Number of Pages Used_____

Teacher_____

NORTH SYDNEY BOYS HIGH SCHOOL

2009 YEAR 10
YEARLY EXAMINATION

Advanced Mathematics

Student Name:_____

General Instructions

- Working time – **120 minutes**
- Write on **one side** of the paper
- Write using blue or black pen
- Board approved calculators may be used
- All necessary working should be shown in every question
- Marks may not be awarded for carelessly or badly arranged work

(To be used by the exam markers only.)

Quest	1	2	4	4	5	6	7	8	9	10	11	Total
	/11	/17	/18	/10	/11	/10	/7	/14	/7	/8	/8	/121

Question 1 (11 marks) **Marks**

a) Evaluate to 3 significant figures $\sqrt[3]{9 \cdot 73 \times 10^5}$ **1**

b) Find the exact value of tan 150° **1**

c) A new Honda cost $43000 on the road. The buyers' trade-in was valued at $17000 and the balance was borrowed at 12% p.a. flat, to be paid back monthly over four years.

i) Calculate the balance. **1**
ii) Calculate the total interest due. **1**
iii) Calculate the monthly payment. **1**
iv) What is the total cost of the car? **1**

d) i) Using the tax table below, calculate the annual tax due on an income of $68500. **2**

Taxable income	Tax on this income
$0 – $6,000	Nil
$6,001 – $35,000	15c for each $1 over $6,000
$35,001 – $80,000	$4,350 plus 30c for each $1 over $35,000

ii) If the 1·5% Medicare levy on income is also included, find the total tax bill for the year. **1**

e) Rationalise the denominator $\dfrac{\sqrt{2}}{3 - \sqrt{5}}$ **2**

Question 2 (17 marks)

a) Solve the following equations

i) $4x - 3 = 10x + 11$ **2**

ii) $\dfrac{3x - 1}{2} - \dfrac{x + 4}{7} = 10$ **3**

iii) $4x^2 - 29x - 24 = 0$ **3**

iv) $3^{6x} = 27^{x-4}$ **2**

b) Solve simultaneously

i) $5p + 3q = -6$ and $3p = 10 - q$ **3**

ii) $y = x^2$ and $y = 20 - x$ **4**

Question 3 (18 marks)

a) The heights of 150 Year 10 boys were measured to the nearest 5cm.

Height	145	150	155	160	165	170	175	180
Frequency	2	8	12	35	39	42	9	3

i) Find the following

1. Mode 2. Mean 3. Median 4. Standard deviation **4**

ii) If a student was picked at random from the group, what is the probability he would be around 155cm tall? **1**

iii) Between what two scores would you find 95% of the scores? **1**

iv) Find the interquartile range. **2**

b) Horatio scored 66% on his Hamlet essay. The mean of the class was 62% and the standard deviation was 6%. This result needed to be standardised to a mean of 70% and a standard deviation of 15%. What is his new mark? **2**

c) Regular NSW number plates come as black on yellow or black on white, both with 4 letters and 2 digits.
What is the probability of a plate having 4 letters the same and 2 digits the same? **2**

d) At a recent Sydney Symphony concert 800 people heard a Beethoven concerto and a Dvorak symphony. 30 people did not like either piece, 620 liked the Dvorak and 470 liked the Beethoven.
What is the probability of a person only liking the Beethoven? **2**

e) From the four kings (hearts, diamonds, spades and clubs) out of a pack of playing cards, two are chosen at random without replacement.

i) Draw a tree diagram showing the possible pairs chosen. **1**

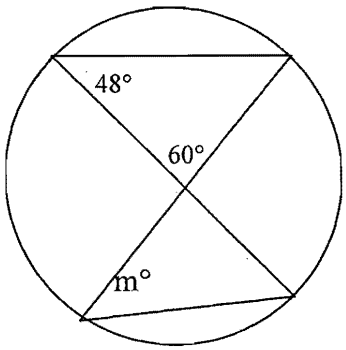
ii) Determine the probability of getting: **3**

1 Two kings the same colour.
2 At least one red king.
3 The king of spades.

Question 4 (10 marks)

a) Find the value of the pronumerals. (No reasons are required) **1,2,1,2**

i)



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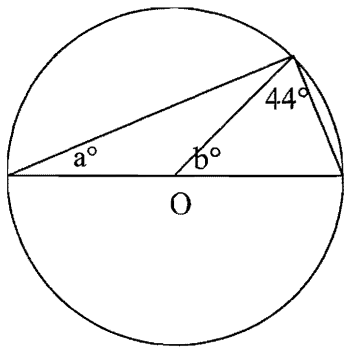

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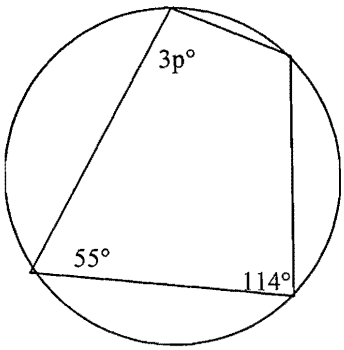
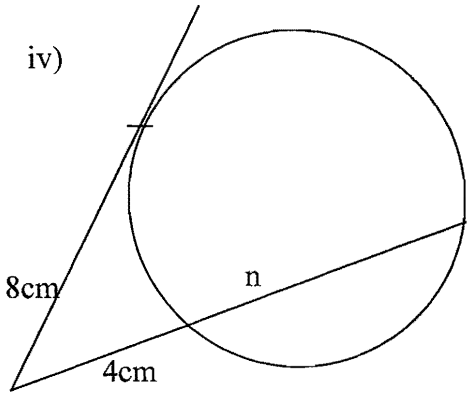
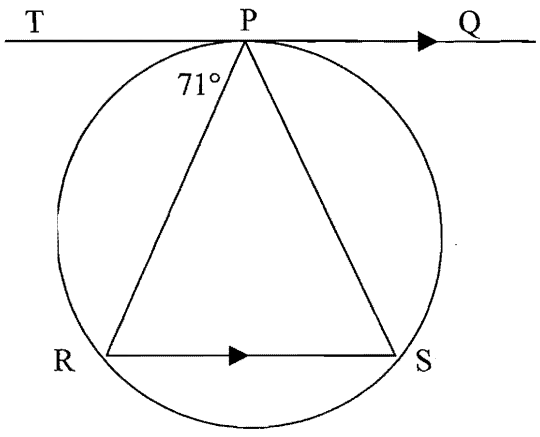


iv)

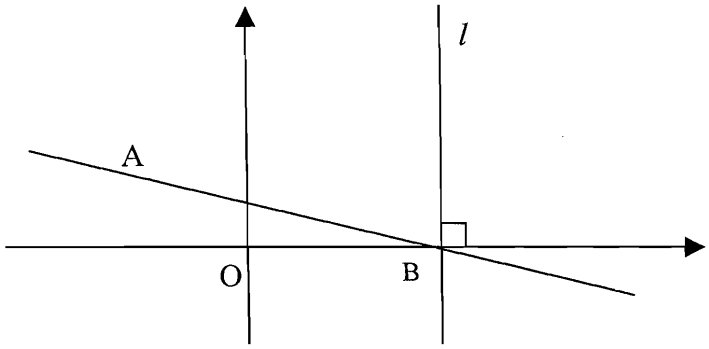


b) PQ is a tangent parallel to RS. Prove PR = PS



Question 5 (11 marks)

a) The diagram below shows the points A(−1,3) and B(2,0). The line l is drawn perpendicular to the x axis through the point B.



i) Calculate the length of AB. **2**

ii) Find the gradient of AB. **2**

iii) What is the size of the acute angle between AB and the x axis? **1**

iv) Show that the equation of the line AB is $x + y - 2 = 0$. **2**

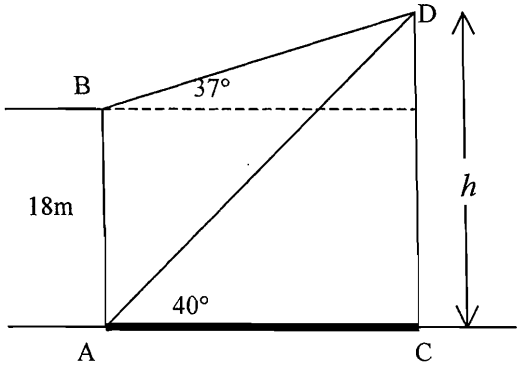
v) Copy the diagram and shade the region defined by $x + y - 2 \leq 0$. **1**

vi) Write down the equation of line l. **1**

vii) The point C on the line l is such that AC is perpendicular to AB.
Find the coordinates of C. **2**

Question 6 (10 marks)

a) The angle of elevation from the top of a small building to a near by steeple is 37° and the angle of elevation to the steeple from the road below is 40°.



i) If AD = x metres and CD = h metres, obtain an expression for x
and hence show that $h = \dfrac{18\sin 127^\circ \sin 40^\circ}{\sin 3^\circ}$ **3**

ii) Hence determine h to the nearest metre. **1**

b) Sketch on separate number planes. **4**

i) $y = 2\cos 3\theta \qquad 0° \leq \theta \leq 360°$

ii) $y = 1 - 2\cos 3\theta \qquad 0° \leq \theta \leq 360°$

c) Solve the equation $\sin\theta = \frac{\sqrt{3}}{2} \qquad 0° \leq \theta \leq 360°$ **2**

Question 7 (7 marks)

a) The top half (by height) of a cone is sliced off forming a smaller cone. **2**
Find the ratio of the volume of the smaller cone to the original cone.

b) If a cone with height 12cm and radius 12cm has the top half cut off.
Find the volume of the truncated cone. (Hint: part a above, may be of some help.) **3**

c) A full spherical water tank develops a leak at the bottom of the tank.
Draw a sketch of the height of the water remaining against time as
the water leaks out at a constant rate. **2**

Question 8 (14 marks)

a) On separate number planes sketch the following functions and relations.
Show all the important features, such as: intercepts, axes of symmetry,
asymptotes, vertices and centres etc.

i) $y = x^2 - 8x + 21$ **3**

ii) $y = \frac{1}{x+2}$ **3**

iii) $y = 4^x$ **2**

iv) $y = (x + 5)^3$ **2**

v) $(x - 8)^2 + (y - 10)^2 = 16$ **2**

b) Find the locus of P(x,y) if P is
4 times the distance from A$(-8,0)$ than from B$(7,0)$ **2**

Question 9 (7 marks)

a) Explain in words why $y = x^2$ is a function and why $x^2 + y^2 = 1$ is not a function. In your answer you must show a clear understanding of what is/is not a function. **2**

b) In each case, find the inverse function $f^{-1}(x)$ **4**

i) $f(x) = 4 - 2x$

ii) $f(x) = \dfrac{2 - x}{3 + x}$

c) Give an example of a function, where $f(x) = f^{-1}(x)$ **1**

Question 10 (8 marks)

a) Find the value of x.

i) $\log_4 64 = x$ **1**

ii) $\log 3x - \log 2 = \log(x + 6)$ **2**

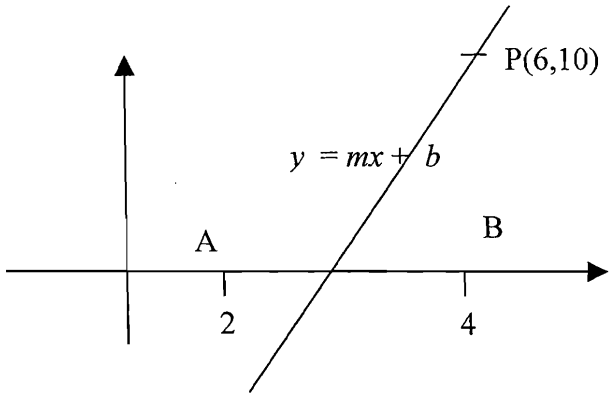
iii) $3^{x+1} = 18$ **2**

b) How long will it take \$P to double in value if it is invested at 5·5%p.a. compounding annually. Give your answer to the nearest month. **3**

TURN OVER TO PAGE 7 FOR FURTHER QUESTIONS

Question 11 (8 marks)

a)

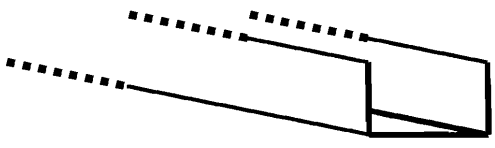


The line $y = mx + b$ passes through P(6,10) and the interval AB.

i) Find the minimum and maximum values that m can take. **2**

ii) Find the minimum and maximum values that b can take. **2**

b) A sheet of metal, 60cm wide, of indefinite length is bent to form an open, rectangular gutter. Let the height of the gutter be x.



Find the dimensions of the gutter to give maximum cross-sectional area. **4**

END OF EXAMINATION

Suggested Solutions

Question 1

(a) (1 mark)

$$\sqrt[3]{9.73 \times 10^5} = 99.09\cdots = 99.1 \text{ (3 s.f.)}$$

(b) (1 mark)

$$\tan 150^\circ = -\frac{1}{\sqrt{3}}$$

(c) i. (1 mark)

$$\$43\,000 - \$17\,000 = \$26\,000$$

ii. (1 mark)

$$\begin{aligned} I &= 26\,000 \times 0.12 \times 4 \\ &= \$12\,480 \end{aligned}$$

iii. (1 mark)

$$\begin{aligned} \text{Payment} &= \frac{26\,000 + 12\,480}{48} \\ &= \$801.67 \end{aligned}$$

iv. (1 mark)

$$C = 43\,000 + 12\,480 = \$55\,480$$

(d) i. (2 marks)

✓ [1] for calculating the cost of the marginal rate of tax.

✓ [1] for final answer.

$$\begin{aligned} \text{Tax} &= 4\,350 + 0.3(68\,500 - 35\,000) \\ &= \$14\,400 \end{aligned}$$

ii. (1 mark)

$$\begin{aligned} \text{Total} &= 14\,400 + (68\,500 \times 0.015) \\ &= 15\,427.50 \end{aligned}$$

(e) (2 marks)

✓ [1] for multiplying by the correct conjugate surd.

✓ [1] for final answer

$$\begin{aligned} \frac{\sqrt{2}}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}} &= \frac{3\sqrt{2}+\sqrt{10}}{9-5} \\ &= \frac{3\sqrt{2}+\sqrt{10}}{4} \end{aligned}$$

Question 2

(a) i. (2 marks)

✓ [1] for obtaining $6x = -14$ (or equivalent).

✓ [1] for final simplified answer.

$$\begin{aligned} \underset{-4x}{4x} \underset{-11}{-3} &= \underset{-4x}{10x} \underset{-11}{+11} \\ 6x &= -14 \\ x &= -\frac{14}{6} = -\frac{7}{3} \end{aligned}$$

ii. (3 marks)

✓ [1] for removing all fractions to obtain $7(3x-1) - 2(x+4) = 140$ (or equivalent).

✓ [1] for obtaining $19x - 15 = 140$ (or equivalent).

✓ [1] for final simplified answer.

$$\begin{aligned} \frac{3x-1}{\underset{\times 14}{2}} - \frac{x+4}{\underset{\times 14}{7}} &= \underset{\times 14}{10} \\ 7(3x-1) - 2(x+4) &= 140 \\ 21x - 7 - 2x - 8 &= 140 \\ 19x \underset{+15}{-15} &= \underset{+15}{140} \\ 19x &= 155 \\ x &= \frac{155}{19} \end{aligned}$$

iii. (3 marks)

✓ [1] for correct factorisation.

✓ [1] for $x = -\frac{3}{4}$.

✓ [1] for $x = 8$.

$$\begin{aligned} 4x^2 - 29x - 24 &= 0 \\ (4x+3)(x-8) &= 0 \\ x &= -\frac{3}{4}, 8 \end{aligned}$$

iv. (2 marks)

✓ [1] for obtaining $6x = 3x - 12$.

✓ [1] for final answer.

$$3^{6x} = 27^{x-4} = \left(3^3\right)^{x-4}$$
$$3^{6x} = 3^{3x-12}$$
$$\underset{-3x}{6x} = \underset{-3x}{3x} - 12$$
$$3x = -12$$
$$x = -4$$

(b) i. (3 marks)

✓ [1] for correct method.

✓ [1] for each correct value of p and q.

$$\begin{cases} 5p + 3q = -6 & (1) \\ 3p + q = 10 & (2) \end{cases}$$
$$(1) - 3 \times (2) :$$
$$-4p = -36$$
$$p = 9 \qquad (3)$$

Substitute (3) to (2)

$$3(9) + q = 10$$
$$27 + q = 10$$
$$\therefore q = -17$$

ii. (4 marks)

✓ [1] for obtaining $(x - 4)(x + 5) = 0$.

✓ [3] for correct final answer of $(4, 16)$ and $(-5, 25)$.

$$\begin{cases} y = x^2 \\ y = 20 - x \end{cases}$$
$$x^2 = 20 - x$$
$$x^2 + x - 20 = 0$$
$$(x - 4)(x + 5) = 0$$
$$x = 4, -5$$
$$y = 16, 25$$
$$\therefore (4, 16) \text{ or } (-5, 25)$$

Question 3

(a) i. (4 marks)

- Mode $= 170$.
- $\overline{x} = 164.3 (\approx 164)$.
- $\widetilde{x} = 165$.
- $\sigma_n = 6.94$.

ii. (1 mark)

$$P(155) = \frac{12}{150} = \frac{2}{25}$$

iii. (1 mark)

$$x_{2\sigma} = 164 \pm 2\sigma$$
$$= 150.13, 177.87$$
$$\therefore 150\,\text{cm}, 178\,\text{cm}$$

iv. (2 marks)

$$Q_1 = 160$$
$$Q_2 = 170$$
$$\therefore IQR = 170 - 160 = 10$$

(b) (2 marks)

✓ [1] for correct calculation of 66% as the proper z score.

✓ [1] for correct final answer.

$$z = \frac{x - \mu}{\sigma} = \frac{66 - 62}{6} = \frac{2}{3}$$
$$\underset{\times 15}{\frac{2}{3}} = \underset{\times 15}{\frac{x - 70}{15}}$$
$$10 = x - 70$$
$$x = 80$$

(c) (2 marks)

✓ [1] for correct numerator.

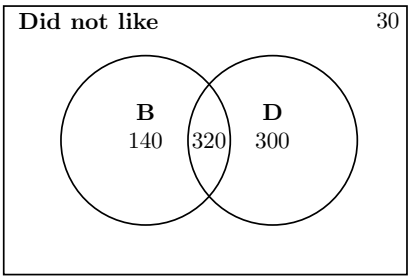
✓ [1] for correct denominator.

$$\text{Sample space} : 26^4 \times 10 \times 10$$
$$\text{Favourable outcome} : 26 \times 10$$
$$P(\text{1 letter \& 1 number}) = \frac{26 \times 10}{26^4 \times 100}$$
$$= \frac{1}{26^3 \times 10}$$
$$= \frac{1}{17\,576 \times 10}$$
$$= \frac{1}{175\,760}$$

(d) (2 marks)

✓ [1] for method.

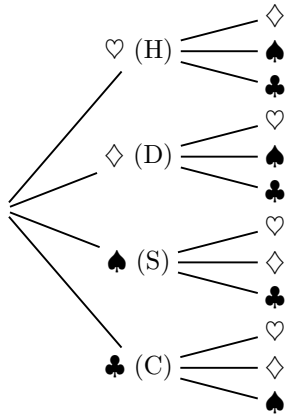
✓ [1] for final answer.



$$P(B) = \frac{150}{800} = \frac{3}{16}$$

(e) i. (1 mark)

✓ [1] for the list of possible pairs. Note that the tree diagram produces duplicated pairs.



Possible pairs are

- ♡♢ (HD)
- ♡♠ (HS)
- ♡♣ (HC)
- ♢♠ (DS)
- ♢♣ (DC)
- ♠♣ (SC)

ii. 1./ (1 mark)

$$P(\text{same colour}) = \frac{2}{6} = \frac{1}{3}$$

2./ (1 mark)

$$\begin{aligned} P(\text{at least 1 red}) &= 1 - P(\text{no red}) \\ &= 1 - \frac{1}{6} = \frac{5}{6} \end{aligned}$$

3./ (1 mark)

$$P(\spadesuit) = \frac{3}{6} = \frac{1}{2}$$

Question 4

(a) i. (1 mark)

$$m = 48^\circ$$

ii. (2 marks)

$$a = 46^\circ \quad \Big| \quad \begin{aligned} b &= 180^\circ - 2 \times 44^\circ \\ &= 92^\circ \end{aligned}$$

iii. (1 mark)

$$p = \frac{180 - 144}{3} = 22^\circ$$

iv. (2 marks)

✓ [1] for correct application of tangent/intercept rule to obtain $4(n+4) = 8^2$.

✓ [1] for final answer.

$$\begin{aligned} \underset{\div 4}{4}(n+4) &= \underset{\div 4}{8^2} \\ n + 4 &= 16 \\ n &= 12 \end{aligned}$$

(b) (4 marks)

✓ [1] for each correct bullet point.

- $\angle TPR = \angle PRS = 71^\circ$ (alternate angles on $\parallel$ lines TP, RS)
- $\angle TPR = \angle PSR = 71^\circ$ (angles in the alternate segment)
- $\therefore \triangle PRS$ has equal base angles, $\triangle PRS$ is isosceles.
- $\therefore PR = PS$.

Question 5

(a) (2 marks)

✓ [1] for correct application of distance formula.

✓ [1] for final answer.

$$\begin{aligned} d &= \sqrt{(-1-2)^2 + (3-0)^2} \\ &= \sqrt{9+9} = \sqrt{18} \\ &= 3\sqrt{2} \end{aligned}$$

(b) (2 marks)

$$m = \frac{3-0}{-1-2} = -1$$

(c) (1 mark)

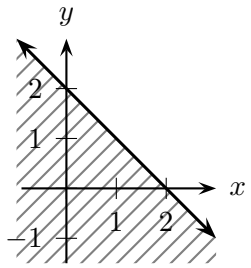
$$m = \tan\theta = 1 \Rightarrow \theta = 45^\circ$$

(d) (2 marks)

✓ [-1] for each missing line of working.

$$y - 3 = -1(x + 1)$$
$$y - 3 = -x - 1$$
$$x + y - 2 = 0$$

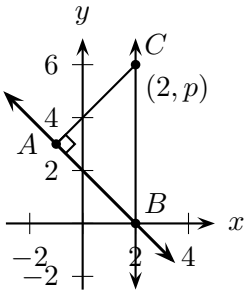
(e) (1 mark)



(f) (1 mark)

$$x = 2$$

(g) (2 marks)



Gradient of AC is 1 as it is perpendicular to the line $x + y - 2 = 0$.

$$\frac{p-3}{2+1} = 1$$
$$p - 3 = 3$$
$$p = 6$$

Question 6

(a) i. (3 marks)

✓ [1] for expression in x.

✓ [1] for $\sin 40^\circ = \frac{h}{x}$.

✓ [1] for final line.

Let $AD = x$. $\angle ADB = 127^\circ$, $\angle BAC = 50^\circ$ and $\angle ADB = 3^\circ$.

$$\frac{x}{\sin 127^\circ} = \frac{18}{\sin 3^\circ}$$
$$x = \frac{18 \sin 127^\circ}{\sin 3^\circ}$$

In $\triangle ADC$,

$$\sin 40^\circ = \frac{h}{x}$$
$$h = x \sin 40^\circ$$
$$= \frac{18 \sin 40^\circ \sin 127^\circ}{\sin 3^\circ}$$

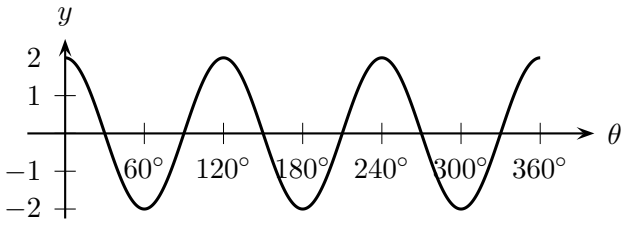
ii. (1 mark)

$$h = 176.6 \cdots \approx 177 \text{ m}$$

(b) i. (2 marks)

✓ [1] for correctly sketched amplitude.

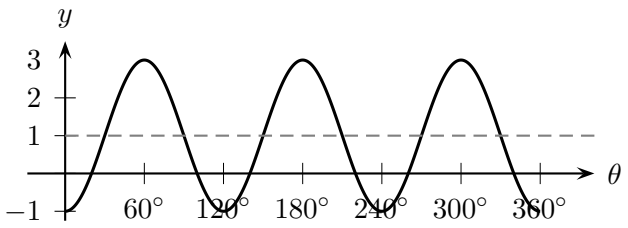
✓ [1] for correctly sketched period.



ii. (2 marks)

✓ [1] for negative "flip".

✓ [1] for correctly upward shift.



(c) (2 marks)

$$\sin \theta = \frac{\sqrt{3}}{2}$$
$$\theta = 60^\circ, 120^\circ$$

Question 7

(a) (2 marks)

✓ [1] for each correct line of working.

$$h_1 : h_2 = 1 : 2 \quad \Rightarrow \quad V_1 : V_2 = 1 : 8$$

(b) (3 marks)

✓ [1] for volume of larger cone.

✓ [1] for reasoning.

✓ [1] for final answer.

$$V_{\text{larger cone}} = \frac{\pi r^2 h}{3} = \frac{\pi \times 12^2 \times 12}{3}$$
$$= 576\pi$$

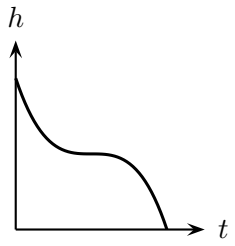
As the larger cone has volume 8 times the smaller cone, then the truncated cone must have $\frac{7}{8}$ of the volume of the larger cone.

$$V = \frac{7}{8} \times 576\pi$$
$$= 504\pi \approx 1\,583.4\,\text{cm}^3$$

(c) (2 marks)

✓ [1] for axes.

✓ [1] for reasonably correct shape.



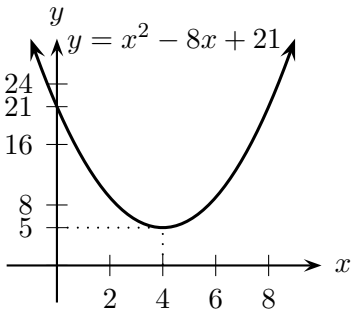
Question 8

(a) i. (3 marks)

✓ [1] for correct shape.

✓ [1] for vertex.

✓ [1] for y intercept.

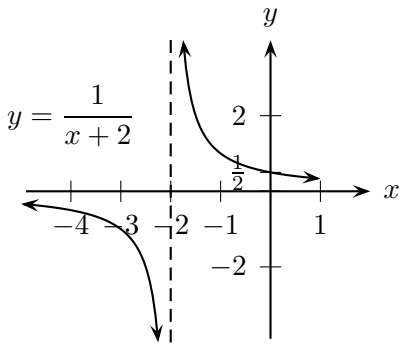


ii. (3 marks)

✓ [1] for correct shape.

✓ [1] for asymptote.

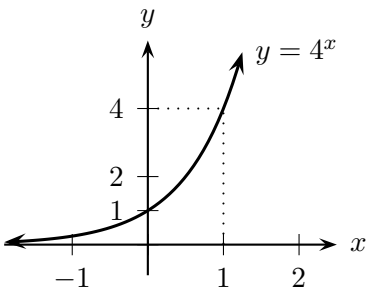
✓ [1] for y intercept.



iii. (2 marks)

✓ [1] for correct shape & asymptote.

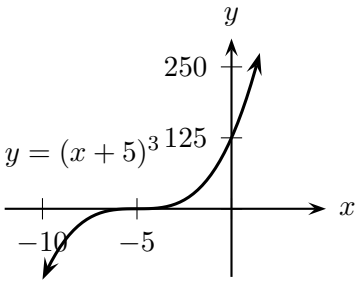
✓ [1] for y intercept.



iv. (2 marks)

✓ [1] for correct shape & position.

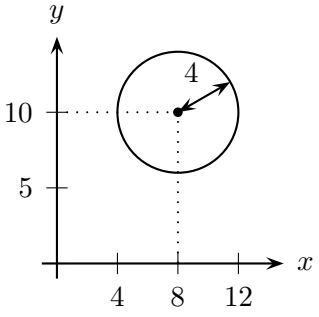
✓ [1] for x and y intercepts.



v. (2 marks)

✓ [1] for correct position including showing the centre (must not cross any axes).

✓ [1] for correct radius.



(b) (2 marks)

✓ [1] for method.

✓ [1] for final answer. If only the final answer is provided, award [2].

$$A(-8,0) \qquad B(7,0) \qquad P(x,y)$$
$$PA = 4PB$$
$$\sqrt{(x+8)^2+y^2} = 4\sqrt{(x-7)^2+y^2}$$
$$(x+8)^2+y^2 = 16\left((x-7)^2+y^2\right)$$
$$(x+8)^2-16(x-7)^2 = 16y^2-y^2$$
$$[(x+8)-4(x-7)]\,[(x+8)+4(x-7)] = 15y^2$$
$$[-3x+36]\,[5x-20] = 15y^2$$
$$\cancel{3}(x-12)\cancel{5}(x-4) = \cancel{15}y^{\cancel{2}\,1}$$
$$x^2-16x+48+y^2 = 0$$
$$x^2-16x+64-64+48+y^2 = 0$$
$$(x-8)^2+y^2 = 16$$

Hence the locus is a circle of radius 4, centre $(8,0)$.

Question 9

(a) (2 marks)

✓ [2] for showing understanding of a function.

✓ [1] only for stating "vertical line test".

- A function must only have one corresponding y value for each x value in its domain. This is true for $y = x^2$ but not so for $x^2 + y^2 = 1$ as $x = \frac{1}{2}$ would imply $y = \pm\frac{\sqrt{3}}{2}$.

(b) i. (2 marks)

✓ [1] for interchanging variables.

✓ [1] for final answer.

$$y = 4 - 2x$$

Interchange variables,

$$x = 4 - 2y$$
$$2y = 4 - x$$
$$y = 2 - \frac{1}{2}x$$

ii. (2 marks)

✓ [1] for obtaining $xy + y = 2 - 3x$.

✓ [1] for final answer.

$$y = \frac{2-x}{3+x}$$

Interchange variables,

$$x = \frac{2-y}{3+y}$$
$$x(3+y) = 2-y$$
$$\underset{-3x}{3x} + \underset{+y}{xy} = \underset{-3x}{2} - \underset{+y}{y}$$
$$xy + y = 2 - 3x$$
$$\underset{\div(x+1)}{y(x+1)} = \underset{\div(x+1)}{2-3x}$$
$$y = \frac{2-3x}{x+1}$$

(c) (1 mark)

$$y = x \qquad y = \frac{1}{x} \qquad y = -x \qquad \text{etc}\ldots$$

Question 10

(a) i. (1 mark)

$$x = \log_4 64$$
$$4^x = 64$$
$$x = 3$$

ii. (2 marks)

✓ [1] for obtaining $\frac{3x}{2} = x + 6$.

✓ [1] for final answer.

$$\log 3x - \log 2 = \log(x+6)$$
$$\log\frac{3x}{2} = \log(x+6)$$
$$\frac{3x}{2} = x+6$$
$$3x = 2x+12$$
$$x = 12$$

iii. (2 marks)

✓ [1] for obtaining $x+1=\frac{\log 18}{\log 3}$.

✓ [1] for final answer.

$$\begin{aligned} 3^{x+1} &= 18 \\ (x+1)\log 3 &= \log 18 \\ x+1 &= \frac{\log 18}{\log 3} \\ x &= \frac{\log 18}{\log 3} - 1 \\ &\approx 1.63 \end{aligned}$$

(b) (3 marks)

✓ [1] for obtaining $2P = P(1+0.055)^n$.

✓ [1] for obtaining $n=\frac{\log 2}{\log 1.055}$.

✓ [1] for final answer.

$$A = P(1+r)^n$$

$A = 2P$, $r = 0.055$, $n =$?

$$\begin{aligned} 2\cancel{P} &= \cancel{P}(1+0.055)^n \\ 2 &= 1.055^n \\ n\log 1.055 &= \log 2 \\ n &= \frac{\log 2}{\log 1.055} \\ &= 12.946\cdots \\ &= 12 \text{ yrs } 11 \text{ mths} \end{aligned}$$

Question 11

(a) i. (2 marks)

$$\begin{aligned} m_{AP} &= \frac{10-0}{6-2} \\ &= \frac{10}{4} = \frac{5}{2} \\ \therefore m_{\min} &= \frac{5}{2} \end{aligned} \qquad \begin{aligned} m_{BP} &= \frac{10-0}{6-4} \\ &= \frac{10}{2} = 5 \\ m_{\max} &= 5 \end{aligned}$$

ii. (2 marks)

• When $m=\frac{5}{2}$,

$$\begin{aligned} y &= \frac{5}{2}x + b\Big|_{\substack{x=6\\y=10}} \\ 10 &= \frac{5}{\cancel{2}} \times \cancel{6}^{3} + b \\ 10 &= 15 + b \\ b &= -5 \end{aligned}$$

• When $m=5$,

$$\begin{aligned} y &= 5x + b\Big|_{\substack{x=6\\y=10}} \\ 10 &= 5(6) + b \\ b &= -20 \end{aligned}$$

Hence $b_{\max} = -5$, $b_{\min} = -20$.

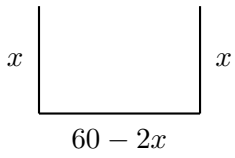
(b) (4 marks)

✓ [1] for diagram.

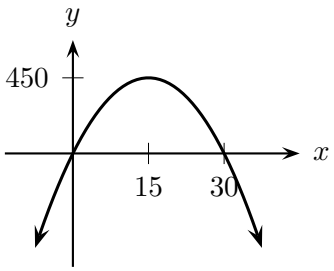
✓ [1] for obtaining an expression of A in terms of x.

✓ [1] for concluding maximum $A = 15$.

✓ [1] for final dimensions.



$$A = x(60-2x) = 60x - 2x^2$$



Maximum value of $A = 2x(30-x)$ occurs when

$$\begin{aligned} x &= -\frac{b}{2a} \\ &= -\frac{60}{2\times(-2)} = 15 \end{aligned}$$

Hence the dimensions that give this maximum cross sectional area is

$$x = 15 \qquad 60 - 2x = 30$$

i.e. 15 cm × 30 cm.