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) $\left(3x^2+7\right)^6$ **2**

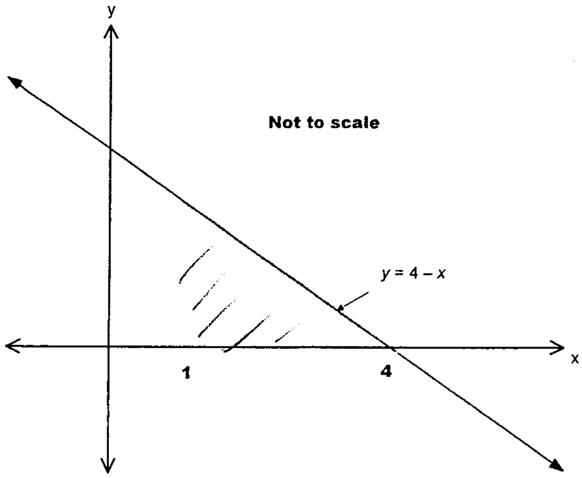
ii) $\dfrac{\sin 2x}{e^{2x}}$ **2**

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

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

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

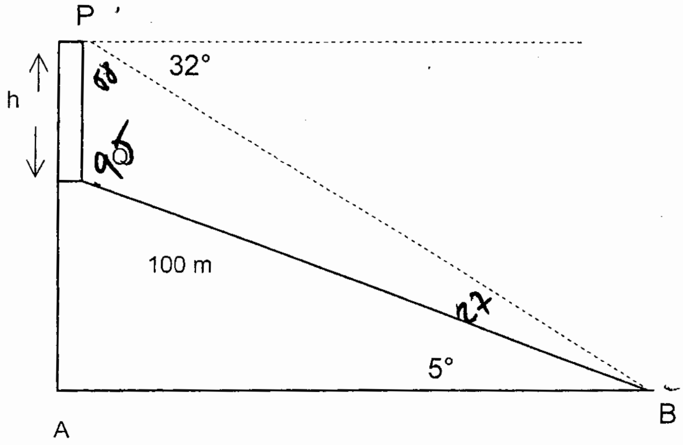
Calculate the volume of the solid formed when the area bounded by the function, x axis and $x = 1$ is rotated around the x axis.



(d) Evaluate $\displaystyle\lim_{x\to 0}\frac{\sin 3x}{2x}$ **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 is100 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**

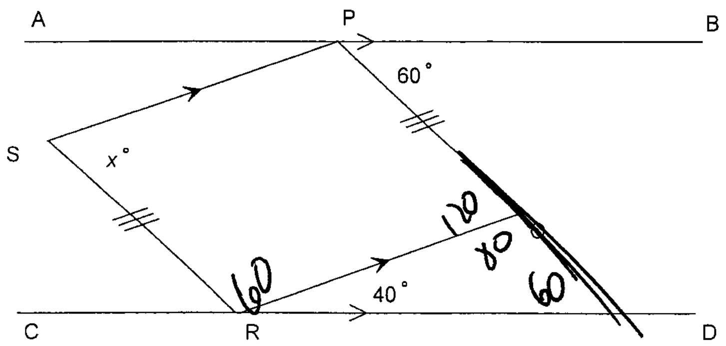
(b) For the arithmetic sequence 2, 7, 12, 17, ...

(i) Find a value of the nth Term **1**

(ii) Find the 23^{rd} term **1**

(iii) Find the sum of the first 47 terms **1**

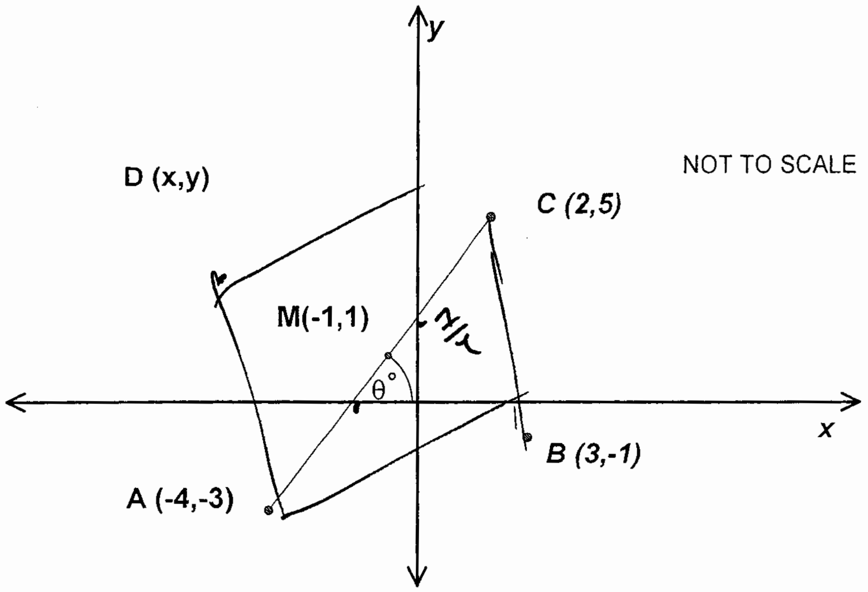
(c) In the diagram, AB || CD and PQRS is a parallelogram. **3**



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**

Question 4 **(12 Marks)** Use a Separate Sheet of paper **Marks**



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

a) Find the coordinates of D such that M is the midpoint of BD **2**

b) Using the facts already known, explain the why ABCD is a parallelogram. **1**

c) Find the size of θ to the nearest degree. **2**

d) Show that the equation of AC is $4x - 3y + 7 = 0$ **2**

e) Find the perpendicular distance between B and the line AC **3**

f) **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 $-2 \le x \le 2$ **2**

Question 6 **(12 Marks)** Use a Separate Sheet of paper **Marks**

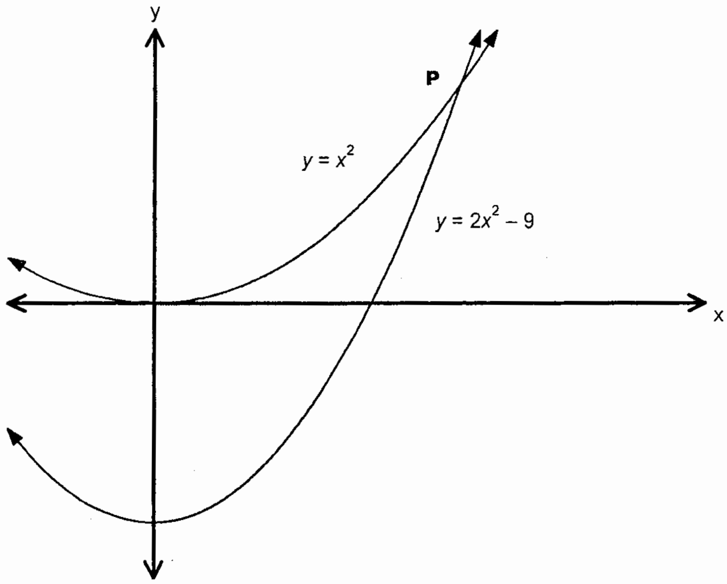
(a) The equation of a parabola is given by $x^2 - 4x - 2y + 8 = 0$. Find the:

(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 $\dfrac{(1+\tan^2\theta)\cot\theta}{\cos ec^2\theta} = \tan\theta$ **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**

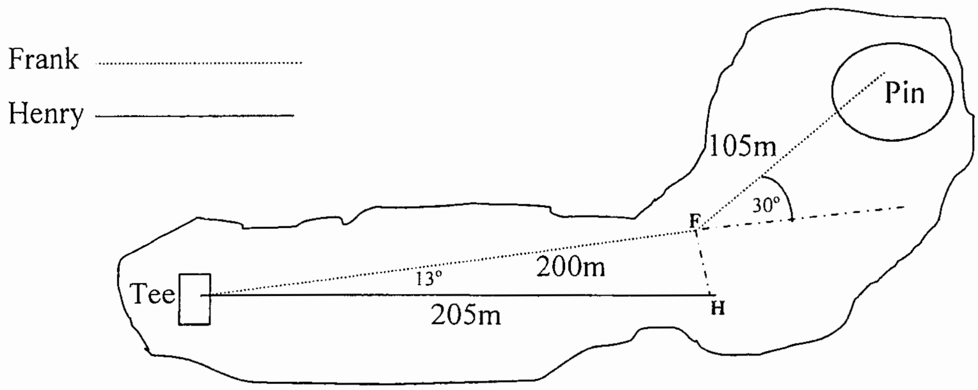
x	3	3.25	3.5	3.75	4	4.25	4.5
$f(x)$	1.0	0.8	0.65	0.55	0.5	0.48	0.45

Question 8 **(12 Marks)** Use a Separate Sheet of paper **Marks**

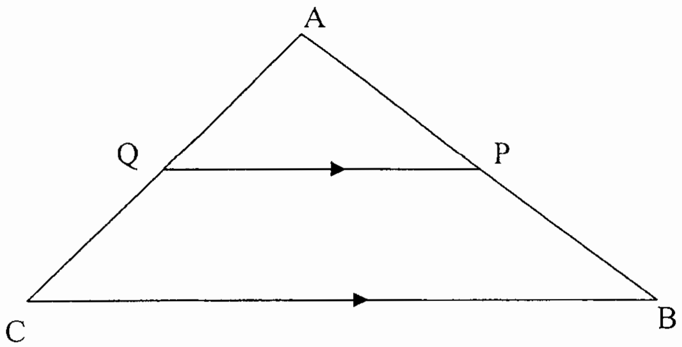
(a) The 18th hole at Royal Maples is a dogleg to the left. Frank hits a 200m drive then turns left 30° and hits a 105m shot to the pin.

(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 ΔABC. PQ is drawn parallel to BC.



(i) Prove that $\Delta ABC \,|||\, \Delta APQ$. **2**

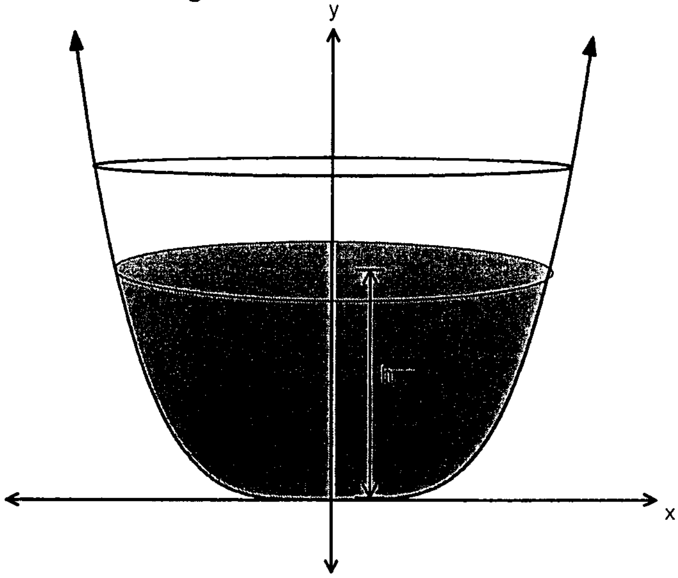
(ii) Explain why Q is the midpoint of AC. **2**

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

$0 \le x \le 2\pi$

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 $1\text{cm} = 1\text{unit}$.



(i) If the depth of the wine is h cm, show that the volume of wine is $\frac{8\pi h^2}{3}$ 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 $0 \le x \le 2\pi$ **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**

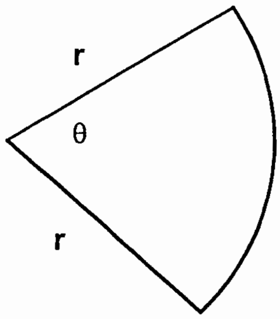
Question 10 (12 Marks) Use a Separate Sheet of paper **Marks**

(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 30^{th} 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 : $\ln x = \log_e x, \quad x > 0$

Sydney Technical High School
Trial 2011
Mathematics

Question 1

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

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

) $\frac{3\pi}{8} = 67° 30'$

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

$a = 8 \quad b = 4$

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

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

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

Question 2

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

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

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

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

b i) $\int \frac{dx}{3x+5} = \frac{1}{3}\int \frac{3}{3x+6}\,dx$
$= \frac{1}{3}\ln(3x+5) + c$

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

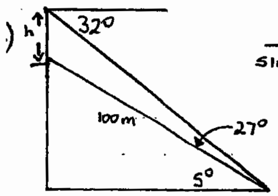
$y = 4-x$
$y^2 = (4-x)^2$

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

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

Question 3

a)



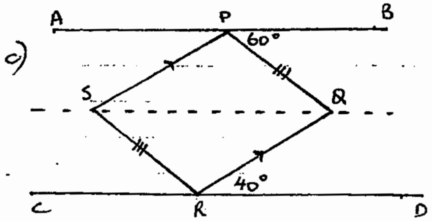
$\frac{h}{\sin 27°} = \frac{100}{\sin 58°}$
$h = \frac{100 \sin 27°}{\sin 58°}$
$h = 54 \text{ m}$

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

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

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

c)



Construct a line through SQ, ∥ to AB and CD
∠SQR = ∠QRD = 40°
(alternate ∠'s are equal in parallel lines SQ∥)
∠SQP = ∠BPQ = 60°
(alternate ∠'s are equal in parallel lines SQ∥)
∴ ∠PQR = 100°
∴ x = ∠PSR = 100°
(opposite ∠'s of a parallelogram PQRS are equal)

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

Question 4 Maria

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 $MC = \frac{5-1}{2+1} = \frac{4}{3}$

$\tan\theta = \frac{4}{3}$

$\theta = 53°$ 2

d) $y-5 = \frac{4}{3}(x-2)$

$3y - 15 = 4x - 8$

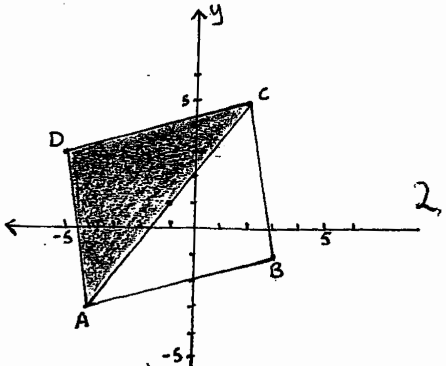
$4x - 3y + 7 = 0$ 2

e) perpendicular distance

$= \frac{|Ax+By+C|}{\sqrt{A^2+B^2}}$

$= \frac{|4\times3 - 3\times-1 + 7|}{\sqrt{4^2+3^2}}$ $\frac{|22|}{\sqrt{25}}$ 3

$= 4.4$



2

$4x - 3y + 7 \leq 0$ test $(0,0)$

$7 \leq 0$

False

Question 5

ai) $x^2 - (2-K)x + 2.25 = 0$

$\Delta = 0$ $\Delta = (2-K)^2 - 4\times2.25\times1$

$0 = (2-K)^2 - 9$

$9 = (2-K)^2$

$\pm3 = 2-K$

$K = -1$ or $K = 5$

aii) If $Kx+1 = x^2 + 2x + 3.25$

$Kx = x^2 + 2x + 2.25$

$0 = x^2 + (2x - kx) + 2.25$

$0 = x^2 + (2-k)x + 2.25$

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 $x = 1$ $y = 4\frac{2}{3}$

$x = -1$ $y = -\frac{2}{3}$

biii) $y'' = 12x^2 - 8x - 4$

Point of inflexion occurs when $y'' = 0$

$12x^2 - 8x - 4 = 0$

$3x^2 - 2x - 1 = 0$

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

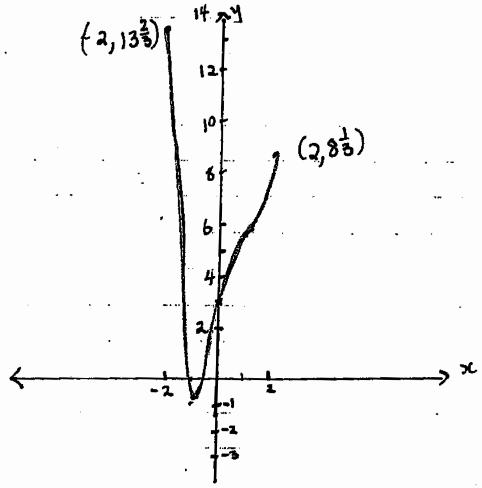
$x = -\frac{1}{3}$ $x = 1$

iv) $(1, 4\frac{2}{3})$ 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) $y = x^2$ $y = 2x^2 - 9$

$x^2 = 2x^2 - 9$

$9 = x^2$

$x = \pm3$

$y = 9$ $P(3,9)$

ii) $\int_0^3 x^2 - (2x^2 - 9)\,dx$

$\int_0^3 -x^2 + 9\,dx = \left[-\frac{x^3}{3} + 9x\right]_0^3$

$= -9 + 27$

$= 18$ units^2

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

$3, 5, 7, \ldots, 35$

$S_n = \frac{n}{2}(a + l)$

$= \frac{17}{2}(3 + 35)$

$= 323$

Question 7

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

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

) $2\log_a x - \log_a 4 = 2\log_a 8$

$\log_a x^2 - \log_a 4 = \log_a 8^2$

$\log_a\left(\frac{x^2}{4}\right) = \log_a 64$

$\frac{x^2}{4} = 64$

$x^2 = 256$

$x = 16$

) $3x^2 - 2x - 4 = 0$

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

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

iii) $(4-\alpha)(4-\beta) = 16 - 4(\alpha+\beta) + \alpha\beta$

$= 16 - 4\left(\frac{2}{3}\right) + -\frac{4}{3}$

$= 12$

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

$A = \frac{0.25}{3}\left[(1+0.45) + 2(0.65+0.5) + 4(0.8+0.55+0.48)\right]$

$A = 0.923$ (3 s f)

Question 8

ai) $= 200^2 + 105^2 - 2\times200\times105\times\cos 150°$

$= 87398$

$= \sqrt{87398}$

$= 295.63$

Distance from tee to pin 295.63m

aii) $FH^2 = 200^2 + 205^2 - 2\times200\times205\ \cos 13°$

$= 2126.65$

$= \sqrt{2126.65}$

$= 46.12$

Using Pythagoras' Theorem

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

$42025 \neq 42127$

OR

$\cos\theta = \frac{200^2 + 46.12^2 - 205^2}{2\times200\times46.12}$

$\cos\theta = 0.0055\,32003$

$\theta = 89°41'$

bi) In ΔAPQ & ΔABC

$\angle A$ is common

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

$\angle APQ = \angle ABC$ " "

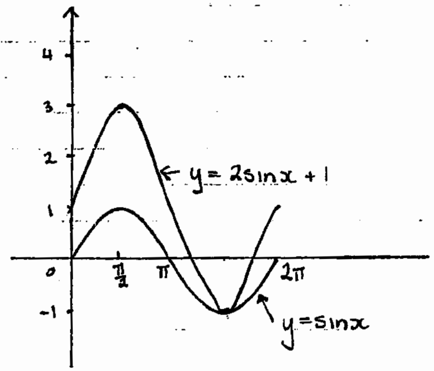
$\therefore \Delta APQ \,|||\, \Delta ABC$ (equiangular)

bii) $\frac{AP}{AB} = \frac{1}{2}$ (P 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) $V = \pi\int_0^h x^2\,dy$ $\quad 16y = x^4$, $\quad 4y^{\frac{1}{2}} = x^2$

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

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

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

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

$4y^{3/2}$ $x^{2/3}$ $= 8y^{3/2}$

/2.

aii) $120 = \frac{8\pi h^{3/2}}{3}$

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

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

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

$h = 5.9$ cm

/2

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

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

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

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

$= 0.298$

1/2

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

let $m = \sin x$

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

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

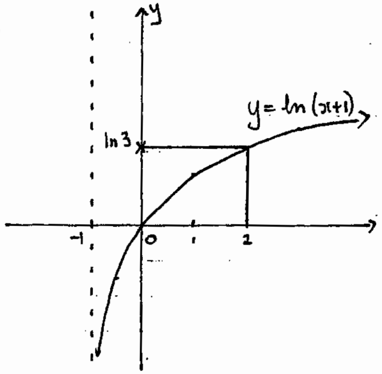
$m = -\frac{1}{2}$ $\quad m = 2$

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

$x = \frac{7\pi}{6}, \frac{11\pi}{6}$ $\quad$ No Solution

/2

9 d i)



1

d ii) $e^y = x+1$

$e^y - 1 = x$

$\text{Area} = (2 \times \ln 3) - \int_0^{\ln 3} e^y - 1 \, dy$

$= 2\ln 3 - \left[e^y - y\right]_0^{\ln 3}$

$= 2\ln 3 - \left[(e^{\ln 3} - \ln 3) - (e^0 - 0)\right]$ 1

$= 2\ln 3 - 3 + \ln 3 + 1$

$= 3\ln 3 - 2$ /3

Question 10.

a i) $n = 30 \times 12 = 360$

$r = 6.6\% \div 12 = 0.0055$

$a = 250 \times 1.0055$

$= \dfrac{250 \times 1.0055 \times (1.0055^{360} - 1)}{0.0055}$

$= \$283\ 530.74$

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

$r = 1.0055$

$n = 120$

$= 313\ 530.74 \times 1.0055^{120}$

$= \$605\ 520.87$

b i) $375 = 2r + l$

$l = 375 - 2r$

$r\theta = 375 - 2r$

$\theta = \dfrac{375 - 2r}{r}$

$\text{Area} = \frac{1}{2} r^2 \theta$

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

$= \dfrac{r(375 - 2r)}{2}$

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

$A' = \dfrac{375}{2} - 2r$

$A'' = -2$

Stat points $A' = 0$

$\dfrac{375}{2} - 2r = 0$

$\dfrac{375}{2} = 2r$

$375 = 4r$

$r = 93.75$

$\theta = 2$

$A = 8789.06$

iii) $8789.06 = \frac{1}{2}(93.75)^2 \theta$

$\theta = 2$

$\theta = 114°35'$ or $115°$

2 radians is required to produce the maximum area

$110° = \dfrac{11\pi}{8}$

$A = \frac{1}{2} \times (93.75)^2 \times \dfrac{11\pi}{18}$

$= 8436.89$

110° does not produce maximum area of 8789.0625 m²