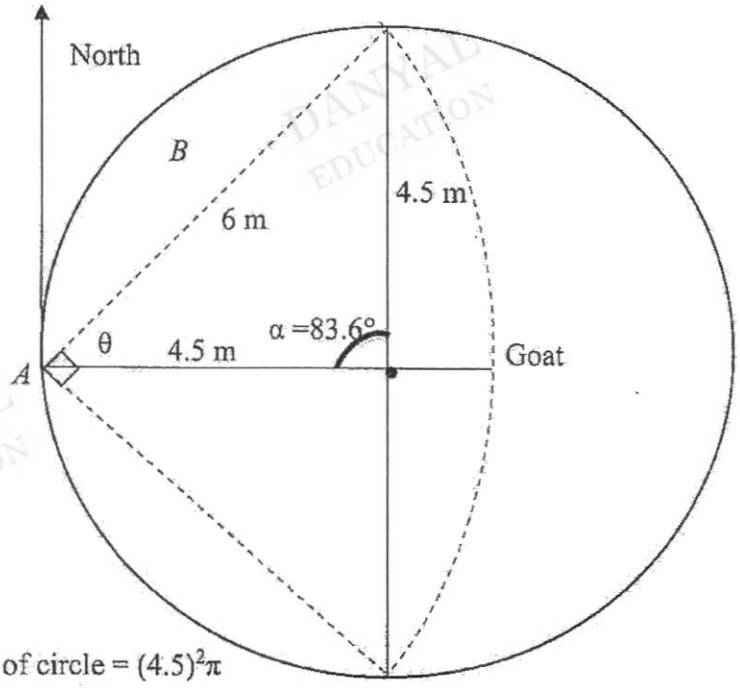
Canberra Secondary School
4E/5NA O Level Mathematics Paper 1 Preliminary Examination 2021
Marking Scheme

Question	Marking Scheme	Marks
1	Greatest possible difference $=1.734-1.605$ OR $=1.7349-1.6050$ $=0.129$ m $=0.130$ m	B1
2	The title of the line graph is biased as it does not allow reader to make judgement. The vertical axis does not start from 0, which exaggerated the differences. (Can accept without the reasoning)	B1 (either one)
3	$\left(2x^2\right)^3 \div 4\sqrt{x}$ $=8x^6 \div 4x^{\frac{1}{2}}$ $=2x^{5\frac{1}{2}}$	M1 A1
4	$9172.05 = 9\times10^3+1\times10^2+7\times10+2\times10^0+5\times10^{-2}$ $a=0, \quad b=-2$	B1, B1
5	$\frac{3}{1-x^2}-\frac{2}{x+1}$ $=\frac{3}{(1-x)(1+x)}-\frac{2}{x+1}$ $=\frac{3-2(1-x)}{1-x^2}$ $=\frac{3-2+2x}{1-x^2}$ $=\frac{1+2x}{1-x^2}$ or $\frac{1+2x}{(1+x)(1-x)}$	M1 A1
6	$\angle DQR = \angle CQP$ (vertically opposite angles) $DQ = CQ$ (given that ratio $DQ:DC=1:2$) $\angle QDR = 180°-90°$ (adjacent angles on straight line) $=90°$ $\angle QDR = \angle QCP = 90°$ (property of a square) $\therefore \Delta DQR$ is congruent to ΔCQP. (ASA) (shown)	M1 A1
7	$2h^2-11h-21=0$ $(2h+3)(h-7)=0$ $2h+3=0$ or $h-7=0$ $h=-\frac{3}{2}$ or $h=7$	M1 A1

8	4 cm : 2.8 km 4 : 280 000 1 : 70 000 $\therefore n = 70\ 000$	M1 A1
9	$x \le \frac{x+4}{3} \le 2x-1$ $3x \le x+4 \le 3(2x-1)$ $3x \le x+4 \le 6x-3$ $3x \le x+4$ and $x+4 \le 6x-3$ $2x \le 4$ and $-5x \le -7$ $x \le 2$ and $x \ge 1\frac{2}{5}$ $\therefore 1\frac{2}{5} \le x \le 2$	 M1 M1 A1
10	$a_{\text{original}} = \frac{k}{x^2}$, where k is a constant $a_{\text{now}} = \frac{k}{(0.5x)^2}$ $a_{\text{now}} = \frac{k}{0.25x^2}$ $\frac{a_{\text{now}}}{a_{\text{original}}} \frac{k}{0.25x^2} \div \frac{k}{x^2}$ $\frac{a_{\text{now}}}{a_{\text{original}}} \frac{1}{0.25}$ $\frac{a_{\text{now}}}{a_{\text{original}}} \frac{4}{1}$ $\therefore a_{\text{now}} : a_{\text{original}} = 4 : 1$	 M1 M1 A1
11	Base of figure = 10 units Vertical height = 6 units Area = 10×6 = 60 square units	M1 M1 A1

12		G1 (correct shape) G1 (correct x and y intercepts) G1 (correct turning point) Can accept if only wrote x and y intercepts
13a	$\sin(180° - A) = \frac{5}{13}$	B1
13b	$\cos(180° - A) = \frac{12}{13}$ OR shown adjacent side is 12 units (1 m) $\cos A = -\frac{12}{13}$	M1 (correct adjacent value) A1
14a		B1 (perpendicular bisector drawn correctly) B1 (mark and label Z correctly)

14b	$\angle PZS = 33°$ (accept angle values of $\pm 1°$)	B1
15a	$5pr - 2ps - 5qr + 2qs$ $= p(5r - 2s) - q(5r - 2s)$ $= (p - q)(5r - 2s)$	M1 A1
15b	$5pr - 2ps - 5qr + 2qs = 0$ $(p - q)(5r - 2s) = 0$ $p - q = 0$ or $5r - 2s = 0$ $p = q$ or $\frac{r}{s} = \frac{2}{5}$ (reject)	 M1 A1
16a	Smallest $x = 1$ Smallest $y = 1$	B1 B1
16b	$33q$ $= 3 \times 11 \times 3 \times 7^2 \times 11$ $= 3^2 \times 7^2 \times 11^2$ Since the indices of the prime factors are multiples of 2, $33q$ is a perfect square.	M1 A1
17ai	5.5 m/s^2	B1
17aii	11 m	B1
17b	$\frac{1}{2} \times 7 \times v = \frac{1}{2} \times 2 \times 11 + 7 \times 11$ $3.5v = 88$ $v = 25.1$ or $25\frac{1}{7}$ or $\frac{176}{7}$	M1 A1
18a	{ 2, 3, 5, 6, 7, 9, 10, 11, 13 }	B1
18b	{ 2, 3, 5, 7, 11, 13 }	B1
18c	{ 6, 9, 10 }	B1
18d	{ 4, 12 }	B1
19	3 : 4 : 5 → 9 : 10 : 11 7.5 : 10 : 12.5 1.5 units → 30 masks 1 unit → 20 masks 9 units → 180 masks There are 180 blue masks.	 M1 M1 M1 A1
20	$\left(\frac{6.5}{5}\right)^3 = \frac{x}{\$1}$ $x = \$2.197$ The larger cup is a better buy since it could have been more costly.	M1 M1 M1 , A1

21a	$\mathbf{P} = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$	B1
21b	$\mathbf{RP} = \begin{pmatrix} 12 & 5 & 3 \\ 3 & 8 & 7 \\ 9 & 4 & 4 \end{pmatrix}\begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$ $= \begin{pmatrix} 41 \\ 17 \\ 31 \end{pmatrix}$	M1 A1
21c	Team Gratitude scores 41 points, Team Respect scores 17 points and Team Compassion scores 31 points. **Team Gratitude is the winner.**	B1
22a	$P(0,-10)$ $Q(5,0)$	B1 B1
22b	$\sqrt{(5)^2+(10)^2}$ $=11.2$ units	M1 A1
23a	067°	B1
23b	 Area of circle = $(4.5)^2\pi$ $\cos\alpha = \frac{4.5^2+4.5^2-6^2}{2(4.5)(4.5)}$ $\alpha = 83.6°$ $\theta = \frac{180°-83.6°}{2}$ (base angles, isos Δ) $\theta = 48.2^{\circ}$	 M1 M1

	Area of sector $= \frac{48.2\times 2}{360}\times\pi(6)^2$ $= 30.2784\ \text{m}^2$ Area of segment B $= \frac{83.6}{360}\times\pi(4.5)^2 - \frac{1}{2}\times(4.5)^2\sin 83.6°$ $= 4.7114\ \text{m}^2$ Probability $= \frac{30.2784+2(4.7114)}{(4.5)^2\pi}$ or $\frac{30.2784+2(4.7114)}{(6)^2\pi}$ $= 0.624$ (to 3 sf) $= 0.351$ (to 3 sf	A1
24a	2 or 4 students	B1
24b	interquartile range = 48.5 – 42.5 = 6 kg	M1 A1
24c	median = 45.5 kg	B1
24d	The cumulative frequency curve will shift to the **right by 5 kg.**	B2
25a	33	B1
25b	$4n+1$	B2
25c	51	B1
25d	$4n + 1 = 50$ $4n = 49$ $n = 49 \div 4$ Since n is not an integer, 50 is not a term of the sequence.	M1 A1