

Sydney Technical High School



2011
TRIAL HIGHER SCHOOL CERTIFICATE
EXAMINATION

Mathematics

General Instructions

- Reading Time - 5 minutes.
- Working Time - 3 hours.
- Write using a blue or black pen.
- Approved calculators may be used.
- A table of standard integrals is provided at the back of this paper.
- All necessary working should be shown for every question.
- Begin each question on a fresh sheet of paper.

Total marks (120)

- Attempt Questions 1-10.
- All questions are of equal value.

Question 1 (12 Marks)

Use a Separate Sheet of paper

Marks

- (a) Factorise $3x^2 - 5x - 2$ 2
- (b) Simplify $2x^2y - yx^2 + xy^2 + 2y^2x$ 1
- (c) Express $\frac{3\pi}{8}$ radians in degrees and minutes. 1
- (d) If $\frac{4}{2-\sqrt{3}} = a + b\sqrt{3}$ find the values of a and b . 2
- (e) Solve $|2x + 5| < 3$ 2
- (f) Find the period and amplitude for the graph of $3y = \sin\left(2x - \frac{\pi}{4}\right)$. 2
- (g) Solve $9^{2x-3} = 27^x$ 2

Question 2 (12 Marks)

Use a Separate Sheet of paper

Marks(a) Differentiate with respect to x :

i) $(3x^2 + 7)^6$ 2

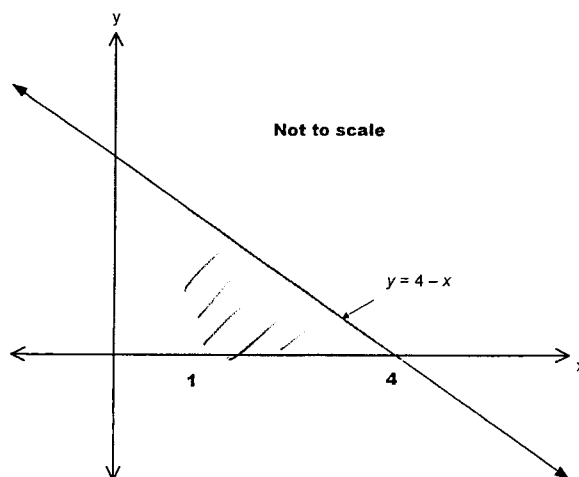
ii) $\frac{\sin 2x}{e^{2x}}$ 2

(b) i) Evaluate $\int \frac{dx}{3x+5}$ 2

ii) $\int_0^1 e^{3x} dx$ 2

(c) $y = 4 - x$ is shown on the graph. 3

Calculate the volume of the solid formed when the area bounded by the function, x axis and $x = 1$ is rotated around the x axis.



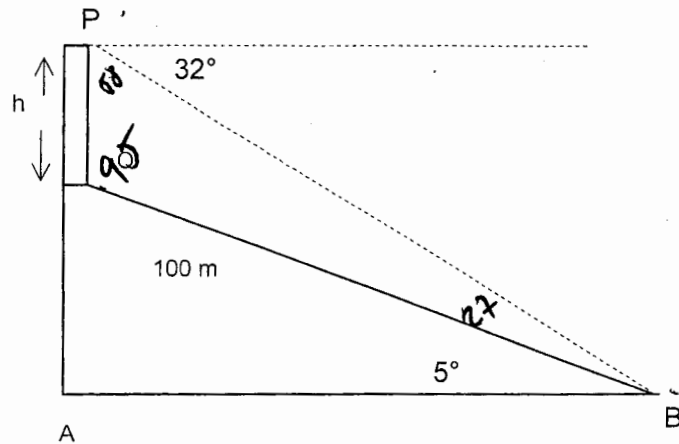
(d) Evaluate $\lim_{x \rightarrow 0} \frac{\sin 3x}{2x}$ 1

Question 3 (12 Marks)

Use a Separate Sheet of paper

Marks

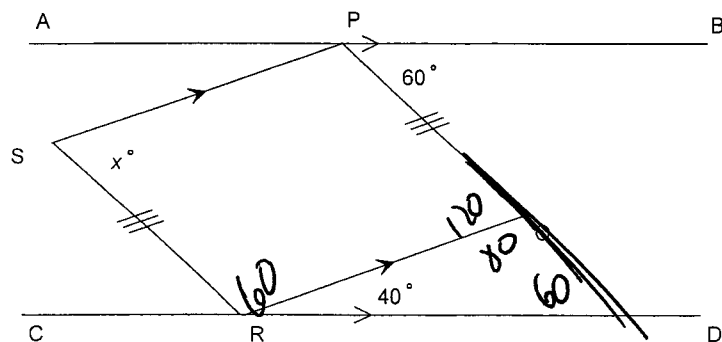
- (a) A vertical tower PQ is at the top of a hill BQ, where Q is 100 metres from the base B. The hill is inclined at 5° to the horizontal as shown below. From the top of the tower the angle of depression to the point B is 32° .



- | | | |
|------|--|---|
| (i) | Copy the diagram and mark on it all of the relevant information. | 1 |
| (ii) | Calculate the height (h) of the tower, to the nearest metre. | 2 |
-
- (b) For the arithmetic sequence 2, 7, 12, 17,
- | | | |
|-------|------------------------------------|---|
| (i) | Find a value of the n th Term | 1 |
| (ii) | Find the 23 rd term | 1 |
| (iii) | Find the sum of the first 47 terms | 1 |

- (c) In the diagram, $AB \parallel CD$ and PQRS is a parallelogram.

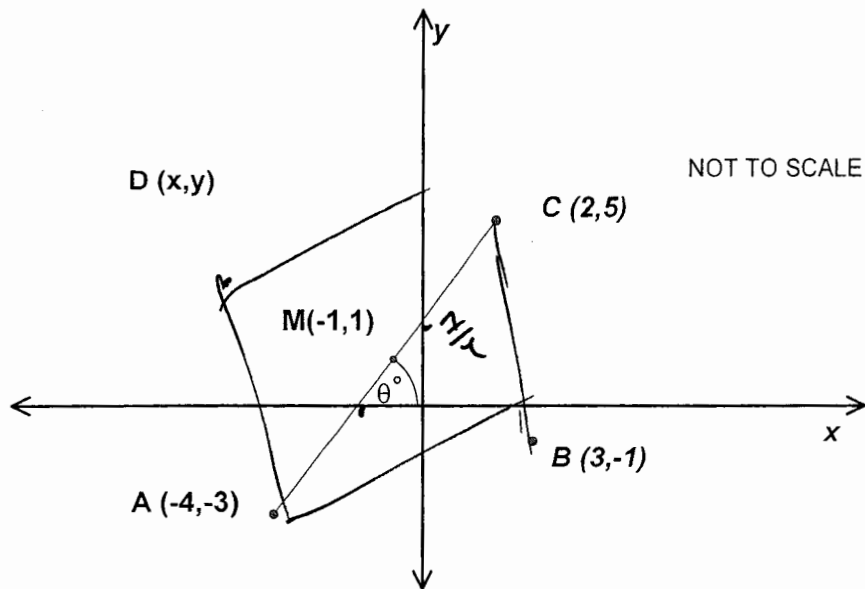
3



Find the value of x , giving reasons.

- d) Find the equation of the tangent to the curve $y = \sin 3x$ at the point where $x = \frac{\pi}{3}$

3



You are given that $M(-1, 1)$ is the midpoint of AC

- Find the coordinates of D such that M is the midpoint of BD 2
- Using the facts already known, explain why $ABCD$ is a parallelogram. 1
- Find the size of θ to the nearest degree. 2
- Show that the equation of AC is $4x - 3y + 7 = 0$ 2
- Find the perpendicular distance between B and the line AC 3
- Copy the diagram into your answer booklet.**
Shade the region inside the quadrilateral $ABCD$, which satisfies the inequality $4x - 3y + 7 \leq 0$ 2

Question 5 (12 Marks)

Use a Separate Sheet of paper

Marks

- (a) (i) Find the value(s) of k for which $x^2 + (2 - k)x + 2.25 = 0$ has equal roots **2**
- (ii) ~~✱~~ Find the value(s) of k for which $y = kx + 1$ is a tangent to $y = x^2 + 2x + 3.25$ **1**
- (b) Consider the curve $y = x^4 - \frac{4}{3}x^3 - 2x^2 + 4x + 3$
- (i) Obtain $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for this function **2**
- (ii) Show that $x = -1$ and $x = 1$ satisfy $\frac{dy}{dx} = 0$ and find the y coordinates. **2**
- (iii) Find the x coordinates of the two points of inflexion. **1**
- (iv) Determine the nature of each of the stationary points. **2**
- (v) Sketch the curve for the domain $-2 \leq x \leq 2$ **2**

Question 6 (12 Marks)

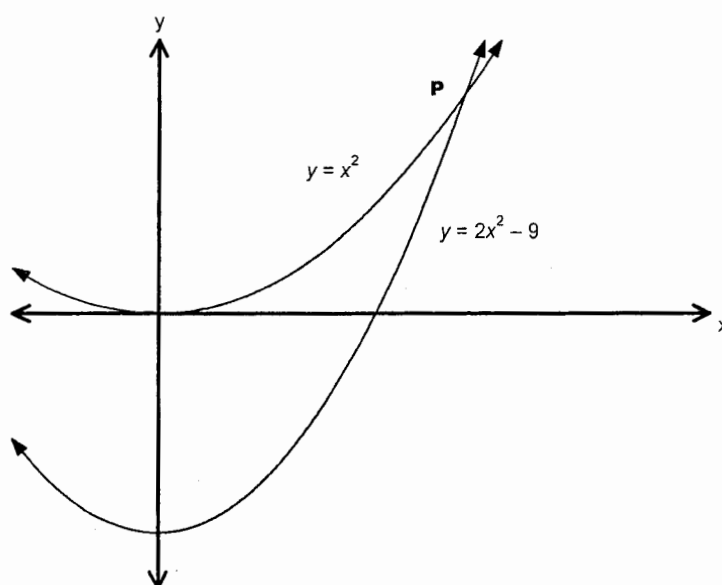
Use a Separate Sheet of paper

Marks

(a) The equation of a parabola is given by $x^2 - 4x - 2y + 8 = 0$. Find the:

- | | | |
|-------|---|---|
| (i) | Vertex | 2 |
| (ii) | Focus | 2 |
| (iii) | Equation of the normal to the parabola at the point (0, 4). | 2 |

(b) P is the point of intersection of $y = x^2$ and $y = 2x^2 - 9$




- | | | |
|------|-------------------------------------|---|
| (i) | Find the coordinates of P. | 2 |
| (ii) | Find the area of the shaded region. | 2 |

(c) Evaluate $\sum_{k=4}^{20} 2k - 5$ 2


Question 7 (12 Marks)

Use a Separate Sheet of paper

Marks

(a) Show that $\frac{(1 + \tan^2 \theta) \cot \theta}{\operatorname{cosec}^2 \theta} = \tan \theta$ 

3

(b) Solve $2 \log_a x - \log_a 4 = 2 \log_a 8$ 

3

(c) If α and β are the roots of the equation $3x^2 - 2x - 4 = 0$, find:

(i) $\alpha + \beta$

1

(ii) $\alpha\beta$

1

(iii) $(4 - \alpha)(4 - \beta)$

2


(d) Use the table to find an approximation to the value of the definite integral

$$\int_3^{4.5} f(x) dx,$$

using Simpson's Rule. Give your answer correct to 3 significant figures.

2

x	3	3.25	3.5	3.75	4	4.25	4.5
$f(x)$	1.0	0.8	0.65	0.55	0.5	0.48	0.45



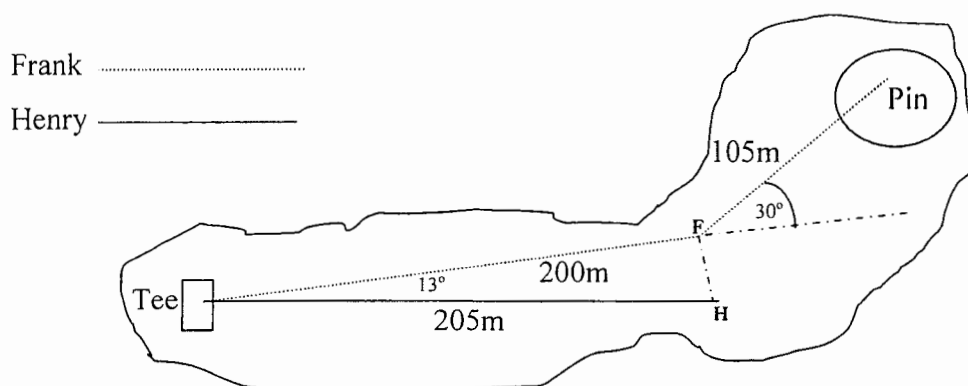
Question 8 (12 Marks)

Use a Separate Sheet of paper

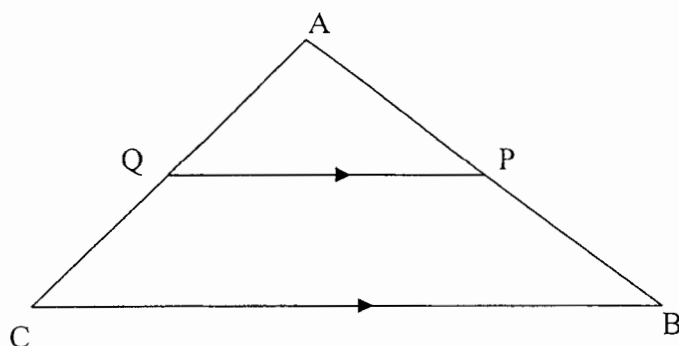
Marks

- (a) The 18th hole at Royal Maples is a dogleg to the left. Frank hits a 200m drive then turns left 30° and hits a 105m shot to the pin.

- (i) What is the straight line distance from the tee to the pin? 3
- (ii) Henry hits his drive a distance of 205m and to the right of Frank's drive line by 13° . Show that the triangle formed by the two initial drives is approximately right angled. 2



- (b) In the diagram below, P is the midpoint of the side AB of the $\triangle ABC$. PQ is drawn parallel to BC.



- (i) Prove that $\triangle ABC \parallel \triangle APQ$. 2
- (ii) Explain why Q is the midpoint of AC. 2



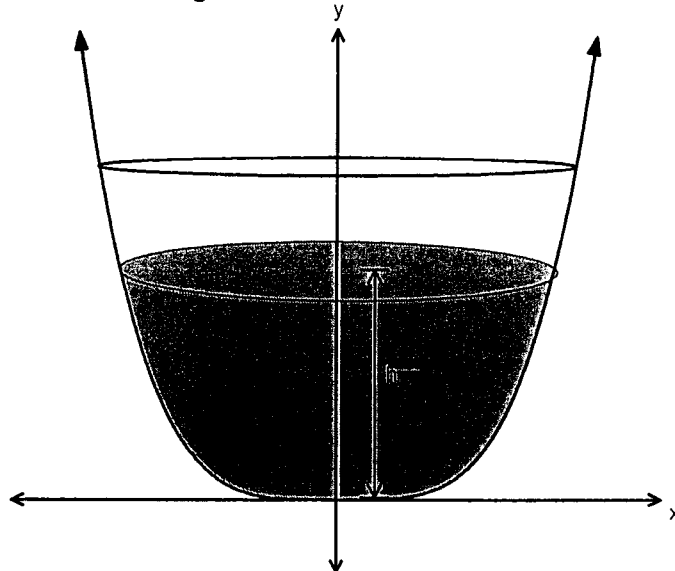
- (c) On the same diagram sketch the graphs of $y = \sin x$ and $y = 2\sin x + 1$ 3
 $0 \leq x \leq 2\pi$

Question 9 (12 Marks)

Use a Separate Sheet of paper

Marks

- (a) A wine glass is formed by rotating part of the curve $16y = x^4$ about the y axis, the scales on both axes being 1cm = 1unit.



- (i) If the depth of the wine is h cm, show that the volume of wine is $\frac{8\pi h^{\frac{3}{2}}}{3}$ mL. 2
- (ii) If the volume is 120 mL, find h correct to one decimal place 2
- (b) Evaluate $\int_0^{\frac{\pi}{6}} (x^2 + \sin 2x) dx$ 2
- (c) Solve: $2 \sin^2 x - 3 \sin x - 2 = 0$ for $0 \leq x \leq 2\pi$ 2
- (d) (i) Sketch $y = \ln(x+1)$ 1
- (ii) Find the area bounded by the curve, the x-axis and the line $x = 2$ 3

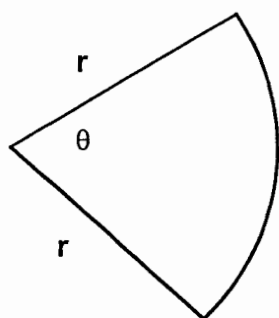
Question 10 (12 Marks)

Use a Separate Sheet of paper

Marks

- (a) (i) Paula is in a superannuation fund to which she contributes \$250.00 at the beginning of each month for 30 years. The fund pays 6.6% pa compounded monthly. If the fund matures at the end of the last month of the 30th year, find the total value of the fund at maturity. **3**
- (ii) After receiving the payout from the fund, Paula sells her Audi for \$30 000 and invests the total of the two assets in an account that earns interest at 6.6% p.a. compounded monthly. How much will the investment be worth after a further 10 years? **2**
- (b) Arcsec Landscaping Company are designing a garden bed for a local park in the shape of a sector with radius r and sector angle θ .

They have a total of 375 metres of garden edging materials to use as the perimeter of the garden bed.

**NOT TO SCALE**

- (i) Show that the area A of the garden bed is given by $A = \frac{r}{2}(375 - 2r)$. **2**
- (ii) Finding the greatest area of the garden bed which can be made using 375 metres of edging material? **3**
- (iii) After inspecting the location for the garden bed the designers calculate that the sector angle for the garden must be less than 110° . Can they still create the garden bed with a maximum area found in (ii)? Justify your answer. **2**

End of Examination

STANDARD INTEGRALS

$$\int x^n dx = \frac{1}{n+1} x^{n+1}, \quad n \neq -1; \quad x \neq 0, \text{ if } n < 0$$

$$\int \frac{1}{x} dx = \ln x, \quad x > 0$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}, \quad a \neq 0$$

$$\int \cos ax dx = \frac{1}{a} \sin ax, \quad a \neq 0$$

$$\int \sin ax dx = -\frac{1}{a} \cos ax, \quad a \neq 0$$

$$\int \sec^2 ax dx = \frac{1}{a} \tan ax, \quad a \neq 0$$

$$\int \sec ax \tan ax dx = \frac{1}{a} \sec ax, \quad a \neq 0$$

$$\int \frac{1}{a^2 + x^2} dx = \frac{1}{a} \tan^{-1} \frac{x}{a}, \quad a \neq 0$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} dx = \sin^{-1} \frac{x}{a}, \quad a > 0, \quad -a < x < a$$

$$\int \frac{1}{\sqrt{x^2 - a^2}} dx = \ln \left(x + \sqrt{x^2 - a^2} \right), \quad x > a > 0$$

$$\int \frac{1}{\sqrt{x^2 + a^2}} dx = \ln \left(x + \sqrt{x^2 + a^2} \right)$$

NOTE : $\ln x = \log_e x, \quad x > 0$

Question 1

c) $3x^2 - 5x - 2 = (3x+1)(x-2)$

d) $2x^2y - yx^2 + xy^2 + 2y^2x$
 $= x^2y + 3xy^2$

e) $\frac{3\pi}{8} = 67^\circ 30'$

f) $\frac{4}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{8+4\sqrt{3}}{1}$

a=8 b=4

g) $|2x+5| < 3$
 $-3 < 2x+5 < 3$
 $-8 < 2x < -2$
 $-4 < x < -1$

$3y = \sin(2x - \frac{\pi}{4})$
 $y = \frac{1}{3} \sin(2x - \frac{\pi}{4})$
 Amplitude = $\frac{1}{3}$
 Period = $\frac{2\pi}{2} = \pi$

$9^{2x-3} = 27^2$
 $(3^2)^{2x-3} = 3^{3 \times 2}$
 $4x-6 = 3 \times 2$
 $x = 6$

Question 2

a) i) $y = (3x^2+7)^6$
 $\frac{dy}{dx} = 6(3x^2+7)^5 \times 6x$
 $= 36x(3x^2+7)^5$

ii) $y = \frac{\sin 2x}{e^{2x}}$

$u = \sin 2x \quad v = e^{2x}$
 $du = 2 \cos 2x \quad dv = 2e^{2x}$

$\frac{dy}{dx} = \frac{e^{2x} \cdot 2 \cos 2x - \sin 2x \cdot 2e^{2x}}{(e^{2x})^2}$
 $= \frac{2e^{2x} [\cos 2x - \sin 2x]}{(e^{2x})^2}$
 $= \frac{2 [\cos 2x - \sin 2x]}{e^{2x}}$

b) i) $\int \frac{dx}{3x+5} = \frac{1}{3} \int \frac{3}{3x+5} dx$
 $= \frac{1}{3} \ln(3x+5) + c$

ii) $\int_0^1 e^{3x} dx = \left[\frac{1}{3} e^{3x} \right]_0^1$
 $= \frac{1}{3} e^3 - \frac{1}{3}$
 $= \frac{1}{3} (e^3 - 1)$

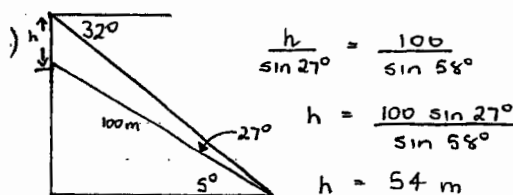
c) $V = \pi \int_1^4 y^2 dx$

$y = 4-x$
 $y^2 = (4-x)^2$

$V = \pi \int_1^4 (4-x)^2 dx$
 $= \pi \left[\frac{(4-x)^3}{3 \times -1} \right]_1^4$
 $= \pi [0 - (-9)]$
 $= 9\pi \text{ units}^3$

d) $\lim_{x \rightarrow 0} \frac{\sin 3x}{2x} = \frac{3}{2} \times \frac{\sin 3x}{3x}$
 $= \frac{3}{2} \times 1$
 $= \frac{3}{2}$

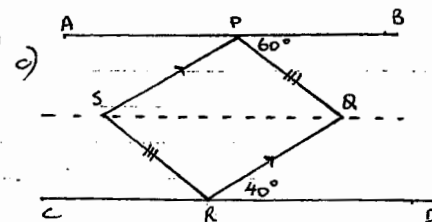
Question 3



b) i) $T_n = 5n - 3$

ii) $T_{23} = 5 \times 23 - 3 = 112$

iii) $S_n = \frac{n}{2} [2a + (n-1)d]$
 $= \frac{47}{2} [2 \times 2 + (47-1) \times 5]$
 $= 5499$



Construct a line through SQ, || to AB and CD.
 $\angle SQR = \angle QRD = 40^\circ$
 (alternate L's are equal in parallel lines SQ || AB and CD)
 $\angle SQP = \angle RPQ = 60^\circ$
 (alternate L's are equal in parallel lines SQ || AB and CD)
 $\therefore \angle PQR = 100^\circ$
 $\therefore x = \angle PSR = 100^\circ$
 (opposite L's of a parallelogram PQRS are equal)

d) $y = \sin 3x$
 $\frac{dy}{dx} = 3 \cos 3x$
 When $x = \frac{\pi}{3}$
 $\frac{dy}{dx} = 3 \cos 3 \times \frac{\pi}{3}$
 $= -3$
 $y = 0$
 $y - 0 = -3(x - \frac{\pi}{3})$
 $y = -3x + \pi$

Question 4

Marie

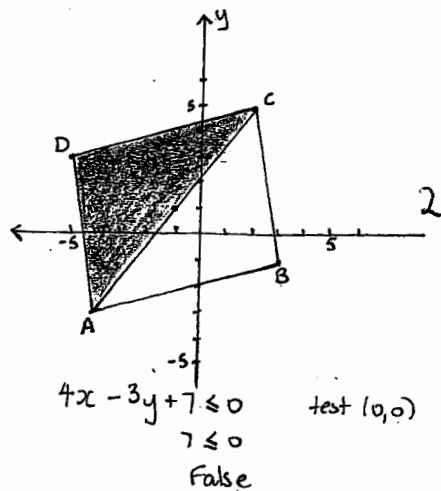
a) $\frac{x+3}{2} = -1$ $\frac{y-1}{2} = 1$
 $x+3 = -2$ $y-1 = 2$
 $x = -5$ $y = 3$
 $D(-5, 3)$ 2

b) Its diagonals bisect each other. 1

c) Gradient of MC = $\frac{5-1}{2+1} = \frac{4}{3}$
 $\tan \theta = \frac{4}{3}$
 $\theta = 53^\circ$ 2

d) $y-5 = \frac{4}{3}(x-2)$
 $3y-15 = 4x-8$
 $4x-3y+7 = 0$

e) perpendicular distance
 $= \frac{|Ax+By+C|}{\sqrt{A^2+B^2}}$
 $= \frac{|4 \times 3 - 3 \times 1 + 7|}{\sqrt{4^2+3^2}} = \frac{12}{5}$ 3



Question 5

ai) $x^2 - (2-k)x + 2.25 = 0$
 $\Delta = 0$ $\Delta = (2-k)^2 - 4 \times 2.25 \times 1$
 $0 = (2-k)^2 - 9$
 $9 = (2-k)^2$
 $\pm 3 = 2-k$
 $k = -1$ or $k = 5$

aii) If $Kx+1 = x^2+2x+3.25$
 $Kx = x^2+2x+2.25$
 $0 = x^2+(2-k)x+2.25$
 $0 = x^2+(2-k)x+2.25$
 So tangent if $k = -1$ or 5

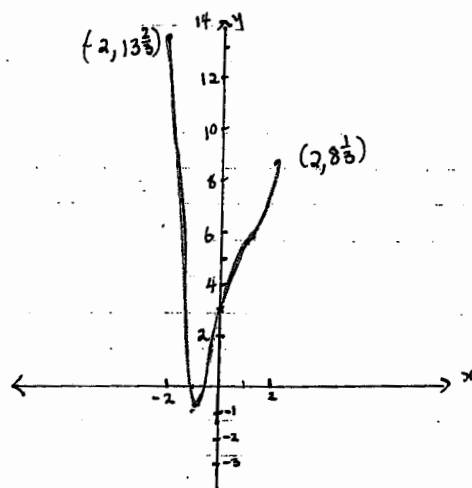
bi) $y = x^4 - \frac{4}{3}x^3 - 2x^2 + 4x + 3$
 $y' = 4x^3 - 4x^2 - 4x + 4$
 $y'' = 12x^2 - 8x - 4$

bii) $f'(1) = 4(1)^3 - 4(1)^2 - 4(1) + 4 = 0$
 $f'(-1) = 4(-1)^3 - 4(-1)^2 - 4(-1) + 4 = 0$
 When $x = 1$ $y = \frac{4}{3}$
 $x = -1$ $y = -\frac{2}{3}$

biii) $y'' = 12x^2 - 8x - 4$
 Point of inflexion occurs when $y'' = 0$
 $12x^2 - 8x - 4 = 0$
 $3x^2 - 2x - 1 = 0$
 $(3x+1)(x-1) = 0$
 $x = -\frac{1}{3}$ $x = 1$

iv) $(1, \frac{4}{3})$ is a horizontal point of inflexion

When $x = -1$
 $f''(-1) > 0$
 \therefore minimum at $(-1, -\frac{2}{3})$



Question 6

a) $x^2 - 4x - 2y + 8 = 0$
 $x^2 - 4x = 2y - 8$
 $x^2 - 4x + 4 = 2y - 8 + 4$
 $(x-2)^2 = 2y - 4$
 $(x-2)^2 = 2(y-2)$

i) Vertex (2, 2)

ii) Focus $4a = 2$
 $a = \frac{1}{2}$

iii) $x^2 - 4x + 8 = 2y$
 $y = \frac{1}{2}(x^2 - 4x + 8)$
 $y' = x - 2$
 When $x = 0$
 $m_1 = -2$
 $m_2 = \frac{1}{2}$
 Equation of normal
 $y - 4 = \frac{1}{2}(x - 0)$
 $y = \frac{1}{2}x + 4$

b i) $y = x^2$ $y = 2x^2 - 9$
 $x^2 = 2x^2 - 9$
 $9 = x^2$
 $x = \pm 3$
 $y = 9$ P(3, 9)

ii) $\int_0^3 x^2 - (2x^2 - 9) dx$
 $\int_0^3 -x^2 + 9 dx = \left[-\frac{x^3}{3} + 9x \right]_0^3$
 $= -9 + 27$
 $= 18 \text{ units}^2$

c) $\sum_{k=4}^{20} 2k - 5$
 $3, 5, 7, \dots, 35$
 $S_n = \frac{n}{2}(a + l)$
 $= \frac{17}{2}(3 + 35)$
 $= 323$

Question 7

$$a) \frac{(1 + \tan^2 \theta) \cot \theta}{\operatorname{cosec}^2 \theta} = \tan \theta$$

$$\begin{aligned} L.H.S &= \frac{(1 + \tan^2 \theta) \cot \theta}{\operatorname{cosec}^2 \theta} \\ &= \frac{\sec^2 \theta \cdot \cot \theta}{\operatorname{cosec}^2 \theta} \\ &= \frac{1}{\cos^2 \theta} \cdot \frac{\cos \theta}{\sin \theta} \div \frac{1}{\sin \theta} \\ &= \frac{1}{\sin \theta \cos \theta} \times \frac{\sin \theta}{1} \\ &= \frac{\sin \theta}{\cos \theta} \\ &= \tan \theta \\ &= R.H.S \end{aligned}$$

$$\begin{aligned} i) \quad 2 \log_a x - \log_a 4 &= 2 \log_a 8 \\ \log_a x^2 - \log_a 4 &= \log_a 8^2 \\ \log_a \left(\frac{x^2}{4}\right) &= \log_a 64 \end{aligned}$$

$$\begin{aligned} \frac{x^2}{4} &= 64 \\ x^2 &= 256 \\ x &= 16 \end{aligned}$$

$$i) \quad 3x^2 - 2x - 4 = 0$$

$$ii) \quad \alpha + \beta = -\frac{b}{a} = -\frac{(-2)}{3} = \frac{2}{3}$$

$$iii) \quad \alpha \beta = \frac{c}{a} = -\frac{4}{3} = -1\frac{1}{3}$$

$$\begin{aligned} iv) \quad (4 - \alpha)(4 - \beta) &= 16 - 4(\alpha + \beta) + \alpha\beta \\ &= 16 - 4\left(\frac{2}{3}\right) + \left(-\frac{4}{3}\right) \\ &= 12 \end{aligned}$$

$$d) \quad A = \frac{h}{3} [\text{sum of Ends} + 2(\text{odd}) + 4(\text{evens})]$$

$$A = \frac{0.25}{3} [(1 + 0.45) + 2(0.65 + 0.5) + (0.8 + 0.55 + 0.48)]$$

$$A = 0.923 \quad (3 \text{ s.f.})$$

Question 8

$$\begin{aligned} ai) \quad &= 200^2 + 105^2 - 2 \times 200 \times 105 \times \cos 150^\circ \\ &= 87398 \\ &= \sqrt{87398} \\ &= 295.63 \end{aligned}$$

Distance from tee to pin 295.63m

$$\begin{aligned} aiv) \quad FH^2 &= 200^2 + 205^2 - 2 \times 200 \times 205 \cos 13^\circ \\ &= 2126.65 \\ &= \sqrt{2126.65} \\ &= 46.12 \end{aligned}$$

Using Pythagoras' Theorem

$$205^2 = 200^2 + 46.12^2$$

$$42025 = 42127$$

OR

$$\cos \theta = \frac{200^2 + 46.12^2 - 205^2}{2 \times 200 \times 46.12}$$

$$\cos \theta = 0.005532003$$

$$\theta = 89^\circ 41'$$

$$bi) \quad \text{In } \triangle APQ \text{ \& } \triangle ABC$$

$\angle A$ is common

$\angle AQP = \angle ACB$ (corresponding \angle s are equal in parallel lines)

$\angle APQ = \angle ABC$ " "

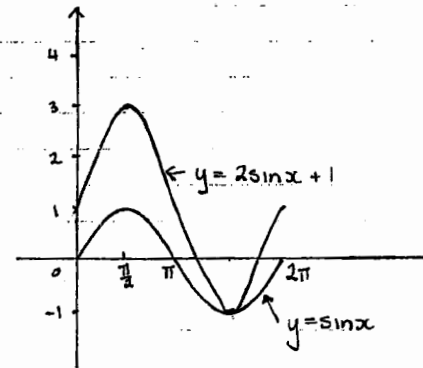
$\therefore \triangle APQ \parallel \triangle ABC$ (equiangular)

$$bii) \quad \frac{AP}{AB} = \frac{1}{2} \quad (P \text{ is midpoint of } AB)$$

$\frac{AP}{AB} = \frac{AQ}{AC}$ (side of similar Δ are in the same ratio)

$$\frac{AQ}{AC} = \frac{1}{2}$$

$\therefore Q$ is midpoint of AC



Question 9

$$ai) \quad v = \pi \int_0^h x^2 dy$$

$$= \pi \int_0^h 4y^{\frac{1}{2}} dy$$

$$= 4\pi \cdot \frac{2}{3} \left[y^{\frac{3}{2}} \right]_0^h$$

$$= \frac{8\pi}{3} \times h^{\frac{3}{2}}$$

$$= \frac{8\pi h}{3} \times \frac{1}{2}$$

$$\begin{aligned} 16y &= x^4 \\ 4y^{\frac{1}{2}} &= x^2 \end{aligned}$$

$$aii) \quad 120 = \frac{8\pi h}{3} \times \frac{1}{2}$$

$$360 = 8\pi h \times \frac{1}{2}$$

$$\frac{360}{8\pi} = h^{\frac{3}{2}}$$

$$h = \sqrt[3]{\left(\frac{360}{8\pi}\right)^2}$$

$$h = 5.9 \text{ cm}$$

$$b) \quad \int_0^{\pi/6} x^2 + \sin 2x \, dx$$

$$= \left[\frac{x^3}{3} - \frac{1}{2} \cos 2x \right]_0^{\pi/6}$$

$$= \left[\left(\frac{\pi}{6}\right)^3 - \frac{1}{2} \cos \left(\frac{2\pi}{6}\right) \right] - \left[0 - \frac{1}{2} \cos 0 \right]$$

$$= \frac{\pi^3}{648} - \frac{1}{4} + \frac{1}{2}$$

$$= 0.298$$

$$c) \quad 2\sin^2 x - 3\sin x - 2 = 0$$

Let $m = \sin x$

$$2m^2 - 3m - 2 = 0$$

$$(2m+1)(m-2) = 0$$

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

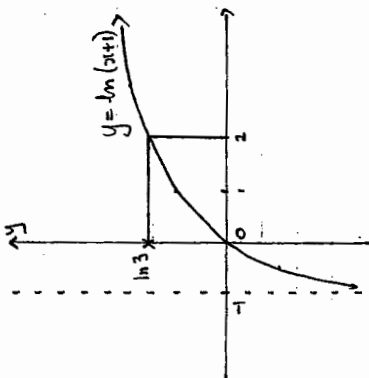
$$m = 2$$

$$\sin x = -\frac{1}{2}$$

$$\sin x = 2$$

$$x = \frac{7\pi}{6}, \frac{11\pi}{6}$$

No Solution



dii) $e^y = x+1$
 $e^y - 1 = x$

$$\begin{aligned} \text{Area} &= (2 \times \ln 3) - \int_0^{\ln 3} e^y - 1 \, dy \\ &= 2 \ln 3 - [e^y - y]_0^{\ln 3} \\ &= 2 \ln 3 - (e^{\ln 3} - \ln 3) - (e^0 - 0) \\ &= 2 \ln 3 - 3 + \ln 3 + 1 \\ &= 3 \ln 3 - 2 \end{aligned}$$

Question 10.

ai) $n = 30 \times 12 = 360^\circ$
 $r = 6.6\% \div 12 = 0.0055$
 $a = 250 \times 1.0055$
 $= \frac{250 \times 1.0055 \times (1.0055^{360} - 1)}{0.0055}$
 $= \$283\,530.74$

ii) $P = 283\,530.74 + 30\,000 = \$313\,530.74$
 $r = 1.0055$

$n = 120$
 $= 313\,530.74 \times 1.0055^{120}$
 $= \$605\,520.87$

bi) $375 = 2r + L$
 $L = 375 - 2r$
 $r \theta = 375 - 2r$
 $\theta = \frac{375 - 2r}{r}$

$\text{Area} = \frac{1}{2} r^2 \theta$
 $= \frac{1}{2} r^2 \left(\frac{375 - 2r}{r} \right)$
 $= \frac{r(375 - 2r)}{2}$

ii) $A = \frac{375r - r^2}{2}$
 $A' = \frac{375}{2} - 2r$
 $A'' = -2$

Stat points $A' = 0$
 $\frac{375}{2} - 2r = 0$
 $\frac{375}{2} = 2r$
 $375 = 4r$
 $r = 93.75$
 $\theta = 2$
 $A = 8789.06$

iii) $8789.06 = \frac{1}{2} (93.75)^2 \theta$
 $\theta = 2$
 $\theta = 114^\circ 35' 04'' \approx 115^\circ$

2 radians is required to produce the maximum area
 $110^\circ = \frac{11\pi}{8}$ $A = \frac{1}{2} \times (93.75)^2 \times \frac{11\pi}{8}$
 $= 8436.89$
 110° does not produce maximum area of 8789.0625 m^2