NAME: _____ **( )** **CLASS:** _____

FAIRFIELD METHODIST SCHOOL (SECONDARY)

PRELIMINARY EXAMINATION 2022
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

MATHEMATICS 4048/02

Paper 2

Date: 24 August 2022 **Duration: 2 hours 30 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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** 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 of the marks for this paper is 100.

For Examiner's Use

Table of Penalties		**Question Number**		
Presentation	□1 □2			
Rounding off	□1		Parent's / Guardian's Signature	**100**

Setter: Mr Joel Li

This question paper consists of 27 printed pages.

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Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

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

Sector area = $\frac{1}{2}r^2\theta$, where θ 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

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

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

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Answer **all** the questions.

1 **(a)** Solve the inequality $\frac{x}{3}+2\leq\frac{3-x}{2}$.

Answer ..... [2]

(b) It is given that $E=\frac{W}{W+x}$.

(i) Find the value of E when $W = 30$ and $x = 18$.

Answer E = ... [1]

(ii) Express W in terms of E and x.

Answer W = ... [2]

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1 **(c)** Solve the equation $\frac{3}{x+1} = 5 - \frac{1}{x-2}$.

Give your solutions correct to 2 decimal places.

Answer x = …… or ……..…… [5]

2 **(a)** Evane plans to travel to the United States of America (USA) for a holiday.

(i) He goes to the travel fair and is given an early bird discount of 15% for a 7-day tour package that costs $2888. Calculate the amount of money he has to pay the travel agent after the addition of 7% Goods and Service Tax (GST) on the discounted price.

Answer $ …… [3]

(ii) He then goes to the money changer to change S$3800 into US dollars. Calculate the amount of US dollars he receives if the exchange rate was US$1 = S$1.43. Leave your answer to the nearest dollar.

Answer US$ …… [2]

2 **(a)** **(iii)** In the following month, he cancelled his holiday plans as he contracted COVID. He changed all his US dollars back at the rate US$1 = S$1.38. Calculate the loss as a percentage of the original amount he changed as a result of the new exchange rate.

Answer ……..……..…% [2]

(b) The marked price of a laptop is $2300. By selling the laptop at a 10% discount, a merchant makes a loss of 5% on its cost price. Find the cost price of the laptop.

Answer $ ……..……..… [3]

3 When x copies of a book are produced, the cost, \$$y$, of each copy is given by the formula $y = 10 + \frac{3600}{x}$.

x	100	200	300	400	600	900	1200
y	46	28	22	p	16	14	13

(a) Find the value of p.

Answer $p =$ …… [1]

(b) On the grid on page 9, draw the graph of $y = 10 + \frac{3600}{x}$ for $100 \le x \le 1200$. [3]

(c) Use your graph to estimate the number of books to be printed if the cost of producing each book is \$30.

Answer ……..…… books [1]

(d) **(i)** By drawing a tangent, find the gradient of the curve when $x = 400$.

Answer ……..……..…… [2]

(ii) Use your answer to **(d)(i)** to state briefly what the gradient represents.

Answer ……

……[1]

(e) In order to sell x books, the selling price of each book must be $\$\left(32-\frac{x}{50}\right)$.

(i) On the same axes on page 9, draw the graph of $y=32-\frac{x}{50}$ to represent the selling price of the books. [2]

(ii) Using your graphs, find the range of the number of books that should be printed if no loss is to be made, assuming all the books will be sold.

Answer ……..…….…… [1]

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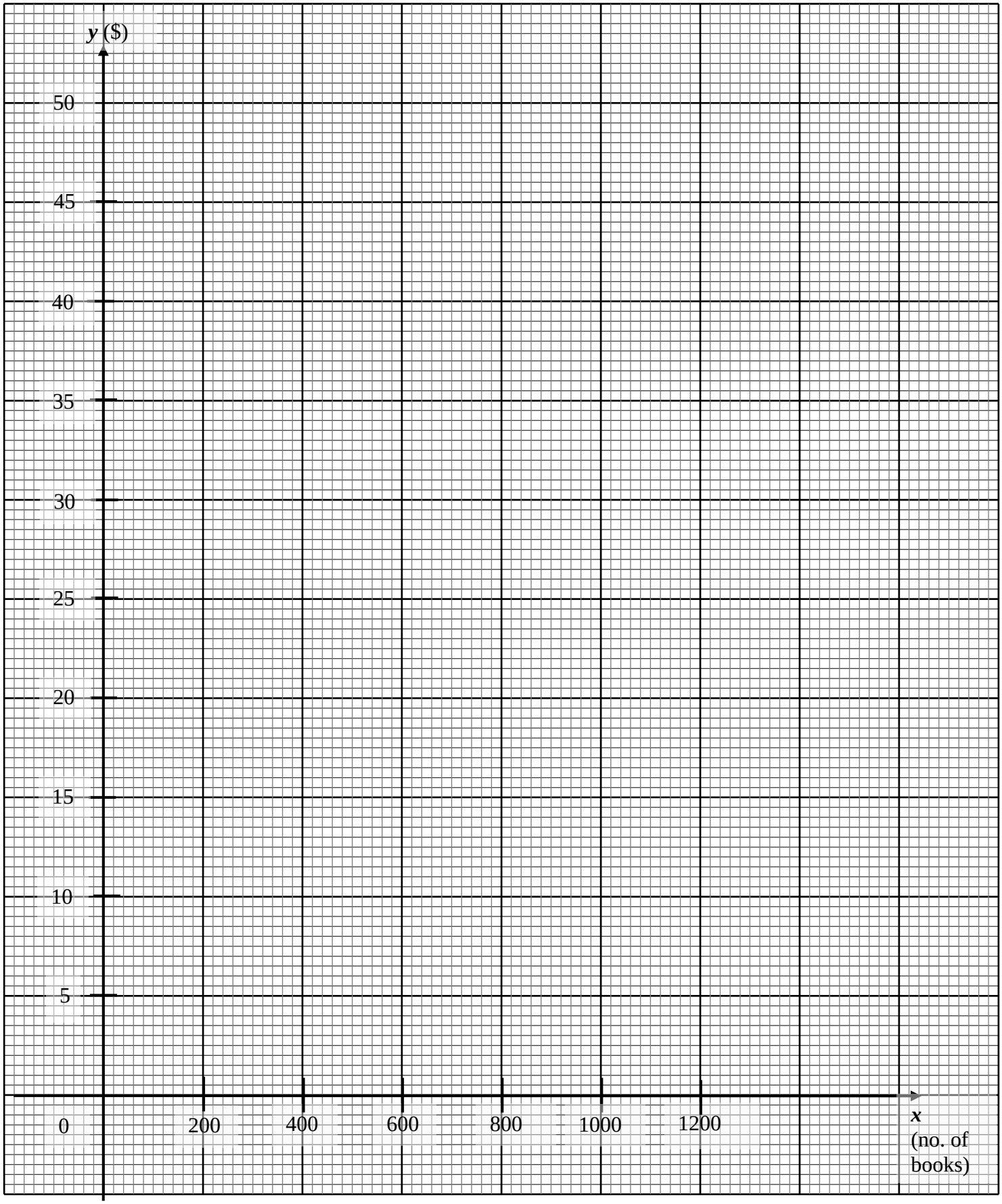
Answer (b)



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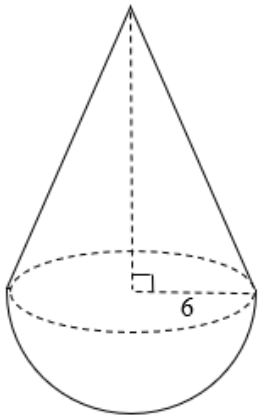
4 The diagram shows a solid consisting of a right circular cone attached to a hemisphere with a common base which is a circle of radius 6 cm. The volume of the cone is equal to twice the volume of the hemisphere.



(a) Show that the height of the cone is 24 cm.

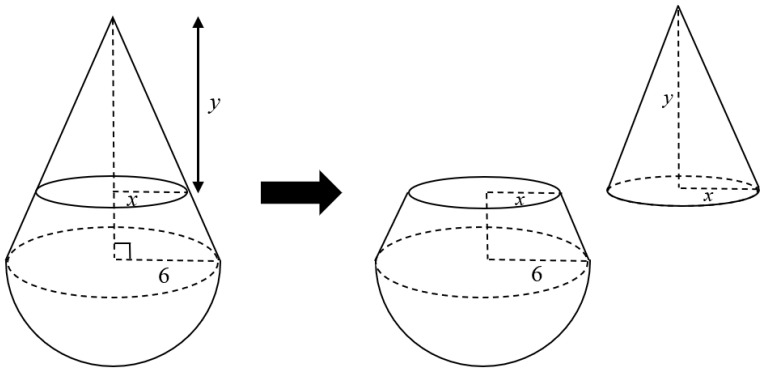
Answer

[2]

(b) Find the total surface area of the solid.

Answer ……..…….…. cm^2 [3]

4 **(c)** The same solid is cut into two parts such that the upper part is a cone of base radius x cm and height y cm.



(i) Find the value of $\frac{x}{y}$.

Answer ……..…… [1]

(ii) Find the value of y such that the volume of the upper part is equal to the volume of the lower part.

Answer y = ……..…… [3]

5 The points P and Q are $(-1, -5)$ and $(2, 4)$ respectively.

(a) Show that the equation of line PQ is $y = 3x - 2$.

Answer

[2]

(b) A line $3y - 2x = 1$ intersects the line PQ at point S, find the coordinates of S.

Answer S (……. , …….) [3]

5 **(c)** Find the length of PQ.

Answer PQ = ……..…… units [2]

(d) Find the equation of the line that passes through P and parallel to the y-axis.

Answer ……..……..…… [1]

(e) Does the point A $(-4, -5)$ lie on the line PQ? Explain and justify your answer.

Answer The point A ……..…… on the line PQ because .....

...……[2]

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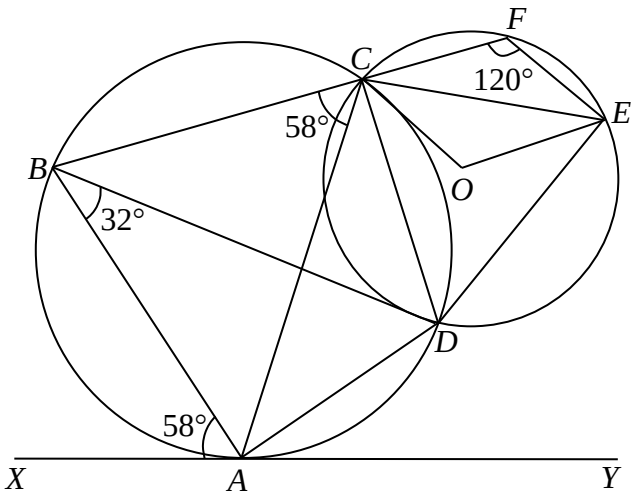
6 In the diagram, *XAY* is a tangent to the circle *ABCD* at *A*. *O* is the centre of the circle *CDEF* and *BCF* is a straight line. It is given that $\angle BCA = \angle XAB = 58°$, $\angle ABD = 32°$ and $\angle CFE = 120°$.



(a) Find angle *ACD*.

Give a reason for each step of your working.

Answer Angle *ACD* = ……° [1]

(b) Explain why *BD* is a diameter of circle *ABCD*.

Answer *BD* is a diameter of circle *ABCD* because .....

..…… [1]

(c) Find angle *DAY*.

Give a reason for each step of your working.

Answer Angle *DAY* = ……° [1]

6 **(d)** Given that $FC = FE$, show that triangle CDE is equilateral.

Give a reason for each step of your working.

Answer [3]

(e) **(i)** Prove that triangle OCE is congruent to triangle FCE.

Answer ……..

……..

……..

……..

……..

…… [3]

(ii) Hence, what is the special name given to quadrilateral $COEF$?

Answer ……..…… [1]

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7 **(a)** Given the sequence 4, 7, 10, 13, 16, …

(i) Find an expression for the nth term (T_n) of the sequence.

Answer T_n = ……..…… [1]

(ii) Write down the 88th term (T_{88}) of this sequence.

Answer T_{88} = ……..…… [1]

(b) Study the following pattern:

Row 1	$1^3 = 1 = \left(\frac{1\times 2}{2}\right)^2$
Row 2	$1^3 + 2^3 = 9 = (1+2)^2 = \left(\frac{2\times 3}{2}\right)^2$
Row 3	$1^3 + 2^3 + 3^3 = 36 = (1+2+3)^2 = \left(\frac{3\times 4}{2}\right)^2$
Row 4	$1^3 + 2^3 + 3^3 + 4^3 = 100 = (1+2+3+4)^2 = \left(\frac{4\times 5}{2}\right)^2$
⋮	⋮
Row n	$1^3 + 2^3 + 3^3 + 4^3 + ... + n^3 = q$

(i) Write down Row 5.

Answer Row 5 = ……..……..……..……..……

……[1]

(ii) Calculate the sum of the numbers in Row 10.

Answer ……..…… [1]

7 **(b)** **(iii)** Express q in terms of n.

Answer q = ……[1]

(iv) Using your result in **(b)(iii)** or otherwise, find the value of n when $q = 1296$.

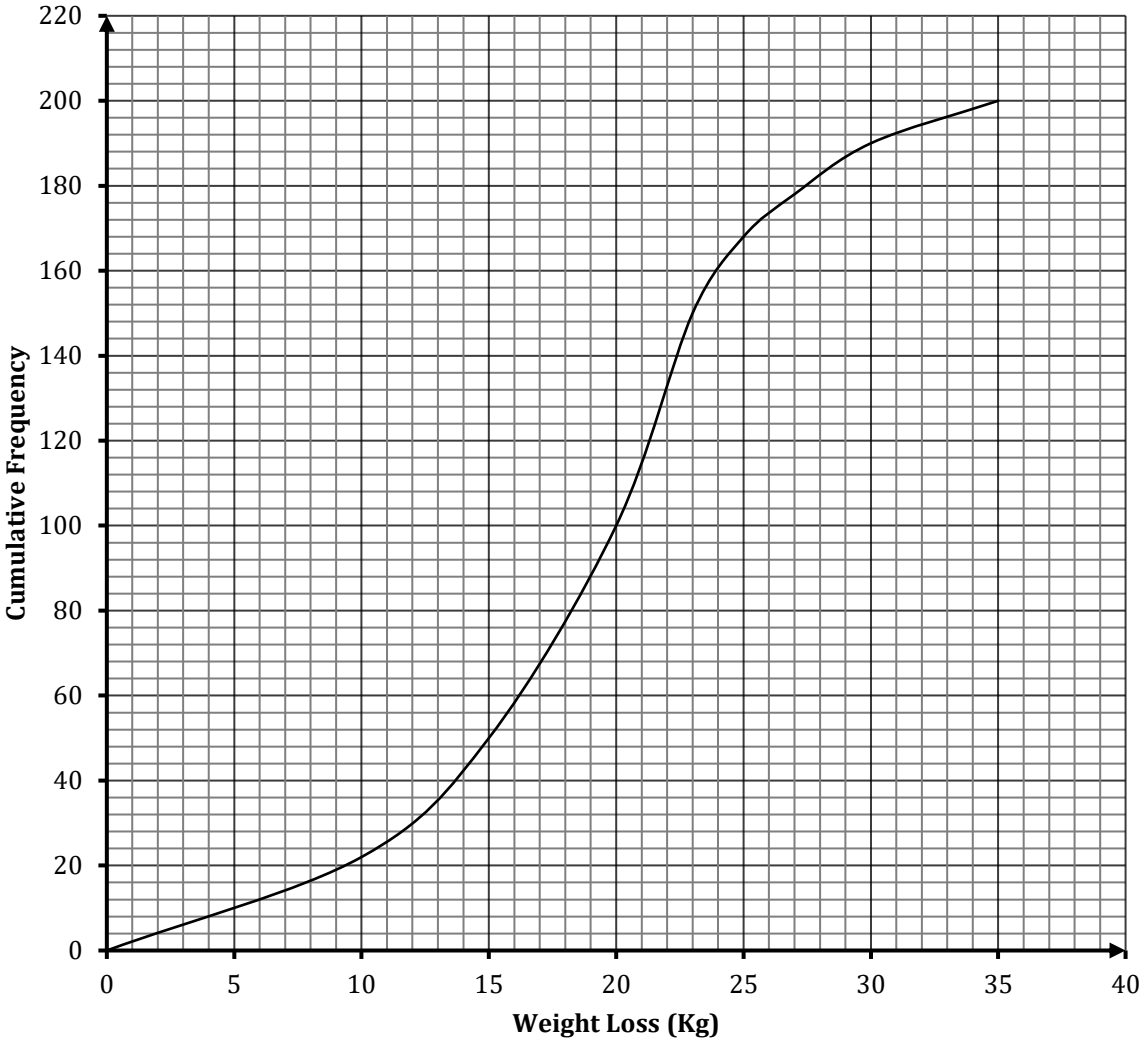
Answer n = ……[2]

(v) A student found the sum of the numbers in a row to be 600. Give a reason why this answer cannot be accepted.

Answer The answer cannot be accepted because ……

……[1]

8 The cumulative frequency curve below shows the amount of weight loss, measured to the nearest kg, of 200 men in Alpha Centre.



The corresponding cumulative frequency table for this distribution is as shown below.

Weight loss (x kg)	≤ 10	≤ 15	≤ 20	≤ 25	≤ 30	≤ 35
Cumulative Frequency	22	p	100	168	190	200

(a) Determine the value of p.

Answer p = ……..…… [1]

8 **(b)** Use the curve to estimate

(i) the median weight loss,

Answer ……..…… kg [1]

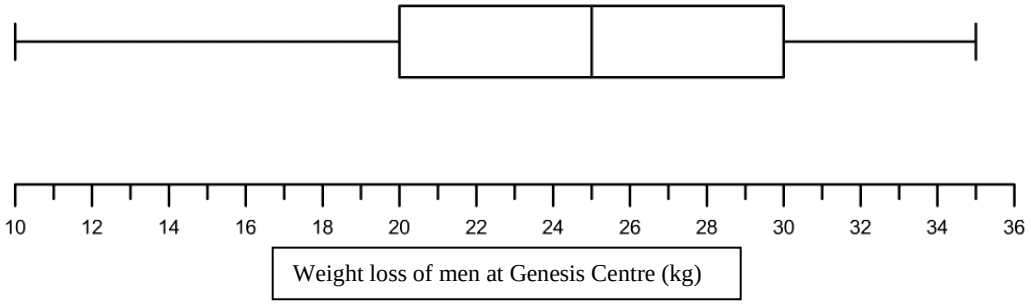
(ii) the interquartile range of the weight loss,

Answer ……..…… kg [2]

(iii) the 44^{th} percentile weight loss.

Answer ……..…… kg [1]

(c) A second fitness centre, Genesis Centre also measured the amount of weight loss by 200 of their men. The box-and-whisker diagram below illustrates their weight loss achieved.



(i) Find the interquartile range of the weight loss.

Answer ……..…… kg [1]

(ii) How many men achieved a weight loss of more than 30 kg?

Answer ……..……..…… men [1]

8 **(c)** **(iii)** A physical instructor claimed that the weight loss program at Alpha Centre is more effective than Genesis Centre. Explain if his statement is true.

Answer ……..

……

…… [1]

(d) Charles needs to take a certification test to become a physical instructor. He takes the certification test until he passes. Each time he takes the test, the probability that Charles passes the test is 0.8. Find the probability that Charles

(i) passes only at the third attempt,

Answer ……..…… [1]

(ii) passes in either the first or second attempt.

Answer ……..…… [2]

9 **(a)** The coordinates of points A, B and C are (4, – 16), (1, 5) and (2, 1) respectively.

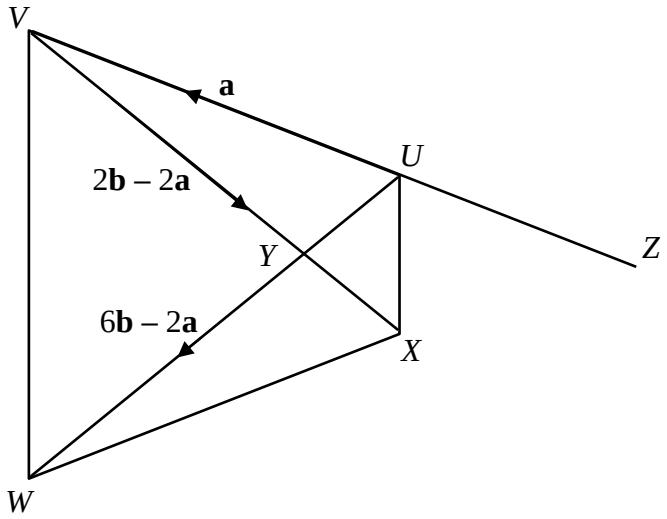
(i) Express $\overrightarrow{BC}$ as a column vector.

Answer $\overrightarrow{BC}$ = ……..…… [1]

(ii) Find $\left|\overrightarrow{BC}\right|$.

Answer $\left|\overrightarrow{BC}\right|$ = ……..…..…… units [2]

9 **(b)** In the diagram, *UVWX* is a trapezium such that $\overrightarrow{UV}$ = **a**, $\overrightarrow{VX}$ = 2**b** – 2**a** and $\overrightarrow{UW}$ = 6**b** – 2**a**. *UW* intersects *VX* at *Y*. *VU* is extended to point *Z* such that *VU* = 2*UZ*.



(i) Express, as simply as possible, in terms of **a** and/or **b**,

(a) $\overrightarrow{VW}$,

Answer $\overrightarrow{VW}$ = …… [1]

(b) $\overrightarrow{WX}$,

Answer $\overrightarrow{WX}$ = …… [1]

(c) $\overrightarrow{XZ}$.

Answer $\overrightarrow{XZ}$ = …… [1]

9 **(b)** **(ii)** Use your answers to part **(b)(i)(b)** and **(b)(i)(c)** to explain why W, X and Z lie on a straight line.

Answer ……...

……

……

……[2]

(iii) Calculate the value of

(a) $\dfrac{\text{Area of } \Delta ZUX}{\text{Area of } \Delta ZVW}$,

Answer ……. [1]

9 (b) (iii) (b) $\dfrac{\text{Area of } \Delta XVW}{\text{Area of } \Delta ZVW}$,

Answer ……..…… [1]

(c) $\dfrac{\text{Area of } \Delta XVW}{\text{Area of trapezium } UVWX}$.

Answer ……..…… [2]

10 A class of students plans to sell all-day breakfast sets during the school carnival in order to raise funds for a charity.

Each breakfast set consists of 2 scrambled eggs, 2 slices of toast, 1 sausage, 1 slice of chicken ham and a cup of coffee.

The students estimate that they will sell 300 all-day breakfast sets.

The cost of the ingredients used are as follows.

Item	Description	Unit cost
Eggs	Pasar Fresh Eggs (10 per pack) Dason Fresh Eggs (15 per pack) Seng Seng Fresh Eggs (10 + 2 per pack)	\$2.70 \$4.55 \$3.70
Bread	Gardenia Enriched Soft White Bread (14 slices) Sunshine Enriched Soft White Bread (12 slices)	\$2.70 \$2.50
Sausages	Master Grocer Valley Farm Chicken Frank (10 per pack) Grand Chef Sausages (6 per pack) (\$0.35 off per 2 packs)	\$5.25 \$3.20
Ham	FairPrice Baked Ham (10 per pack) (20% off per 3 packs) Smart Choice Baked Ham (10 per pack)	\$4.35 \$3.30
Coffee	Nescafe 3 in 1 Instant Coffee (35 per pack) (Buy 5 get 1 free) Indocafe 3 in 1 Coffeemix (25 per pack)	\$6.15 \$3.95

(a) Find the lowest possible total cost of the ingredients required for the 300 all-day breakfast sets.

[Turn over for more working space for Question 10a]

[Working space for Question 10a]

Answer $ ……..…… [5]

10 (b) The school provides $200 in funding for the students and have set two criteria which every class must meet:

Criteria 1: Up to 40% of the sales can be used to cover for their expenses, while the remaining goes to the charity.
Criteria 2: The students must raise at least $600 for charity.

Find the minimum price (to the nearest ten cents) they must charge for each breakfast set such that they meet both criteria.
Justify your answer, showing all necessary workings clearly.
State an assumption you have made in your calculations. [4]

Fairfield Methodist School (Secondary)
Secondary 4 Express / 5 Normal (Academic)
Preliminary Examinations 2022
Mathematics Paper 2

Marking Scheme

Qn No.	Workings	Description	Mark Allocation
1a	$\frac{x+6}{3} \le \frac{3-x}{2}$ $2(x+6) \le 3(3-x)$ $2x+12 \le 9-3x$ $5x \le -3$ $x \le -\frac{3}{5}$	Remove fraction	**M1** **A1**
1bi	$E = \frac{30}{30+18}$ $E = \frac{5}{8}$ or 0.625		**B1**
1bii	$EW + Ex = W$ $EW - W = -Ex$ $W(E-1) = -Ex$ $W = \frac{-Ex}{E-1}$ *or* $\frac{Ex}{1-E}$	Take out W as a common factor	**M1** **A1**
1c	$\frac{3}{x+1} = \frac{5(x-2)-1}{x-2}$ $\frac{3}{x+1} = \frac{5x-10-1}{x-2}$ $3(x-2) = (5x-11)(x+1)$ $3x-6 = 5x^2+5x-11x-11$ $5x^2-9x-5=0$ $x = \frac{9 \pm \sqrt{181}}{10}$ $x = 2.25$ (2d.p.) or $x = -0.45$ (2d.p)	Cross multiply or multiply both sides by $(x+1)(x-2)$ Show correct quadratic equation $\sqrt{181}$ must be simplified	**M1** **M1** **M1** **A1, A1**

Qn No.	Workings	Description	Mark Allocation
2ai	Discounted Price $= 0.85 \times 2888$ = \$2454.80 Price inclusive of GST $= 2454.80 \times 1.07$ = \$2626.64 (nearest cent)		**M1** **M1** **A1**
2aii	Amount of US dollars he receives $= \frac{3800}{1.43}$ = US\$2657.34 = US\$2657 (nearest dollar)		**M1** **A1**
2aiii	**Solution 1** Amount of SG dollars he receives = 2657.34 x 1.38 = \$3667.13 Percentage Loss $= \frac{3800 - 3667.13}{3800} \times 100\%$ = 3.4966 (5 s.f) = 3.50 % (3 s.f) **Solution 2** Amount of SG dollars he receives = 2657 x 1.38 = \$3666.66 Percentage Loss $= \frac{3800 - 3666.66}{3800} \times 100\%$ = 3.5089 (5 s.f) = 3.51 % (3 s.f)		**M1** **A1** **M1** **A1**
2b	Discounted Price = 2300 x 0.9 = \$2070 Cost Price of laptop $= \frac{100}{95} \times 2070$ = \$2178.95 (nearest cent)		**M1** **M1** **A1**
3a	$p = 19$		**B1**
3b	Refer to Graph		**P2** **C1**

Qn No.	Workings	Description	Mark Allocation
3c	170, 180 or 190 books (accept any 1)		**B1**
3di	Gradient = $\frac{10-19}{800-400} = -0.0225$ Accept (– 0.01 to – 0.04)	Tangent accurately drawn Calculated gradient	**M1** **A1**
3dii	Gradient represents the **rate of reduction(decrease) of the cost** of production **per copy of the book**.		**B1**
3ei	Refer to Graph Correct line plotted		**P1** **L1**
3eii	$200 \le x \le 900$		**B1**
4a	Let the height of the cone be h Vol of Cone = 2 x Vol of hemisphere $\frac{1}{3}\pi(6)^2 h = 2 \times \frac{2}{3}\pi(6)^3$ $12h = 288$ $h = \frac{288}{12}$ $h = 24$	 Equate both volumes Show $\frac{288}{12}$	 **M1** **AG1**
4b	Let the slant height of the cone be l. By Pythagoras Theorem, $l^2 = 6^2 + 24^2$ $l = \sqrt{612}$ $l = 24.739$ or 24.738 (truncate 5 sf) Total Surface Area of Solid $= \pi(6)(24.739) + 2\pi(6)^2$ $= 692.51$ (5 s.f) $= 693$ cm^2 (3 s.f) or 692 cm^2 (truncate 5s.f)		**M1** **M1** **A1**
4ci	$\frac{x}{y} = \frac{6}{24} = \frac{1}{4}$ (by similar triangles)		**B1**
4cii	$\frac{x}{y} = \frac{1}{4}$ $x = \frac{1}{4}y$ Volume of fustrum $= \frac{1}{3}\pi(6)^2(24) - \frac{1}{3}\pi x^2 y$ Vol of small cone = Vol of fustrum + Vol of hemisphere $\frac{1}{3}\pi x^2 y = \frac{1}{3}\pi(6)^2(24) - \frac{1}{3}\pi x^2 y + \frac{2}{3}\pi(6)^3$	 Form Equation	 **M1**

Qn No.	Workings	Description	Mark Allocation
	$\frac{2}{3}\pi x^2 y = \frac{1}{3}\pi(6)^2(24) + \frac{2}{3}\pi(6)^3$ $\frac{2}{3}x^2 y = \frac{1}{3}(6)^2(24) + \frac{2}{3}(6)^3$ (divide both sides by π) $\frac{2}{3}x^2 y = 432$ Sub $x = \frac{1}{4}y$ into equation $\frac{2}{3}(\frac{1}{4}y)^2 y = 432$ $\frac{1}{24}y^3 = 432$ $y^3 = 10368$ $y = 21.8$ (3 s.f)	Sub $x = \frac{1}{4}y$ into equation	**M1** **A1**
4cii	**Alternate Solution 2** Let the volume of the top part (cone be V_1), middle fustrum be V_2, and hemisphere by V_3. $\frac{V_1 + V_2}{V_3} = \frac{2}{1}$ $\frac{V_1}{V_1 + V_2} = \left(\frac{x}{6}\right)^3$ $\frac{V_1}{V_1 + V_2} = \left(\frac{\frac{1}{4}y}{6}\right)^3$ given $x = \frac{1}{4}y$ $\frac{V_1}{V_1 + V_2} = \frac{y^3}{13824}$ Therefore, $V_1 : V_1 + V_2 : V_3$ $y^3 : 13824$ $2 : 1$ $y^3 : 13824 : \frac{13824}{2}$ $y^3 : 13824 : 6912$ Since $\frac{V_1}{V_2 + V_3} = \frac{1}{1}$ $\frac{y^3}{13824 - y^3 + 6912} = \frac{1}{1}$ $20736 - y^3 = y^3$ $2y^3 = 20736$	Sub $x = \frac{1}{4}y$ into equation Form Equation	**M1** **M1**

Qn No.	Workings	Description	Mark Allocation
	$y^3 = 10368$ $y = \sqrt[3]{10368}$ $y = 21.8$ (3 s.f)		**A1**
4cii	**<u>Alternate Solution 3</u>** Vol of Solid $= \frac{1}{3}\pi(6)^2(24) + \frac{2}{3}\pi(6)^3$ $= 432\pi$ Vol of Upper part $= 432\pi \div 2 = 216\pi$ $\frac{\text{Vol of Upper}}{\text{Vol of Lower}} = \left(\frac{y}{24}\right)^3$ $\left(\frac{y}{24}\right)^3 = \frac{216\pi}{\frac{1}{3}\pi(6)^2(24)}$ $\frac{y}{24} = \sqrt[3]{\frac{216\pi}{288\pi}}$ $y = 24\sqrt[3]{\frac{216\pi}{288\pi}}$ $y = 21.8$ cm (3.s.f)		**M2** **A1**
5a	Grad of $PQ = \frac{4-(-5)}{2-(-1)}$ $= 3$ Sub (2, 4) into $y = 3x + c$ $4 = 3(2) + c$ $c = 4 - 6$ $c = -2$ $\because y = 3x - 2$ (shown)	Show working for Gradient Show working for *y*-intercept	**B1** **AG1**
5b	$y = 3x - 2$ ------- (1) $3y - 2x = 1$ ------- (2) Sub (1) into (2) $3(3x-2) - 2x = 1$ $9x - 6 - 2x = 1$ $7x = 7$ $x = 1$ Sub x=1 into Eqn (1) $y = 3(1) - 2$ $y = 1$	Elimination or Substitution method Lose 1 mark if x and y values are correct but	**M1** **A1**

Qn No.	Workings	Description	Mark Allocation
	S (1, 1)	state coordinate S wrongly.	**A1**
5c	Length of PQ $=\sqrt{(4-(-5))^2+(2-(-1))^2}$ $=\sqrt{81+9}$ $=\sqrt{90}$ $=9.4868$ (5 s.f) $=9.49$ units (3 s.f)		**M1** **A1**
5d	$x=-1$		**B1**
5e	Substitute $x=-4$ into $y=3x-2$ $y=3(-4)-2$ $y=-12-2$ $y=-14$ The point A does not lie on the line because when $x=-4$, $y=-14\neq-5$.		 **M1** **A1**
6a	$\angle ACD=32°$ ($\angle$s in same seg.)		**B1**
6b	$\angle BCD=32°+58°$ $=90°$ Since it obeys **right angle in semicircle property**, $\Rightarrow BD$ is a diameter. (shown)	Student should show $\angle BCD=90°$ and give correct reason. Can accept short form for circle property.	 **B1**
6c	$\angle DAB=90°$ (right $\angle$ in semicircle) $\angle DAY=180°-90°-58°$ $=32°$ (adj $\angle$s on a straight line)	Award 1 mark as long answer is correct and either reason is given	 **B1**
6d	$\angle FCE=\angle FEC=\frac{180°-120°}{2}$ (base $\angle$s of isos. Δ) $=30°$ $\angle ECD=180°-90°-30°$ (adj. $\angle$s on straight line) $=60°$ $\angle FED=90°$ ($\angle$s in opp. seg.) $\angle CED=90°-30°$ $=60°$ $\therefore\angle CDE=60°$ Since all 3 angles are $60°$ $\Rightarrow\Delta CDE$ is an equilateral Δ. (shown)	 show $\angle ECD=60°$ show $\angle FED=90°$ by stating $\angle$s in opp. seg. show $\angle CED=60°$ and conclude ΔCDE is equilateral.	 **B1** **B1** **AG1**

Qn No.	Workings	Description	Mark Allocation
6d	**Alternate Solution** $\angle CDE = 180 - 120$ = 60° (∠s in opposite segments) $\angle FCD = 180 - 90$ = 90° (adj ∠s on straight line) $\angle FED = 180 - 90$ = 90° (∠s in opposite segments) $\angle FCE = \angle FEC = \frac{180-120}{2}$ = 30° (Base ∠s of Isos. Δ) $\angle ECD = 90 - 30$ = 60° $\angle CED = 180 - 60 - 60$ = 60° (sum of ∠s in Δ) Since all 3 angles are 60° $\Rightarrow \Delta CDE$ is an equilateral Δ. (shown)	show $\angle CDE = 60°$ show $\angle FED = 90°$ by stating ∠s in opp. seg. show $\angle CED = 60°$ and conclude ΔCDE is equilateral.	**B1** **B1** **AG1**
6ei	$\angle COE = 120°$ (∠ at centre = 2 ∠s at circumference) $\Rightarrow \angle OCE = \angle OEC = 30°$ (base ∠s of Isos. Δ) $\angle COE = \angle CFE = 120°$ (A) $\angle OCE = \angle FCE = 30°$ (base ∠s of Isos. Δ) (A) CE is common (S) $\therefore \Delta OCE \equiv \Delta FCE$ (AAS)	Show any two statements with clear reasons given. Correct conclusion and show AAS property	**B2** **B1**
6eii	$COEF$ is a rhombus.		**B1**
7ai	$T_n = 3n + 1$		**B1**
7aii	$T_{88} = 3(88) + 1$ = 265		**B1**
7bi	$1^3 + 2^3 + 3^3 + 4^3 + 5^3 = 225 = (1+2+3+4+5)^2 = \left(\frac{5\times 6}{2}\right)^2$		**B1**
7bii	Sum = $\left(\frac{10\times 11}{2}\right)^2 = 3025$		**B1**
7biii	$q = \left(\frac{n(n+1)}{2}\right)^2$		**B1**
7biv	$1296 = \left(\frac{n(n+1)}{2}\right)^2$ $36 = \frac{n(n+1)}{2}$ (square root both sides) $72 = n^2 + n$ $n^2 + n - 72 = 0$ $(n-8)(n+9) = 0$ $n = 8$ or $n = -9$ (reject)		**M1** **A1**

Qn No.	Workings	Description	Mark Allocation
7bv	600 is not a square number. The sum of all numbers in the rows should be a square number.		**B1**
8a	$p = 50$		**B1**
8bi	20kg		**B1**
8bii	Lower Quartile = 15 kg Upper Quartile = 23 kg Interquartile Range = 23 – 15 = 8 kg		**M1** **A1**
8biii	44^{th} Percentile = 19 kg		**B1**
8ci	Interquartile Range = 30 – 20 = 10 kg		**B1**
8cii	$\frac{1}{4} \times 200 = 50$ men.		**B1**
8ciii	The **median weight loss** of Genesis Fitness Centre is higher than Alpha Fitness Centre (25kg > 20 kg) It is **untrue** that Alpha Fitness Centre is more effective at weight loss.	State median and comment that it is untrue.	**B1**
8di	P (Charles fails the test) $= 1 - 0.8$ $= 0.2$ P (Charles passes only at the third attempt) $= 0.2 \times 0.2 \times 0.8$ $= 0.032$		**B1**
8dii	P(Charles passes in the first attempt) = 0.8 P(Charles passes only at the second attempt) $= 0.2 \times 0.8$ $= 0.16$ P(Charles passes in either the first or second attempt) $= 0.8 + 0.16$ $= 0.96$		**M1** **A1**
9ai	$\overrightarrow{BC} = \overrightarrow{OC} - \overrightarrow{OB}$ $\overrightarrow{BC} = \begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} 1 \\ 5 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} 1 \\ -4 \end{pmatrix}$		**B1**
9aii	$\left\lvert\overrightarrow{BC}\right\rvert = \sqrt{1^2 + (-4)^2}$ $\left\lvert\overrightarrow{BC}\right\rvert = 4.12$ *units*		**M1** **A1**

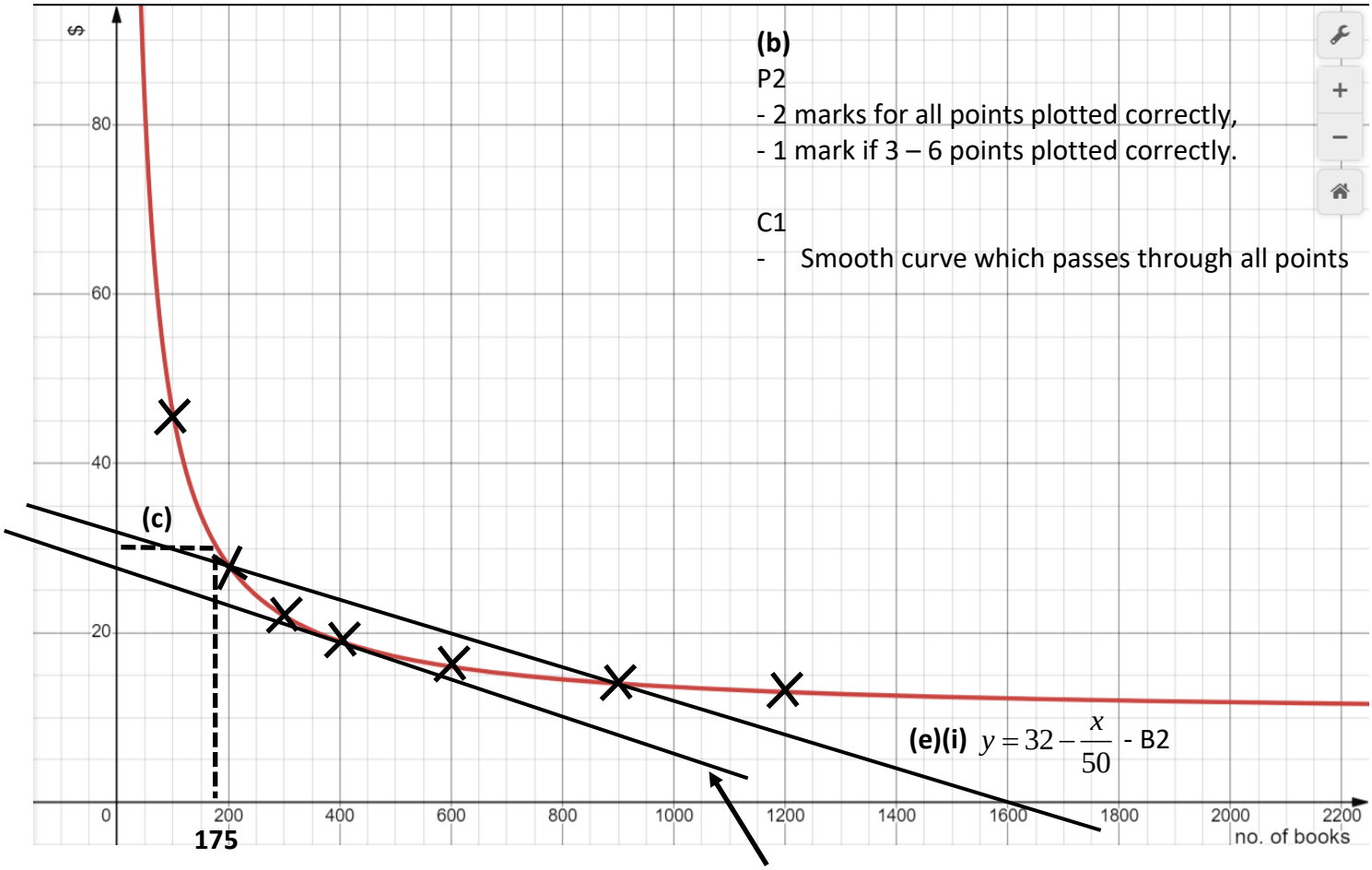
Qn No.	Workings	Description	Mark Allocation
9bia	$\overrightarrow{VW} = \overrightarrow{VU} + \overrightarrow{UV}$ $= -\boldsymbol{a} + (6\boldsymbol{b} - 2\boldsymbol{a})$ $= 6\boldsymbol{b} - 3\boldsymbol{a}$ Or $3(2\boldsymbol{b} - \boldsymbol{a})$		**B1**
9bib	$\overrightarrow{WX} = \overrightarrow{WV} + \overrightarrow{VX}$ $= -(6\boldsymbol{b} - 3\boldsymbol{a}) + 2\boldsymbol{b} - 2\boldsymbol{a}$ $= -4\boldsymbol{b} + \boldsymbol{a}$		**B1**
9bic	$\overrightarrow{XZ} = \overrightarrow{XV} + \overrightarrow{VZ}$ $= -(2\boldsymbol{b} - 2\boldsymbol{a}) - \frac{3}{2}\boldsymbol{a}$ $= -2\boldsymbol{b} + \frac{1}{2}\boldsymbol{a}$		**B1**
9bii	$\overrightarrow{WX} = -4\boldsymbol{b} + \boldsymbol{a} = 2(-2\boldsymbol{b} + \frac{1}{2}\boldsymbol{a})$ $\overrightarrow{XZ} = -2\boldsymbol{b} + \frac{1}{2}\boldsymbol{a}$ $\because \overrightarrow{WX} = 2\overrightarrow{XZ}$ Since $\overrightarrow{WX} = 2\overrightarrow{XZ}$, $\overrightarrow{WX}$ is parallel to $\overrightarrow{XZ}$ with X as the common point. Therefore, the points W, X and Z lie on a straight line.	Show $\overrightarrow{WX} = 2\overrightarrow{XZ}$ or $WX = 2XZ$ Write concluding statement	**M1** **AG1**
9biia	$\frac{\text{Area of } \Delta ZUX}{\text{Area of } \Delta ZVW} = \left(\frac{ZU}{ZV}\right)^2 \qquad \frac{VU}{UZ} = \frac{2}{1}$ $= \left(\frac{1}{1+2}\right)^2$ $= \frac{1}{9}$		**B1**
9biiib	$\frac{\text{Area of } \Delta XVW}{\text{Area of } \Delta ZVW} = \frac{\frac{1}{2} \times XW \times h}{\frac{1}{2} \times ZW \times h} \qquad \frac{XW}{ZX} = \frac{2}{1}$ $= \frac{2}{2+1}$ $= \frac{2}{3}$		**B1**
9biiic	$\overrightarrow{UX} = \overrightarrow{UW} + \overrightarrow{WX}$ $= 6\boldsymbol{b} - 2\boldsymbol{a} - 4\boldsymbol{b} + \boldsymbol{a}$ $= 2\boldsymbol{b} - \boldsymbol{a}$ $\overrightarrow{VW} = 6\boldsymbol{b} - 3\boldsymbol{a} = 3(2\boldsymbol{b} - \boldsymbol{a})$ $\therefore VW = 3UX$	Show $VW = 3UX$	**M1**

Qn No.	Workings	Description	Mark Allocation
	$\frac{\text{Area of } \Delta XVW}{\text{Area of trapezium } UVWX} = \frac{\frac{1}{2}\times VW \times h}{\frac{1}{2}\times (UX+VW)\times h}$ $= \frac{VW}{UX+VW}$ $= \frac{3}{1+3}$ $= \frac{3}{4}$		**A1**
10a	**<u>Eggs</u>** **Number of Eggs required = 300 x 2 = 600 eggs** **Price for 600 eggs:** 60 packs of Pasar Eggs: \$2.70 x 60 = \$162 (cheapest) 40 packs of Dason Eggs: \$4.55 x 40 = \$182 50 packs of Seng Seng Eggs: \$3.70 x 50 = \$185 **<u>Cheapest cost of 300 Breakfast Set (Eggs) = \$162</u>** **<u>Bread</u>** **Number of slices of bread required** **= 300 x2 = 600 slices of bread** **Price for at least 600 slices of bread:** 43 packets of Gardenia Bread: \$2.70 x 43 = \$116.10 (cheaper) 50 packets of Sunshine Bread: \$2.50 x 50 = \$125 **<u>Cheapest cost of 300 Breakfast Sets (Bread) = \$116.10</u>** **<u>Sausage</u>** **Number of Sausages required = 300 sausages** **Price of 300 sausages:** 30 packs Master Grocer: \$5.25 x 30 = \$157.50 50 packs of Grand Chef: $(\$3.20\times 50)-(\$0.35\times 25)=\$151.25$ (cheaper) **<u>Cheapest cost of 300 Breakfast Sets (Sausage) = \$151.25</u>** **<u>Ham</u>** **Number of slices of ham required = 300 slices of ham** **Price of 300 slices of ham:** 30 packs of FairPrice Ham: $(4.35\times 30)\times 0.8=\$104.40$ 30 packs of Smart Choice Ham: 3.30 x 30 = \$99 (cheaper) **<u>Cheapest cost of 300 Breakfast Sets (Ham) = \$99</u>**	Find Cost of 43 packets of Gardenia Bread **<u>or</u>** 60 packs of Pasar Eggs Find Cost of 50 packs Grand Chef Sausage as cheaper option Find Cost of 30 packs of Smart Choice Ham as cheaper option	EB 1 S1 H1

Qn No.	Workings	Description	Mark Allocation
	<u>Coffee</u> **Number of packets required = 300 packets** **Price of at least 300 packets of coffee** 9 packs of Nescafe (inclusive of 1 free): $\$6.15\times 8=\$49.20$ 12 packs of Indocafe: $\$3.95\times 12=\$47.40$ (cheaper) **<u>Cheapest cost of 300 Breakfast Sets (Indocafe Coffee)</u>** **<u>= $47.40</u>** **Lowest Possible Cost for 300 all day breakfast** = 162 + 116.10 + 151.25 + 99 + 47.40 = $575.75	Find Indocafe Coffee as cheaper option Lowest Total Cost	C1 A1
10b	Assumption: - No cost incurred for cooking. - No food wastage made during the cooking - All 300 sets are sold	Any valid assumptions	A1
10b	**Solution 1** Funded expenses = $575.75 – $200 = $375.75 Total sales class must make to raise at least $600 for charity = funded expenses + charity amount = $575.75 – $200 + $600 = $975.75 To make sure up to 40% of the sales can be used to cover expenses $= \frac{375.75}{975.75}\times 100\%$ = 38.508% (less than 40%) Minimum amount to charge for each breakfast set $= \frac{975.75}{300}$ = $3.30 (nearest ten cent)	Total Sales (with criteria 2) Check that the total sales meet the criteria 1 Correct minimum price	S1 C1 P1

Qn No.	Workings	Description	Mark Allocation
10b	**Solution 2** Funded expenses = \$575.75 – \$200 = \$375.75 Total sales class must make to if used 40% to cover expenses $= \frac{100}{40} \times 375.75$ = \$939.375 Amount left for charity = \$939.375 – \$375.75 = \$563.625 (not enough for charity) Additional amount needed to raise at least \$600 for charity = \$600 – \$563.625 = \$36.375 Adjusted total sales class = \$939.375 + \$36.375 = \$975.75 Minimum amount to charge for each breakfast set $= \frac{975.75}{300}$ = \$3.30 (nearest ten cent)	Total Sales (with criteria 1) Check that the total sales meet the criteria 2 Correct minimum price	S1 C1 P1

Question 3



(b)
P2
- 2 marks for all points plotted correctly,
- 1 mark if 3 – 6 points plotted correctly.

C1
- Smooth curve which passes through all points

(e)(i) $y = 32 - \frac{x}{50}$ - B2

(d)(i) – accurate tangent drawn (M1)

Gradient = $\frac{10-19}{800-400} = -0.0225$ - A1

(e)(ii) $200 \le x \le 900$ - B1

End of marking scheme