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TAMPINES SECONDARY SCHOOL

Secondary Four Express/ Five Normal Academic
Preliminary Examination 2023

NAME			
CLASS		**REGISTER NUMBER**	

MATHEMATICS **4052/01**

24 August 2023

2 hours 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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 of 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 **90**.

[Turn over

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\vartheta$, where ϑ is in radians

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions

1 Tom invests \$4500 at a compound interest of 2.8 % per year for 5 years.

Calculate the total value of his investment at the end of 5 years.

Answer \$ _____ [2]

2 Given that $y = -4(3)^x$, which of the following represents the graph of y against x?

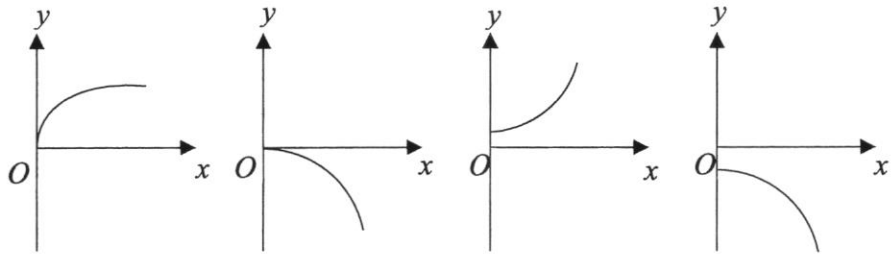


Diagram 1 Diagram 2 Diagram 3 Diagram 4

Answer Diagram _____ [1]

3 Given that $3 \times 27^n = 1$, find the value of n.

Answer: $n =$ _____ [2]

4 The table below shows the distribution of ages of some students participating in a soccer tournament.

Age (in years)	13	14	15	16	17
Number of students	8	5	x	6	2

Given that the median age is 14 years, state the range of values of x.

Answer: _____ [2]

5 Box A contains four cards numbered 1, 4, 8 and 10. Box B contains three cards numbered 2, 5 and 7.

One card with number x is drawn from Box A and another card with number y is drawn from Box B. The possibility diagram shows the sum of the numbers x and y.

(a) Complete the possibility diagram.

+	**1**	**4**	**8**	**10**
2	3	6	10	12
5	6		13	15
7	8	11	15	

[2]

(b) Find, in simplest form, the probability that

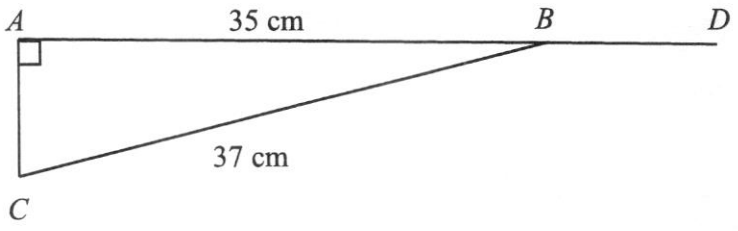
(i) $x + y$ is a prime number.

Answer: _____ [1]

(ii) $\frac{1}{2}x + \frac{1}{2}y \geq 8\frac{1}{2}$.

Answer: _____ [2]

6 In the diagram below, ABD is a straight line, $\angle DAC = 90°$, $AB = 35$ cm and $BC = 37$ cm.



(a) Find AC.

Answer: _____ cm [1]

(b) Write as a fraction

(i) $sin\ \angle ABC$,

Answer: _____ [1]

(ii) $cos\ \angle CBD$.

Answer: _____ [1]

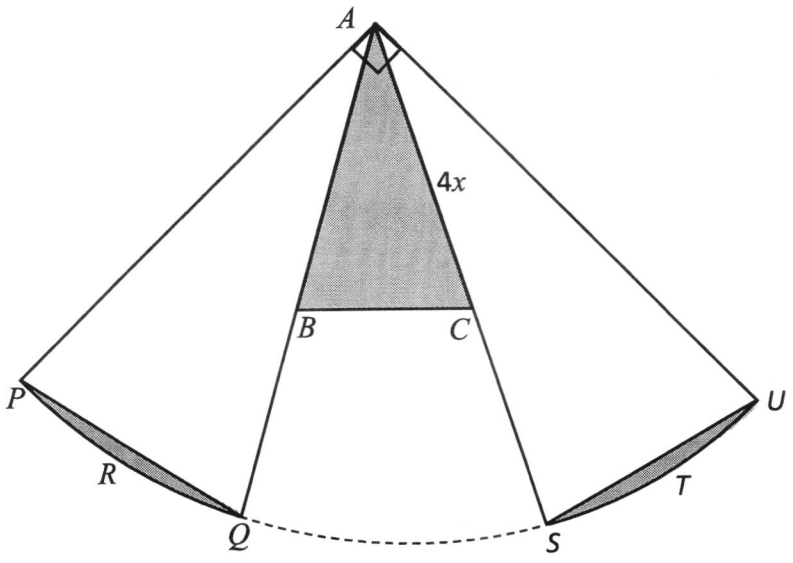
7 A worker works in a fast-food restaurant for 13 hours. The worker is paid $\$x$ for working at normal rate and $\$y$ for working at overtime rate. If he works for 10 hours at the normal rate and 3 hours at overtime rate, he will be paid \$124. On Saturdays, if he works for 8 hours at the normal rate and 5 hours at overtime rate, he will be paid \$133.

Form and solve two simultaneous equations to find the normal and overtime rate of pay.

Answer: Normal rate \$ _____

Answer: Overtime rate \$_____ [4]

8



The diagram shows an isosceles triangle ABC. Angle PAQ = angle BAC = angle SAU. $AC = 4x$.

Angle $PAU = 90°$. $APRQ$ and $AUTS$ are two identical sectors. B is the mid-point of AQ and C is the mid-point of AS.

Show that the shaded area can be expressed as $(p\pi + q)x^2$ where p and q are constants.

Answer:

[6]

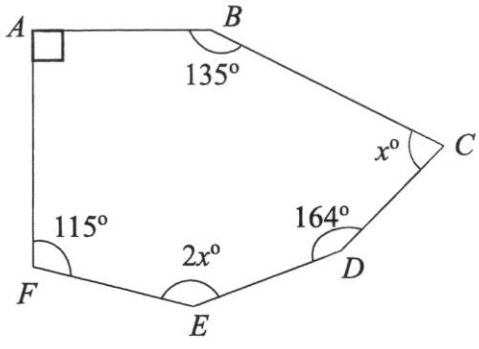
9 n is a positive integer.

Show that, for all n, $(6n+1)^2 - (6n-1)^2$ is a multiple of 24.

Answer:

[2]

10



Given the diagram above, find the value of x.

Answer: x = _____ [2]

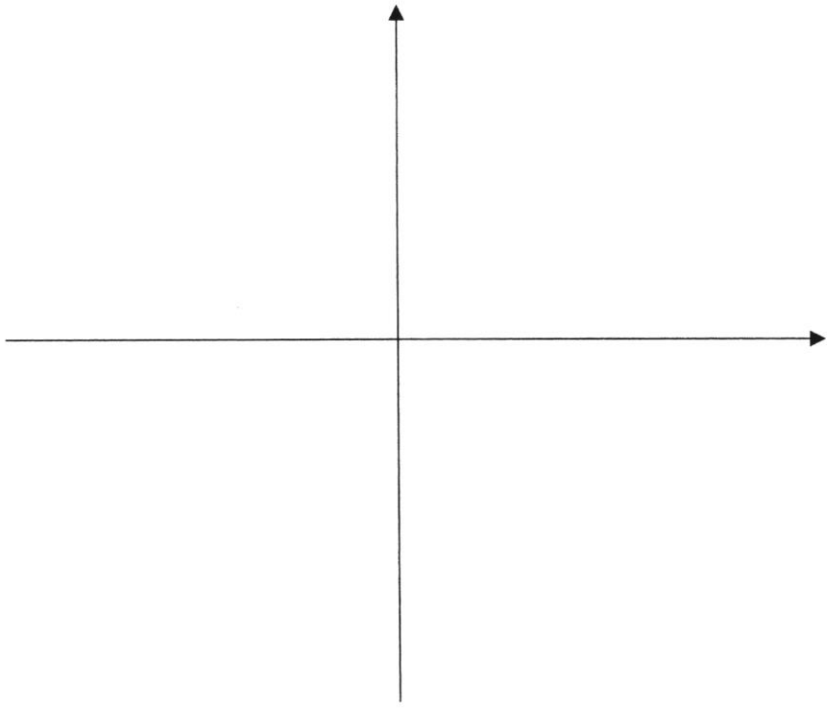
11 (a) Express $7-8x+x^2$ in the form of $p+(x+q)^2$.

Answer _____ [2]

(b) **Sketch** the graph of $y = 7 - 8x + x^2$ on the axes below.

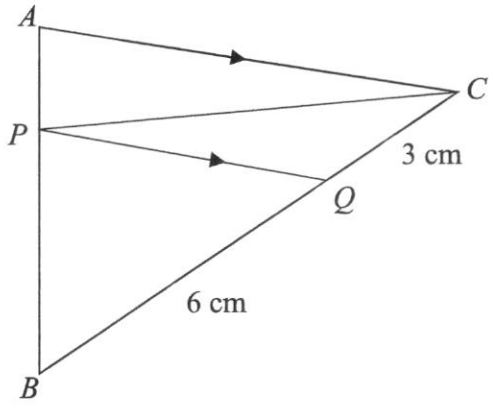
Indicate clearly the coordinates of the points where the graph crosses the axes and the minimum point on the curve.

Answer



[3]

12 In the diagram below, $QC = 3$ cm, $BQ = 6$ cm and PQ is parallel to AC.



(a) Stating your reasons clearly, show that triangle PQB is similar to triangle ACB.

Answer

[2]

(b) Find the value of $\frac{Area\ of\ triangle\ ABC}{Area\ of\ trapezium\ APQC}$.

Answer: _____ [2]

13 A group of 150 adults took part in a run.

The table below shows the distribution of the times taken to complete the run.

Time (t minutes)	$30 < t \leq 40$	$40 < t \leq 50$	$50 < t \leq 60$	$60 < t \leq 70$	$70 < t \leq 80$
Number of adults	25	62	35	22	6

(a) Calculate an estimate of the mean time.

Answer: _____ minutes [1]

(b) Calculate an estimate of the standard deviation.

Answer: _____ minutes [1]

(c) The standard deviation of a second group of adults taking part in the run is 8 minutes. One of the runners in the second group claims that all the runners in the second group run faster as the standard deviation of the second group is lower than the first group.

Explain if you agree and justify your reason.

Answer:

_____

_____

_____

_____ [1]

14 (a) Expand and simplify $(2x - 5q)(2x - 5q)$.

Answer: _____ [2]

(b) Given that $(2x - 5q)(2x - 5q) = 4x^2 + 40x + 100$. Find the value of q.

Answer: q = _____ [3]

15 Simplify $\left(\frac{3x}{4y^2}\right)^{-2}$.

Answer: _____ [2]

16 A map is drawn to a scale of 1 cm to 650 m.

(a) Express the scale in the form 1 : n.

Answer: _____ [1]

(b) A straight road has a length of 20.8 km. Find its length on the map in cm.

Answer: _____ cm [2]

(c) A sea port has an area of 60 cm^2 on the map. Find its actual area in km^2.

Answer: _____ km^2 [2]

17 Written as a product of its prime factors, $1512 = 2^3 \times 3^3 \times 7$ and $720 = 2^x \times 3^y \times 5$.

(a) Find the value of x and y.

Answer: $x =$ _____ [1]

Answer: $y =$ _____ [1]

(b) Find the lowest common multiple of 1512 and 720.

Answer: _____ [1]

(c) Find the smallest positive integer k such that $\frac{720}{k}$ is a square number.

Answer: $k =$ _____ [1]

18 (a) Factorise $12nm - 3n - 4m^2 + m$.

Answer: _____ [2]

(b) Using factorisation, solve $8x^2 - 26x + 15 = 0$.

Answer: _____ or _____ [3]

19 In store A, each cable costs \$12, each charger costs \$25 and each earpiece costs \$16.

In store B, each cable costs \$2 more, each charger costs \$4 less and each earpiece costs \$3 less.

This information can be represented by the matrix $\mathbf{Q} = \begin{pmatrix} 12 & 2 \\ 25 & -4 \\ 16 & -3 \end{pmatrix}$.

Ali and Mary go to the stores.

Ali buys 4 cables, 2 chargers and 3 earpieces.

Mary buys 6 cables and 3 earpieces.

(a) Represent their purchases in a 2×3 matrix **P**.

Answer: _____ [1]

(b) Evaluate the matrix $\mathbf{R} = \mathbf{PQ}$.

Answer: $\mathbf{R} =$_____ [2]

(c) At which store would Ali spend more and by how much more?

Answer: Store _____ [1]

\$ _____ [1]

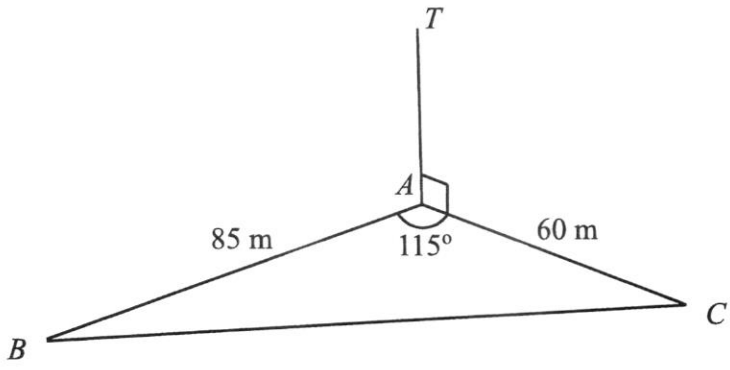
(d) Ali and Mary shop in store B.

John has a 10% discount voucher and Mary has a 5% discount voucher.

How much would they pay altogether for their items?

Answer: \$ _____ [2]

20 In the diagram, ABC are three points on horizontal ground.
$AB = 85$ m, $AC = 60$ m and angle $BAC = 115°$.



(a) Calculate the length of BC.

Answer: _____ m [2]

(b) A girl standing at B is flying a drone T.

The drone, T, is vertically above A.

A string, BT, attached to the drone is at 35° to the horizontal.

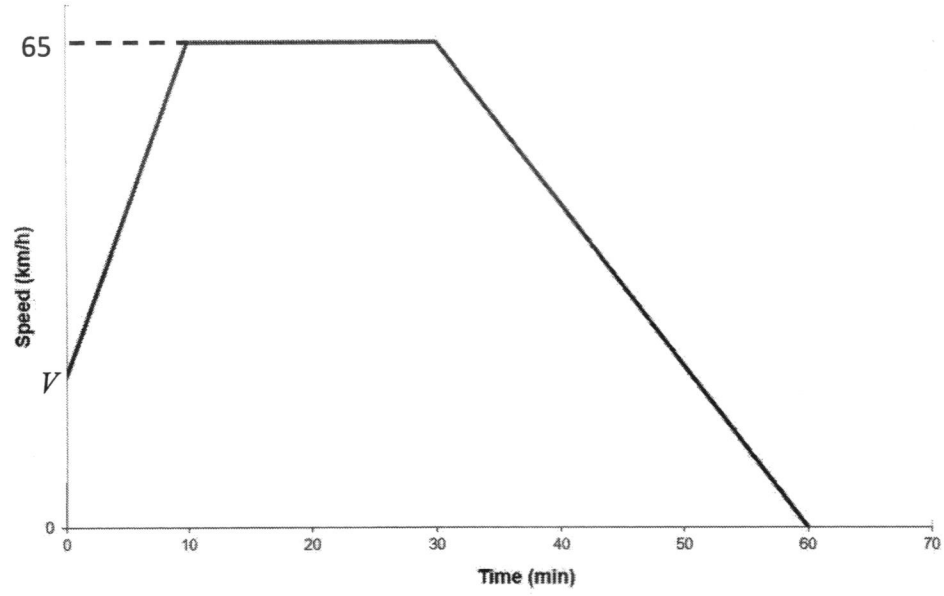
Calculate the angle of elevation of the drone when viewed from C.

Answer: _____ [3]

(c) Calculate the shortest distance from A to BC.

Answer: _____ m [3]

21 The diagram below shows the speed-time graph of the first 60 minutes of a car journey.



(a) The area beneath the speed-time graph represents the distance travelled by the car.

The car travels at the initial speed of V km/h. Given that the distance travelled for the first 30 minutes is 28.75 kilometres. Calculate the value of V.

Answer:

[3]

(b) Hence, find the deceleration of the car in km/h^2 for the last 30 minutes.

Answer: _____ km/h^2 [2]

(c) Find the average speed of the car for the whole journey.

Answer: _____ km/h [2]

22 The coordinates of the points P, Q and R are $(-1, 4)$, $(9, b)$, and $(3, 6)$ respectively.

The line of PQ is parallel to $y = \frac{b}{8}x+c$.

(a) Find PR.

Answer: _____ [2]

(b) Find the equation of the line PQ.

Answer: _____ [3]

(c) Given another equation of the line k is $2y = 4x + 4$, explain the relationship between line PQ and line k.

Answer: _____

_____

_____ [1]

--End of Paper—

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TAMPINES SECONDARY SCHOOL

Secondary Four Express / Five Normal Academic
PRELIMINARY EXAMINATION 2023

NAME

CLASS

REGISTER NUMBER

MATHEMATICS **4052/02**

Paper 2 **25 August 2023**

2 hours 15 minutes

Candidates answer on the Question Paper.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	**Total**

READ THESE INSTRUCTIONS FIRST

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[Turn over

Mathematical Formulae

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length $= r\theta$, where θ 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)** It is given that $p = \sqrt{\dfrac{64 - qr}{q}}$ where q is non-zero.

(i) Find p when $q = 4$ and $r = -9$.

Answer $p =$ .....[1]

(ii) Express q in terms of p and r.

Answer $q =$ .....[3]

(b) Solve $\dfrac{5}{6-x} + \dfrac{4}{x-6} = 2$.

Answer $x =$ .....[3]

(c) Solve the inequality $3x-7 \leq \frac{50}{3}x+6$.

Answer .....[2]

(i) Represent your answer in part **(c)** on the number line below.

Answer

[1]

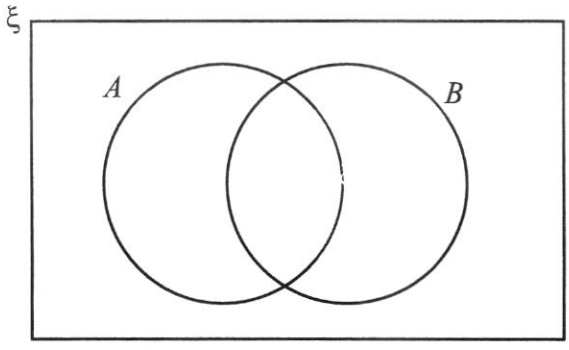
(ii) Hence state the least integer value of x.

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

2 **(a)** $\xi = \{\text{integers } x\text{: } 0 < x \leq 10\}$
$A = \{\text{prime numbers}\}$
$B = \{(x - 5)(4 - x) = 0\}$

(i) Complete the Venn Diagram to illustrate this information.

Answer



[1]

(ii) List the elements in $(A \cup B)'$.

Answer .....[1]

(iii) C is a proper subset of A. Anthony claims that $n(C) \leq 4$.
Explain with reasons if Anthony's claim is valid.

Answer

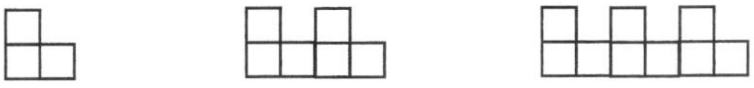
.....

.....

.....

.....[2]

(b) A L-shaped block is made of 3 squares of 1-cm^2 each and has a perimeter of 8 cm.
The following pattern shows L-shaped blocks joined together.



1 L-shaped block 2 L-shaped blocks 3 L-shaped blocks

The values for the perimeter of the 1 L-shaped block and 2 L-shaped blocks are given below.

Number of L-shaped blocks	1	2	3	4
Perimeter (cm)	8	14	***a***	***b***

(i) Find a and b.

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

(ii) Write down the perimeter of a n L-shaped block in terms of n.

Answer .....[1]

(iii) If the perimeter of a n L-shaped block is 2258 cm, find the number of squares in this n L-shaped block.

Answer .....[2]

3 **(a)** The population of Singapore was estimated at 5 985 000 in June 2023.

(i) Write 5 985 000 in standard form.

Answer .....[1]

The land area of Singapore is 734.3 km^2.

(ii) Find the population of Singapore per km^2. Write your answer in standard form, correct to 2 significant figures.

Answer .....[2]

(b) The value of a painting in 2022 was 20% more than its value in 2021 but 16% less than its value in 2023. If the painting is valued at \$20 000 in 2023, find its value in 2021.

Answer \$.....[3]

(c) Mr and Mrs Raj are travelling from Singapore to Malaysia.
In Singapore, the exchange rate is 100 Singapore Dollars ($) = 335 Malaysian Ringgit (RM) .
In Malaysia, the exchange rate is 100 Malaysian Ringgit (RM) = 33.5 Singapore Dollars ($).

Mr Raj wants to change $1000 into Malaysian Ringgit in Singapore. Mrs Raj claims that there is no difference whether Mr Raj changes the money in Singapore or Malaysia.
Do you agree with Mrs Raj? Justify your answer, showing all workings clearly.

Answer

[3]

4 **(a)** $\overrightarrow{PQ} = \begin{pmatrix} 11 \\ 2 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$.

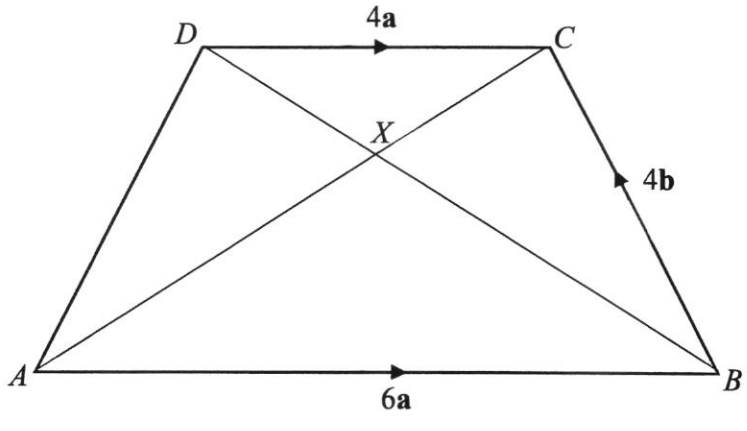
(i) Find $\left|\overrightarrow{PR}\right|$.

Answer ..... units [2]

(ii) Q is the point (2, 3). Find the position vector of P.

Answer ..... [2]

(b) $ABCD$ is a trapezium where AB is parallel to DC. The diagonals AC and BD intersect at X. $\overrightarrow{AB} = 6\mathbf{a}$, $\overrightarrow{DC} = 4\mathbf{a}$ and $\overrightarrow{BC} = 4\mathbf{b}$.



(i) Find the ratio $AX : XC$.

Answer ..... : .....[1]

(ii) Express as simply as possible, $\overrightarrow{AD}$ in terms of **a** and/or **b**.

Answer $\overrightarrow{AD}$ = ...[1]

(iii) E is a point on DC extended.
Given $\overrightarrow{AE} = 8\mathbf{a} + 4\mathbf{b}$, show that $ABED$ forms a parallelogram.

Answer

[1]

(iv) Hence find the ratio

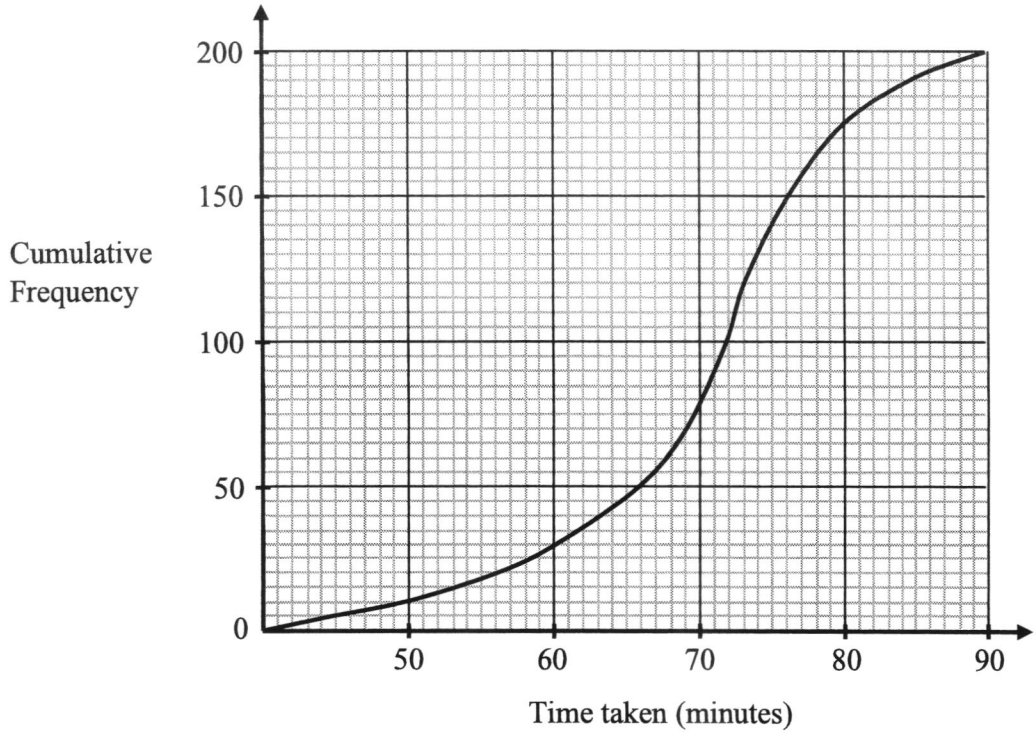
(a) area triangle ABE : area parallelogram $ABED$,

Answer ..... : .....[1]

(b) area triangle ABE : area triangle ACD.

Answer ..... : .....[1]

5 The cumulative frequency curve shows the distribution of the time taken by 200 Secondary One boys to complete a task in January.



(a) Use the graph to find

(i) the 15th percentile,

Answer .....minutes [1]

(ii) the median time,

Answer .....minutes [1]

(iii) the interquartile range.

Answer .....minutes [2]

(b) 12.5% of the boys took more than n minutes.
Find n.

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

(c) With practice, each boy uses 5 less minutes to complete the same task in June.
Describe how the cumulative frequency curve would have been different.

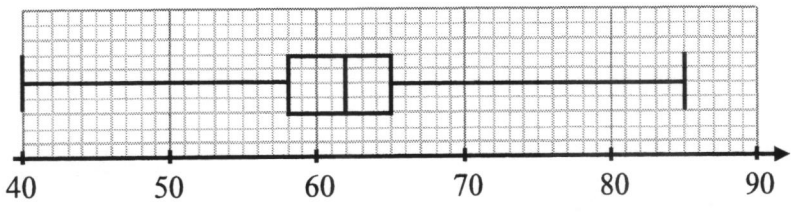
Answer .....

.....

.....

..... [1]

(d) The box-and-whiskers plot below shows the time taken by 200 Secondary One girls to complete the same task in January.



Time taken (minutes)

Make two comments comparing the times taken by the boys and girls to complete the task.

Answer

1. .....

.....

.....

.....

2. .....

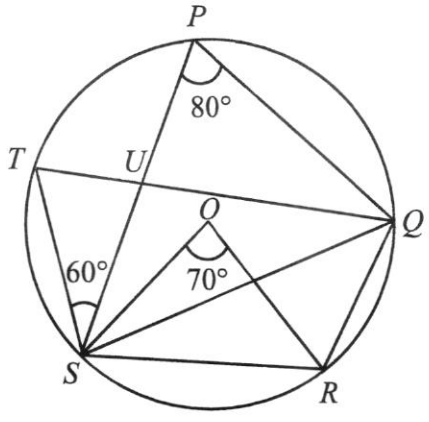
.....

.....

..... [2]

6 **(a)** In the diagram, P, Q, R, S and T are points on a circle, centre O.

Angle $SPQ = 80°$, angle $PST = 60°$ and angle $SOR = 70°$.



(i) Find angle TUS.
Give a reason for each step of your working.

Answer Angle TUS = ... ° [2]

(ii) Find angle SQR.
Give a reason for each step of your working.

Answer Angle SQR = ... ° [1]

(iii) Find angle ORS.
Give a reason for each step of your working.

Answer Angle ORS = ... ° [1]

(iv) Find angle ORQ.
Give a reason for each step of your working.

Answer Angle ORQ = ...° [2]

(v) Explain, with clear workings and reasonings, whether lines OS and QR are parallel.
Answer

.....

.....

.....

.....[2]

(b) There are $(2n + 3)$ red marbles, $(4n - 1)$ green marbles and $(18 - 2n)$ blue marbles in a bag.

(i) Given that the probability of drawing a red or green marble is $\frac{19}{22}$, show that $n = 6$.

Answer

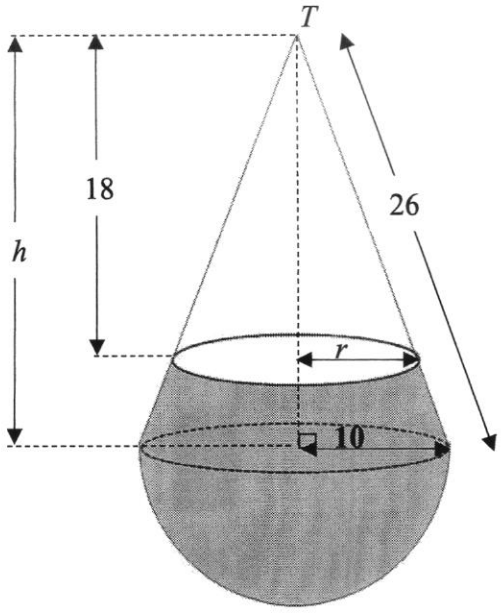
[2]

(ii) Hence find the probability of drawing 2 red marbles, one after another without replacement.

Answer .....[2]

7 The diagram shows a container formed from a cone and a hemisphere.
The cone has base radius 10 cm, vertical height h cm and slant height 26 cm.
The hemisphere has radius 10 cm.

Water enters the container through a tiny hole, T at the top of the cone.
The water reaches a height 18 cm from T and forms a circular top with radius r cm.



(a) Find the height of the cone.

Answer ..... cm [1]

(b) Using similar triangles, show that $r = 7\frac{1}{2}$.

Answer

[2]

(c) Find the surface area of the container that is in contact with the water.

Answer ..... cm^2 [3]

(d) Find the volume of the water in the container.

Answer ..... cm^3 [3]

8 **(a)** Complete the table of values for $y = \frac{x^3}{2} - 3x + 2$.

x	−3	−2	−1	0	1	2	3
y		4	4.5	2	−0.5	0	6.5

[1]

(b) On the grid on the next page, draw the graph of $y = \frac{x^3}{2} - 3x + 2$ for $-3 \leq x \leq 3$. [3]

(c) Use your graph to write down an inequality in x to state the range of values of x where $y > 5$.

Answer .....[1]

(d) By drawing a straight line, find the gradient of the graph at $x = 2$.

Answer .....[2]

(e) **(i)** On the same grid, draw the graph of $y = x - 1$. [1]

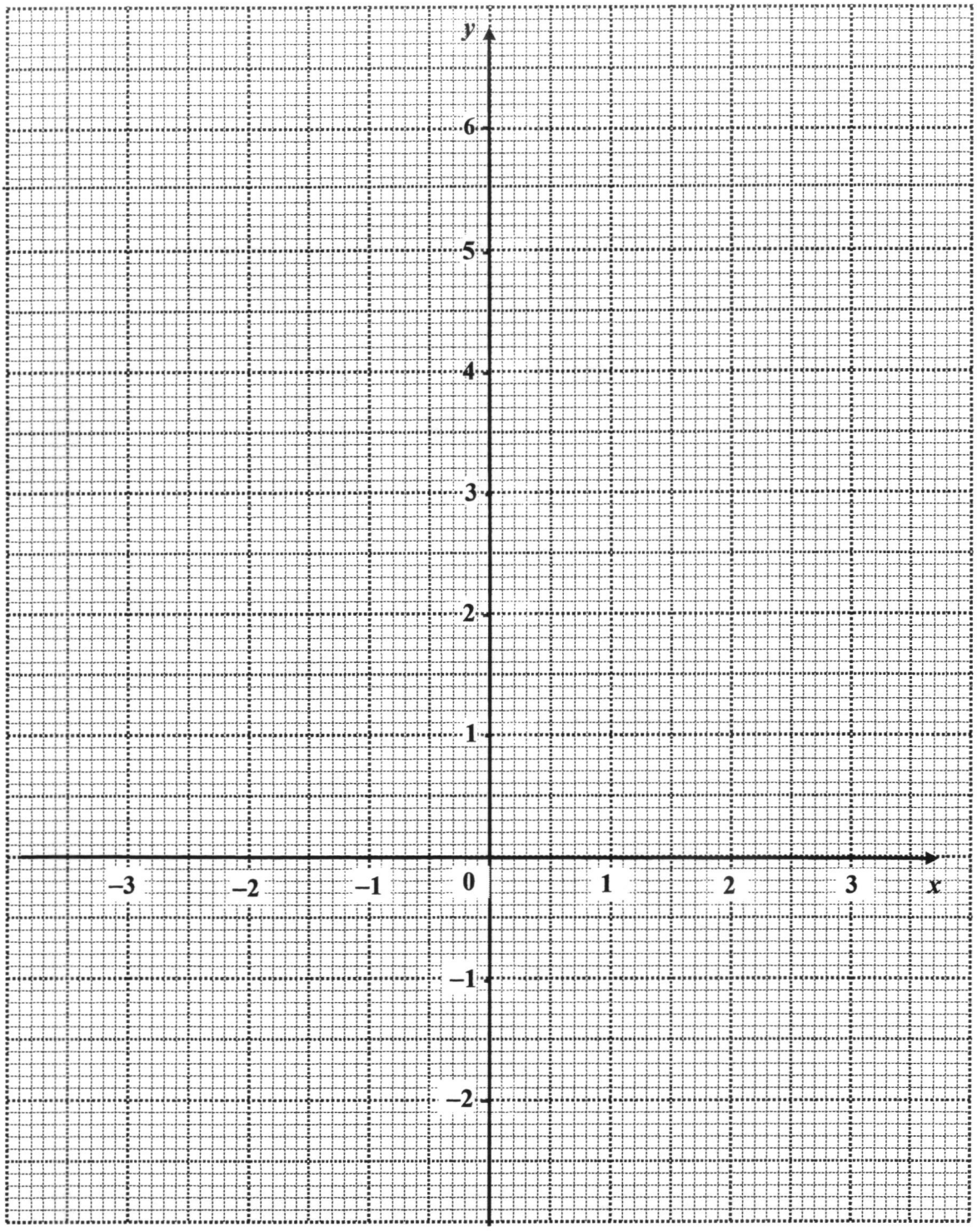
(ii) Show that the points of intersection of the line $y = x - 1$ and the curve $y = \frac{x^3}{2} - 3x + 2$ give the solutions of $x^3 - 8x + 6 = 0$.

Answer

[2]

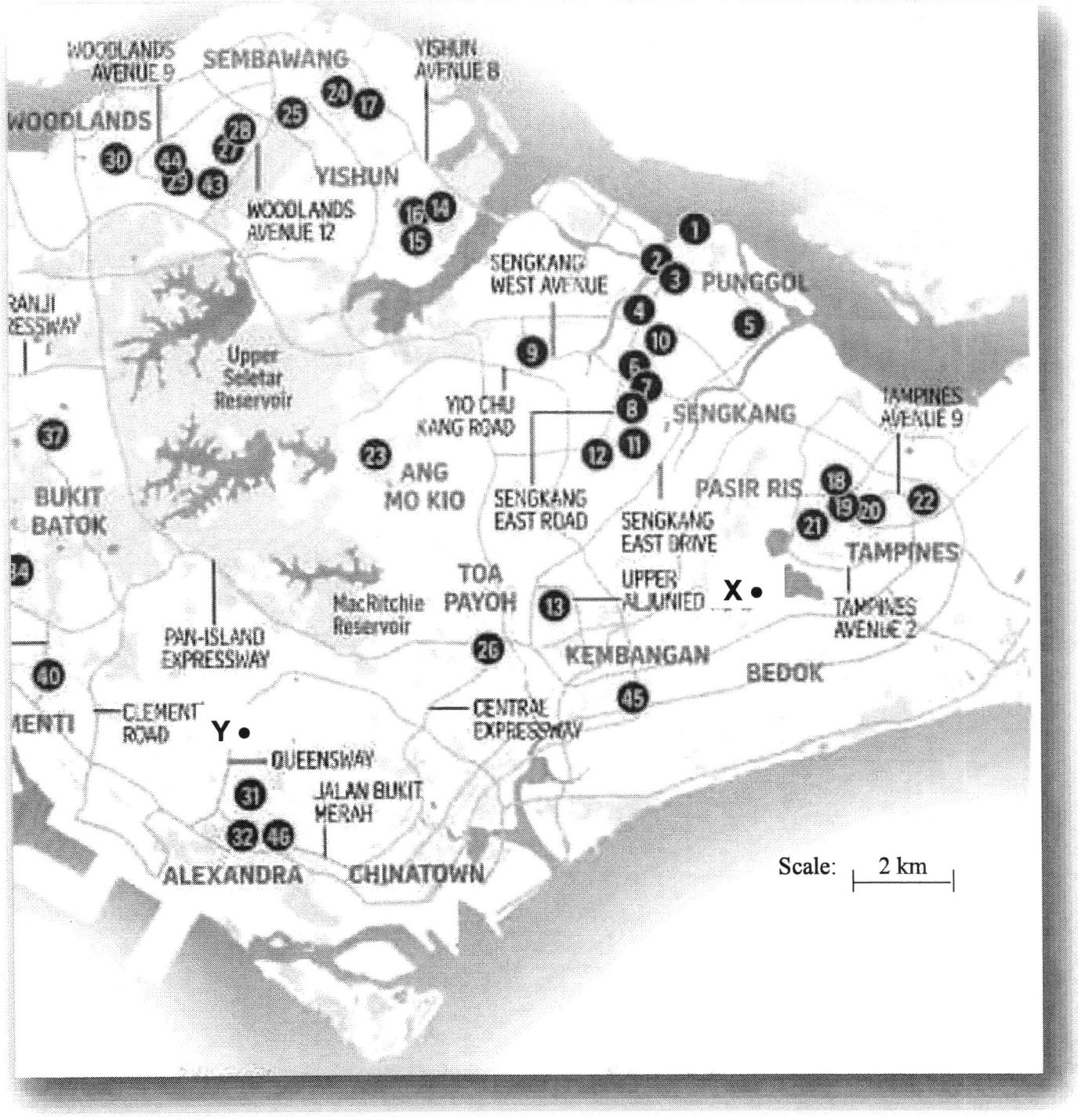
(iii) Use your graph to solve $x^3 - 8x + 6 = 0$.

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



9 Retrieved from The Straits Times, 10 June 2023. *More budget meal options are in the works for Singaporeans. The Housing Board, in collaboration with the Government Technology Agency, launched the BudgetMealGoWhere website to help residents locate HDB coffee shops offering budget meals within 2 km of their residence.*

The diagram below shows part of the map of Singapore. The locations of HDB coffee shops offering budget meals on the map are numbered as shown.



(a) Sally resides at the location marked 'X' in the diagram.

(i) Construct on the diagram, a circle centre X with radius 2 km. [1]

(ii) Using your answer from part **(a)(i)**, write down the coffee shop(s) number within 2 km of Sally's residence.

Answer Coffee shop(s) .....[1]

Mary resides at the location marked 'Y' in the diagram.

(iii) Construct on the diagram, a perpendicular bisector of XY. [1]

(iv) Sally and Mary decide to meet at a coffee shop that is equidistant from their residences. Using your answer from part **(a)(iii)**, write down the coffee shop(s) number that they can meet.

Answer Coffee shop(s) .....[1]

(b) After meeting Mary, Sally needs to run multiple errands to different parts of Singapore. She decides to rent a car from 8am to 12pm for that day.

The tables below show the cost of car rental from two companies, GetCar and FindCar.

GetCar's Rental Charges

Timings	Cost / hour	Remarks
12am – 8am	$4	- Additional mileage charge at $0.39/km - No petrol charge
8am – 6pm	$7	
6pm – 12am	$9	

FindCar's Rental Charges

Timings	Cost / hour	Remarks
12am – 6am	$5	- Additional mileage charge at $0.39/km - Petrol charges to be paid by driver
6am – 9am	$3	
9am – 6 pm	$5	
6pm – 12am	$7	

The table below shows the price per litre of different grades of petrol from three different petrol companies, Company Messo, Company Shore and Company SCP. Each litre of petrol allows 12.5 km of travel.

Petrol Grade	Company Messo	Company Shore	Company SCP
	Price per litre (Discounted price per litre if ABC Bank credit card is used)		
92	$2.70 (NA)	-	$2.70 (NA)
95	$2.75 (NA)	$2.79 ($2.20)	$2.74 (NA)
98	$3.22 (NA)	$3.28 ($2.59)	$3.22 (NA)

Sally estimates that she needs to travel 67 km that day. She carries an ABC Bank credit card. She wants to minimise her costs in the rental. Suggest the company from which Sally should rent the car. Justify any decisions you make and show your calculations clearly.

Answer

[6]

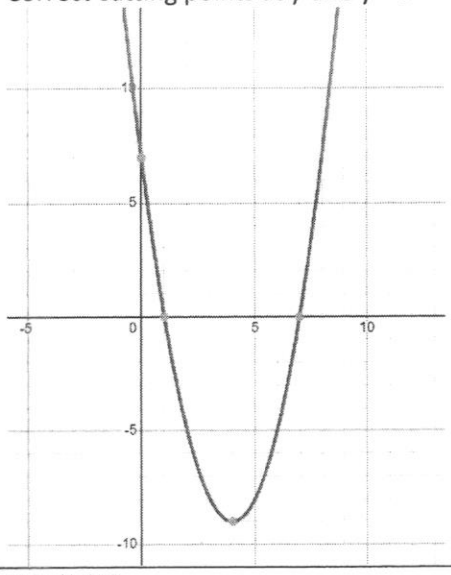
Mark Scheme **Tampines Secondary School**
Mathematics Department

Marking Scheme for 3E Math Preliminary Examination

[√ means follow through] **Total Marks : 90**

No.	Solutions	Mark
1	$A = P(1+\frac{R}{100})^n$ $A = 4500\ (1+\frac{2.8}{100})^5$ =5166.28	M1 A1
2	Diagram 4	B1
3	$3 \times 27^n = 1$ or $27^n = \frac{1}{3}$ $3^1 \times 3^{3n} = 3^0$ or $3^{3n} = 3^{-1}$ $3^{3n+1} = 3^0$ $n = -\frac{1}{3}$	M1 A1
4	Listing or any method 8 numbers 13 on the left 14 14 14 14 14 15 …….. 8 numbers 16,17 on the right When x =1 , median is 14 When x =2, …. When x = 4 median is 14 When x = 5, median is 14.5 Range of x is $0 \le x \le 4$ or $0 \le x < 5$.	M1 o.e A1
5a	9, 17	B2
5bi	$\frac{1}{3}$	B1
5bii	$\frac{1}{2}x + \frac{1}{2}y \ge \frac{17}{2}$ ➔ $x + y \ge 17$ $= \frac{1}{12}$	M1 A1 or B2
6a	12	B1
6bi	$\frac{12}{37}$	B1
6bii	$-\frac{35}{37}$	B1

7	$10x + 3y = 124 - - - - - - - - (1)$ $8x + 5y = 133 - - - - - - - - (2)$ Any method $(1) \times 5: 50x + 15y = 620 - - - - - - - - (2)$ $(1) \times 3: 24x + 15y = 399 - - - - - - - - (2)$ x = normal rate = \$8.5 y = overtime rate = \$13	M1 M1 any method A1 A1
8	Angle PAQ =.angle BAC = angle $\angle SAU = \frac{\pi}{6}$ Area of triangle $ABC = \frac{1}{2}(4x)(4x)sin\frac{\pi}{6} = 4x^2$ Area of sector APRQ/AUTS $= \frac{1}{2}r^2\theta = \frac{1}{2}(8x)(8x)\frac{\pi}{6} = \frac{16\pi}{3}x^2$ Area of triangle ASU / APQ $= \frac{1}{2}(8x)(8x)sin\frac{\pi}{6} = 16x^2$ Area of segment = $(2)\frac{16\pi}{3}x^2 - (2)(16)x^2$ (or at least 1 segment shown) Area of shaded region = $4x^2 + (2)\frac{16\pi}{3}x^2 - (2)16x^2$ $= (\frac{32}{3}\pi - 28)x^2$	M1 M1 M1 M1 M1 A1
9	$(6n+1)^2 - (6n-1)^2 = (6n + 1 - (6n-1))(6n + 1 + 6n - 1)$ = 2(12n) = 24 n Or $36n^2 + 12 + 1 - (36n^2 - 12 + 1)$ = 24n	M1 A1
10	$(n-2) \times 180 = 720$ $3x + 135 + 115 + 164 + 90 = 720$ $x = 72$	M1 A1

11a	$7 - 8x + x^2 = x^2 - 8x + 7$ $= (x-4)^2 - 16 + 7$ $= (x-4)^2 - 9 = -9 + (x + (-4))^2$	 M1 o.e A1
11b	(4, -9) turning point indicated Correct cutting points at x-axis x = 1, 7 Correct cutting points at y-axis y = 7  	B1 B1 B1
12a	PQ // AC $\angle BPQ = \angle BAC$ (corresponding angles) $\angle BQP = \angle BCA$ (corresponding angles) $\angle PBQ = \angle ABC$ (common angles) Since all corresponding angles of triangle ABC and triangle PBQ are equal, hence triangle ABC is similar to triangle PBQ. (AAA Similarity test or AA similarity test)	 M1 for any 1 correct equal angles shown A1 conclusion with 2nd angle shown
12b	$\frac{Area\ of\ triangle\ ABC}{Area\ of\ triangle\ PBQ} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$ $\frac{Area\ of\ triangle\ ABC}{Area\ of\ trapezium\ APQC} = \frac{9}{5}$ or 1.8	M1 A1

13a	Mean $= \frac{\Sigma ft}{\Sigma t} = \frac{25\times35+62\times45+35\times55+22\times65+6\times75}{150} = 49.8$	B1
13b	Standard deviation $= \sqrt{\frac{\Sigma ft^2}{\Sigma t} - mean(\bar{t})^2} =$ $\sqrt{\frac{25\times35^2+62\times45^2+35\times55^2+22\times65^2+6\times75^2}{150} - mean(\bar{t})^2}$ $=10.565 = 10.6$ minutes	B1
13c	His claim is wrong as the standard deviation measures consistency and how close the values are to one another, small standard deviation can mean most runners runs slower too.	B1
14a	$= 4x^2 - 10xq - 10xq + 25q^2$ by expansion or o.e $= 4x^2 - 20qx + 25q^2$	M1 A1 or B2
14b	$4x^2 - 20qx + 25q^2 = 4x^2 + 40x + 100$ $-20q = +40$ $q = -2$ $25q^2 = 100$ $q = 2, q = -2$ Hence $q = -2$	 M2 A1
15	$\left(\frac{3x}{4y^2}\right)^{-2} = \frac{1}{\left(\frac{3x}{4y^2}\right)^2}$ or $\left(\frac{4y^2}{3x}\right)^2$ seen $= \frac{16y^4}{9x^2}$	M1 A1

16a	1 : 65000	B1
16b	1 : 65000 1cm : 0.65 km 32 cm rep 20.8 km 32 cm	 M1 A1
16c	1 : 65000 1cm : 0.65 km Area scale: $1cm^2$: 0.4225 km^2 60 cm^2 : 20.35 km^2 20.35 km^2	 M1 A1
17a	$x = 4$	B1
	$y = 2$	B1
17b	LCM = $2^4 \times 3^3 \times 5 \times 7$	B1
17c	$k = 5$	B1
18a	$12nm - 3n - 4m^2 + m = 3n(4m - 1) - m(4m - 1)$ $= (4m - 1)(3n - m)$	M1 A1
18b	$8x^2 - 26x + 15 = 0$ $(2x - 5)(4x - 3) = 0$ $x = \frac{5}{2}$ *or* 2.5 $x = \frac{3}{4}$ *or* 0.75	 M1 A1 A1

19a	$P = \begin{pmatrix} 4 & 2 & 3 \\ 6 & 0 & 3 \end{pmatrix}$	B1
19b	$R = \begin{pmatrix} 4 & 2 & 3 \\ 6 & 0 & 3 \end{pmatrix}\begin{pmatrix} 12 & 2 \\ 25 & -4 \\ 16 & -3 \end{pmatrix}$ $=\begin{pmatrix} 146 & -9 \\ 120 & 3 \end{pmatrix}$	M1 for 2 values correct for the 2 by 2 matrix.
19c	Store A $9	B1 B1
19d	($146 − 9)*0.9+($123)*0.95 = $240.15	M1 A1
20a	$BC^2 = 85^2 + 60^2 - 2(85)(60)cos115$ $BC^2 = 15135.70627$ $BC^2 = 123.0272 = 123\ m$	 M1 A1
20b	$\tan 35 = \frac{TA}{85}$ $TA = 59.517 = 59.5$ $\tan\theta = \frac{TA}{TC} = \frac{59.517}{60}$ $\theta = 44.768 = 44.8°$	M1 M1 A1
20c	Area of triangle ABC = $\frac{1}{2}absinc = \frac{1}{2}(85)(60)\sin 115$ =2311.084857 or 2550sin115 =2310 m² $\frac{1}{2}bh = 2311.084857\ or\ 2550sin115$ $\frac{1}{2}(123.02)h = 2311.084857\ or\ 2550sin115$ $h = 37.572 = 37.6$	M1 M1 o.e A1

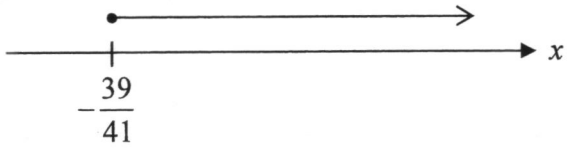
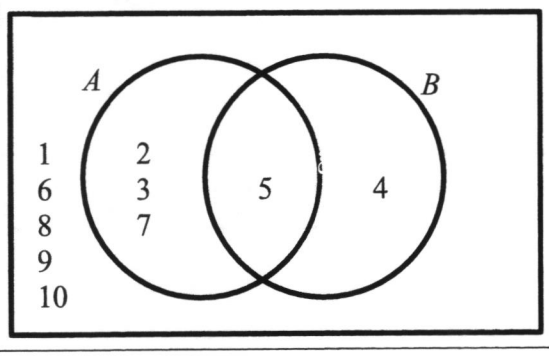
21a	$65 \times \frac{20}{60} + \frac{1}{2} \times \frac{10}{60}(v + 65) = 28.75$ $\frac{65}{3} + \frac{1}{12}(v + 65) = 28.75$ $\frac{1}{12}(v + 65) = \frac{85}{12}$ $v + 65 = 85$ $v = 85 - 65 = 20$ (shown)	M1 M1 o.e A1
21b	$a = \frac{0-65}{\frac{30}{60}} = -130$ km/h Deceleration = 130 km/h	M1 or o.e A1
21c	Total distance travelled = $28.75 + 0.5(65)\left(\frac{30}{60}\right) = 45\ km$ Average speed = $\frac{45\ km}{1\ h} = 45$ km/h	M1 A1
22a	Distance of PR = $\sqrt{(-1-3)^2 + (4-6)^2}$ $= \sqrt{20} = 4.4721.. = 4.47$	M1 A1
22b	$\frac{b-4}{9-(-1)} = \frac{b}{8}$ $\frac{b-4}{10} = \frac{b}{8}$ $8b - 32 = 10b$ $-32 = 2b$ $b = -16$ $y = -\frac{16}{8}x + c$ $4 = -2(-1) + c$ $4 = 2+c$ $C = 2$ $\quad y = -2x + 2$	M1 M1 A1

22c	$2y = 4x + 4$ $y = 2x + 2$ Line k and line PQ are reflection of one another with respect to the y-axis.	 A1

Tampines Secondary School

2023 Sec 4E/5N Mathematics 4052/02 Preliminary Examination Mark Scheme

[√ means follow through] **Total Marks : 90**

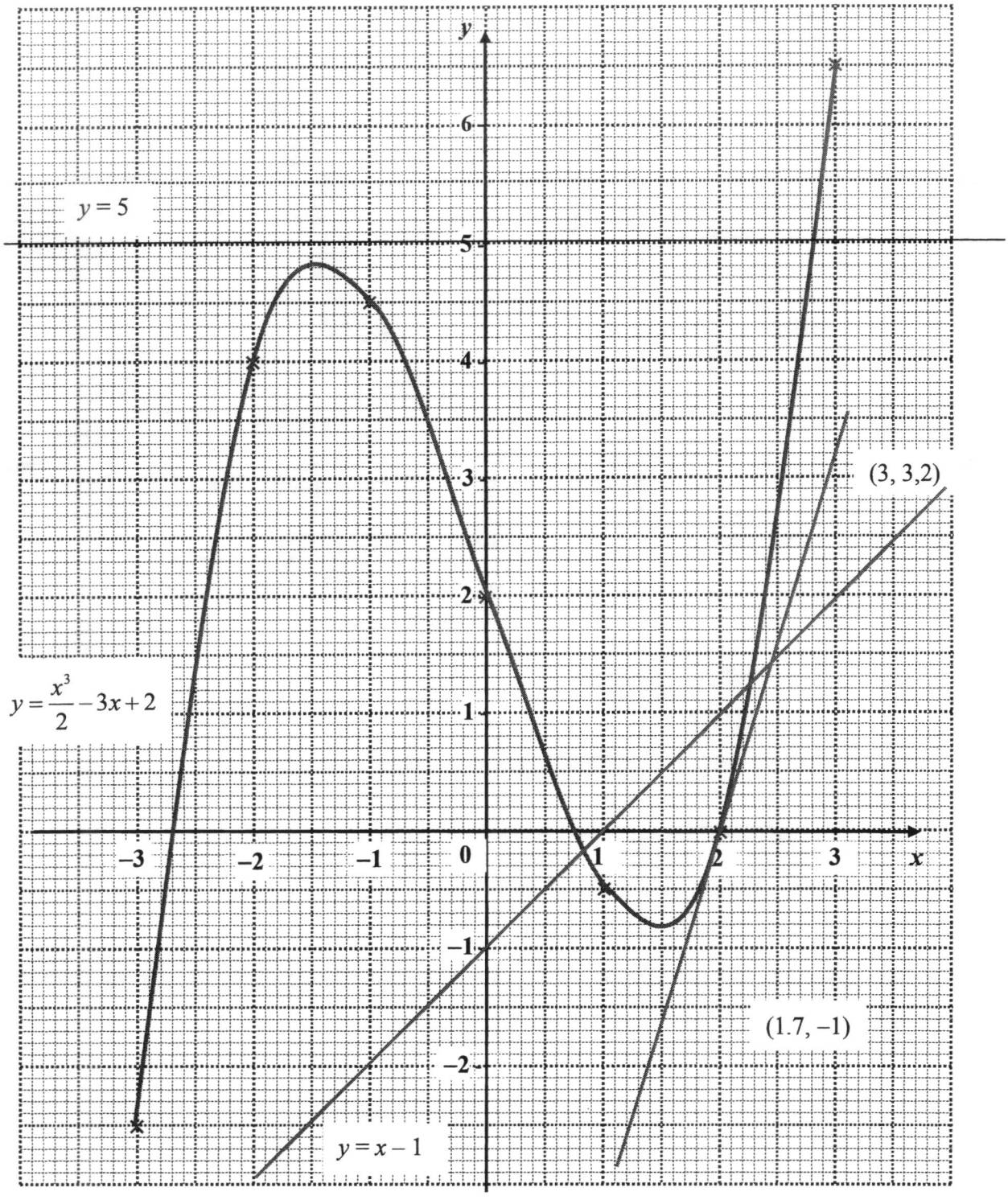
Qn	Solutions	Marks Allocation	
1a(i)	5	B1	
1a(ii)	$p=\sqrt{\dfrac{64-qr}{q}}$ $p^2=\dfrac{64-qr}{q}$ $p^2q=64-qr$ $q(p^2+r)=64$ $q=\dfrac{64}{p^2+r}$	M1: Sq both sides M1: Remove fraction A1	
1(b)	$\dfrac{5}{6-x}+\dfrac{4}{x-6}=2$ $\dfrac{5}{6-x}-\dfrac{4}{6-x}=2$ $\dfrac{1}{6-x}=2$ $1=12-2x$ $x=5.5$	M1: Combine fraction M1: Remove fraction A1	
1(c)	$3x-7\le\dfrac{50}{3}x+6$ $-\dfrac{41}{3}x\le 13$ $x\ge-\dfrac{39}{41}$	M1 A1	
1c(i)		B1	
1c(ii)	0	√B1	**11**
2a(i)		B1	

2a(ii)	1, 6, 8, 9, 10	√B1	
2a(iii)	**n(*A*) = 4**. If *C* is a proper subset of *A*, the number of **elements in *C* must be less than 4**. Hence Anthony's claim in **not valid**.	B1: soi n(*A*) = 4 B1: soi n(*C*) <4	
2b(i)	$a = 20, b = 26$	B2	
2b(ii)	$6n + 2$	B1	
2b(iii)	$6n + 2 = 2258$ $n = 376$ No. of squares = 1128	 M1 A1	**9**
3a(i)	5.985×10^6	B1	
3a(ii)	$\frac{5985000}{734.3} = 8150.6$ $= 8.2 \times 10^3$	M1 A1	
3(b)	Value in 2022 $= \frac{84}{100} \times 20\,000 = \$16\,800$ Value in 2021 $= \frac{16\,800}{120} \times 100\%$ $= \$14\,000$	M1 M1 A1	
3(c)	<u>If exchange in Singapore</u> Amount of RM= 3350 <u>If exchange in Malaysia</u> Amount of RM $= \frac{1000}{33.5} \times 100$ $= 2985.07$ Since RM 3350 in Singapore > RM2985 in Malaysia, I do not agree with Mrs Raj.	A1 M1 A1	**9**
4a(i)	$\overrightarrow{PR} = \begin{pmatrix} 8 \\ 6 \end{pmatrix}$ $\lvert\overrightarrow{PR}\rvert = 10$ units	M1 A1	
4a(ii)	$\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$ $\begin{pmatrix} 11 \\ 2 \end{pmatrix} = \overrightarrow{PO} + \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ $\overrightarrow{OP} = \begin{pmatrix} -9 \\ 1 \end{pmatrix}$	 M1 A1	
4b(i)	3 : 2	B1	
4b(ii)	**2a** + **4b**	A1	
4b(iii)	$\overrightarrow{AE} = \overrightarrow{AB} + \overrightarrow{BE}$ **8a** + **4b** = **6a** + $\overrightarrow{BE}$		

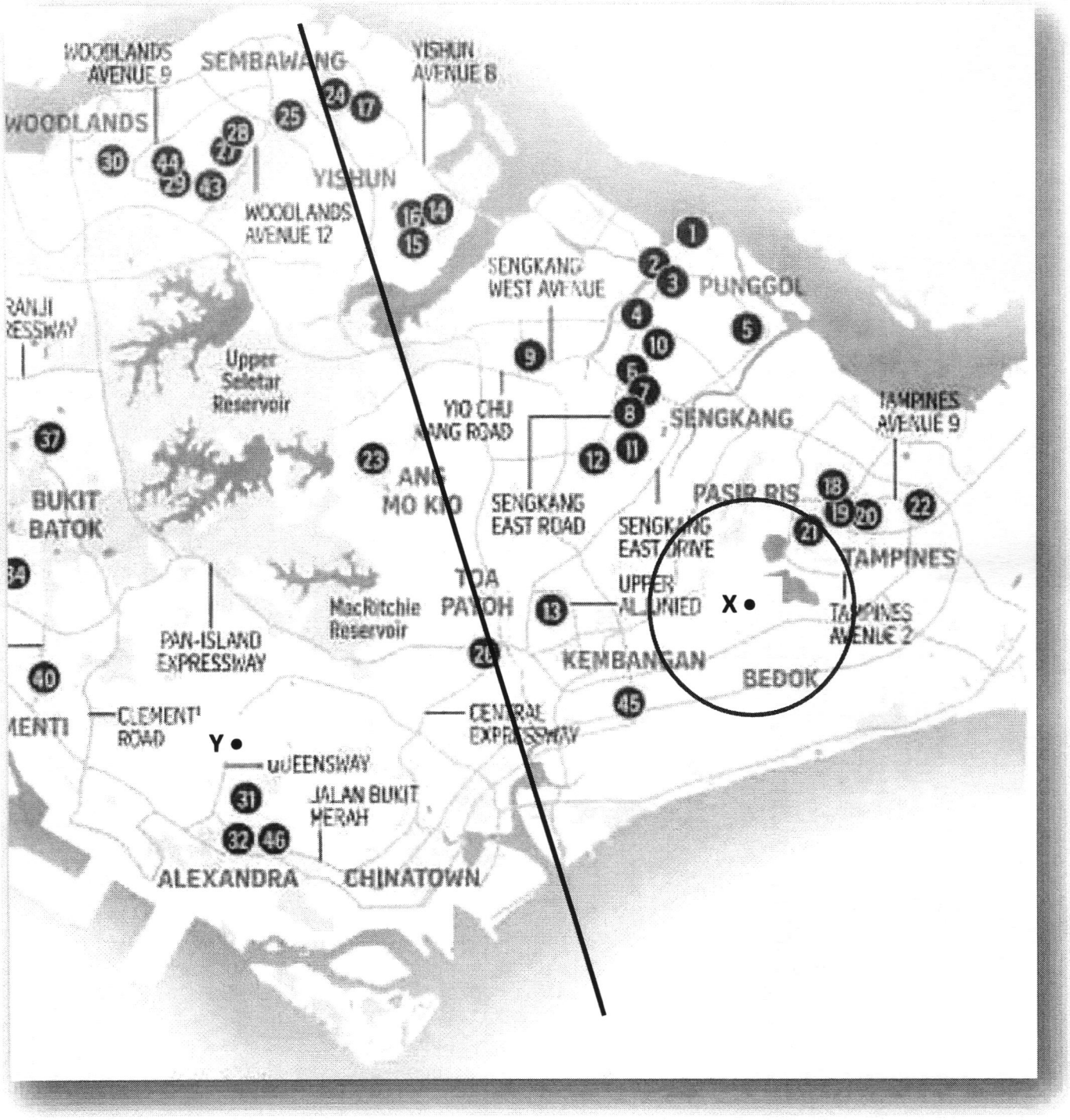
	$\overrightarrow{BE} = 2\mathbf{a} + 4\mathbf{b} = \overrightarrow{AD}$ Hence $ABED$ forms a parallelogram.	A1	
4biv(a)	1 : 2	B1	
4biv(b)	3 : 2	B1	**9**
5a(i)	60 minutes	B1	
5a(ii)	72 minutes	B1	
5a(iii)	$76 - 66$ $= 10$ minutes	M1 A1	
5(b)	$12.5\% \times 200 = 25$ boys $n = 80$	M1 B1	
5(c)	The cumulative frequency would be shifted to the left by 5 minutes.	B1	
5(d)	Secondary 1 Girls Median = 62 minutes Interquartile range = 7 minutes 1. The **girls took a shorter time** to complete the task as compared to the boys because the **girls' median at 62 minutes is shorter** than then boys' median at 72 minutes. 2. The time taken by the **girls** to complete the task is **more consistent** because the interquartile ranges for the **girls at 7 minutes is shorter than the boys' at 10 minutes.**	B1 B1	**9**
6a(i)	Angle $STU = 80°$ (Angles in the same segment) Angle $TUS = 180° - 60° - 80°$ (Sum of angles in triangle) $= 40°$	B1 B1	
6a(ii)	35° (Angle at centre = 2 angle at circumference)	B1	
6a(iii)	55° ($OS = OR$, sum of angles in isos triangle)	B1	
6a(iv)	Angle $SRQ = 180° - 80°$ (angles in opp segment) $= 100°$ Angle $ORQ = 100° - 55°$ $= 45°$	M1 A1	
6a(v)	Angle $OSR = 55°$ Angle $SRQ = 100°$ Since Angle OSR + Angle $SRQ \neq 180°$, Angle OSR + Angle SRQ are **not interior angles of parallel lines** lines OS and QR are **not** parallel.	M1 A1	

6b(i)	$\frac{2n+3+4n-1}{2n+3+4n-1+18-2n}=\frac{19}{22}$ $\frac{6n+2}{20+4n}=\frac{19}{22}$ $132n+44=380+76n$ $56n=366$ $n=6\,(shown)$	M1 A1	
6b(ii)	$\frac{15}{44}\times\frac{14}{43}=\frac{105}{946}$	M1, A1	**12**
7(a)	24 cm	B1	
7(b)	$\frac{r}{10}=\frac{18}{24}$ $r=7\frac{1}{2}$ (shown)	M1 A1	
7(c)	Surface area = SA of hemisphere + SA of cone $=2\pi(10)^2+26\pi(10)-\pi(7.5)\sqrt{18^2+7.5^2}$ $=986\text{ cm}^2$	M1: $2\pi(10)^2$ M1: $\sqrt{18^2+7.5^2}$ A1	
7(d)	Volume = Vol of hemisphere + Volume of frustrum $=\frac{2}{3}\pi(10)^3+\frac{37}{64}\times\frac{1}{3}\pi(10)^2\times24$ $=3550\text{ cm}^3$	M1: $\frac{2}{3}\pi(10)^3$ M1: $\frac{1}{3}\pi(10)^2\times24$ A1	**9**
8(a)	–2.5	B1	
8(b)	Smooth curve passing through all points 5 or less points marked correctly; All points marked correctly	G1 P1/2	
8(c)	$x>2.8$ [±0.2]	B1	
8(d)	Gradient = $\frac{3.2-(-1)}{3-1.7}$ $=3.23$	B1: Tangent on graph A1	
8e(i)	$y=x-1$ drawn on grid	B1	
8e(ii)	$\frac{x^3}{2}-3x+2=x-1$ $\frac{x^3}{2}-4x+3=0$ $x^3-8x+6=0$ *(shown)*	M1 A1	
8e(iii)	0.8; 2.25 [±0.1]	B2	**12**

Question 8 Mark Scheme



Question 9 Mark Scheme



Qn	Solutions	Marks Allocation	
9a(i)	Correct construction	B1	

9a(ii)	21	√B1	
9a(iii)	Correct construction	B1	
9a(iv)	24 & 26	√B1	
9(b)	**Renting from GetCar** Car rental & mileage charges = (\$7×4) + (\$0.39×67) = \$54.13 **Renting from FindCar** Car rental & mileage charges = (\$3×1 + \$5×3) + (\$0.39×67) = \$44.13 Amount of petrol needed = $\frac{67}{12.5}$ = 5.36 litres Fuel Charges = \$2.20 × 5.36 = \$11.792 Total charges = 44.13 + 11.792 = \$55.92 > \$54.13 Since it costs less to rent from GetCar, Sally should rent from Company GetCar.	M1: 7×4 M1: 0.39×67 M1: \$3×1 + \$5×3 M1 M1 A1	