SYDNEY BOYS HIGH
MOORE PARK, SURRY HILLS

JULY 2009
TASK #3
YEAR 12

Mathematics

General Instructions:

- Reading time—5 minutes.
- Working time—2 hours.
- Write using black or blue pen.
- Board approved calculators may be used.
- All necessary working should be shown in every question if full marks are to be awarded.
- Marks may NOT be awarded for messy or badly arranged work.
- Answer in simplest exact form unless otherwise stated.

Total marks—89 Marks

- Attempt questions 1–6.
- The mark-value of each question is boxed in the right margin.
- Start each NEW section in a separate answer booklet.
- Hand in your answer booklets in 3 sections:
  Section A(Questions 1 and 2),
  Section B(Questions 3 and 4),
  Section C(Questions 5 and 6),

Examiner: Mr P. Bigelow

This is an assessment task only and does not necessarily reflect the content or format of the Higher School Certificate.

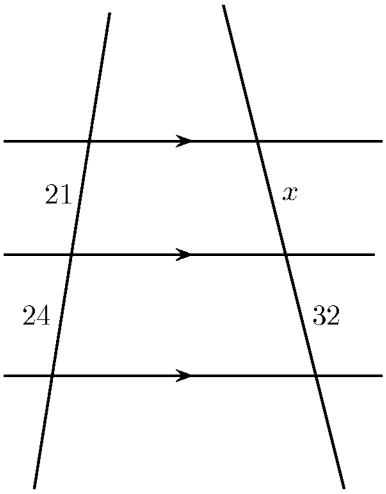
Section A

Marks

Question 1 (15 marks)

(a) Find a primitive of $1 - 2x$. $\boxed{1}$

(b) $\boxed{2}$



Find the value of x, stating reasons.

(c) Differentiate $\boxed{4}$

(i) $\cos 4x$,

(ii) $\ln(4x + 5)$,

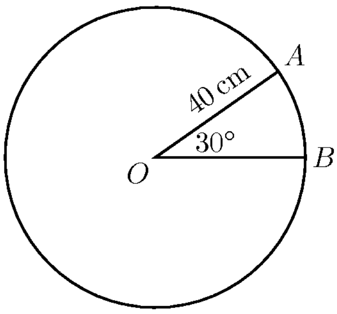
(iii) $\dfrac{\sin x}{x}$,

(iv) $\sqrt{e^x}$.

(d) Find x, correct to three significant figures, if $e^x = 4$. $\boxed{1}$

(e) Write down the exact value of $2 \cos {}^{\pi}\!/_{4}$. $\boxed{1}$

(f) $\boxed{2}$



O is the centre of the circle with radius 40 cm. Find the length of the minor arc AB which subtends $30°$ at O.

(g) Sketch $y = 3 \cos 2x$ for $0 \leqslant x \leqslant 2\pi$. $\boxed{2}$

(h) Find correct to two decimal places $\boxed{2}$

(i) $\log_e \dfrac{11}{4}$,

(ii) $\tan 4^c$.

Marks

Question 2 (14 marks)

(a) Evaluate

(i) $\displaystyle\int_0^{16} \sqrt{x}\,dx$, $\boxed{1}$

(ii) $\displaystyle\int_0^{9} e^{\frac{x}{3}}\,dx$, $\boxed{1}$

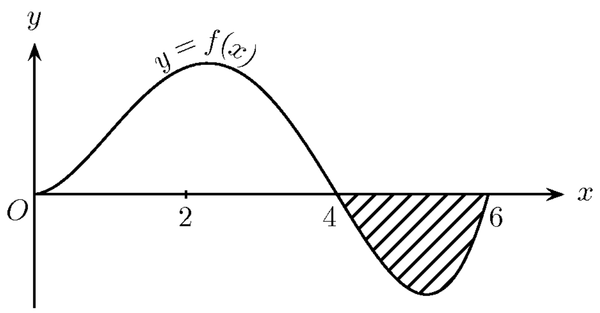
(iii) $\displaystyle\int_{\frac{1}{6}}^{\frac{1}{2}} \cos \pi x\,dx$. $\boxed{2}$

(b) The gradient of any point on the curve $y = f(x)$ is given by $f'(x) = 2x - 5$. Given that the point $(2, -3)$ lies on the curve, find its equation. $\boxed{2}$

(c) Find the equation of the normal to $y = \ln x$ at the point $(1, 0)$. $\boxed{2}$

(d) If $f(x) = \dfrac{3}{1+3x}$, find $\displaystyle\int_0^1 f(x)\,dx$. $\boxed{2}$

(e)



Given that

$$\int_0^4 f(x)\,dx = 15,$$

and that

$$\int_0^6 f(x)\,dx = 9;$$

(i) what is the area of the shaded region, $\boxed{1}$

(ii) and what is the value of $\displaystyle\int_4^6 f(x)\,dx$? $\boxed{1}$

(f) A doctor reports that: $\boxed{2}$

"Although the patient's blood-pressure is rising,
attempts to bring it back to normal are taking effect."

If the patient's blood-pressure is given by B,
what can be said about $\dfrac{dB}{dt}$ and $\dfrac{d^2B}{dt^2}$?

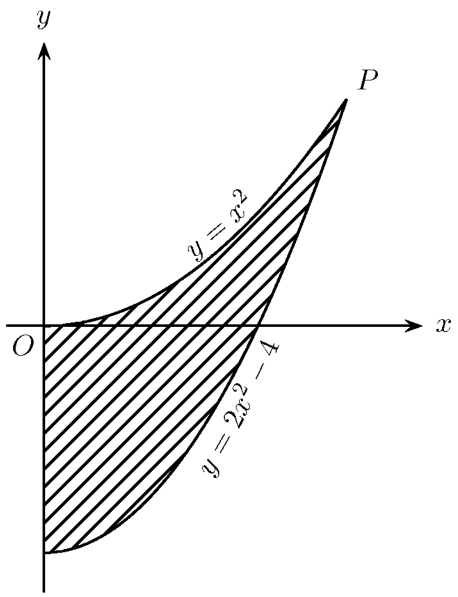
Section B

(Use a separate writing booklet.)

Marks

Question 3 (15 marks)

(a)



P is the point of intersection of $y = x^2$ and $y = 2x^2 - 4$.

(i) Find the coördinates of P. **1**

(ii) Find the area of the shaded region. **2**

(b) Find $\displaystyle\lim_{x \to 0} \frac{\sin 2x}{3x}$. **1**

(c) Find the slope of the tangent to $y = 4\tan 2x$ at the point where $x = {}^{\pi}/_{6}$. **2**

(d) If $y = e^{2x} - 3$, prove that $\dfrac{dy}{dx} - 2y - 6 = 0$. **2**

(e) $A(2,\ 3)$ $B(4,\ -1)$ and $C(-4,\ -5)$ are the vertices of a triangle.

(i) Find D and E, the midpoints of AB and AC respectively. **2**

(ii) Show that DE is parallel to BC. **2**

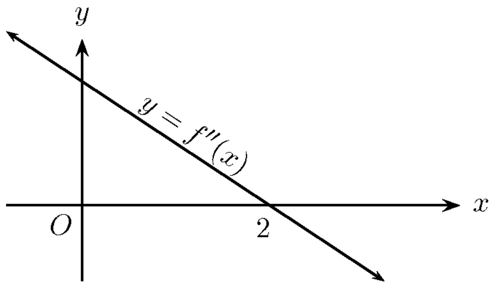
(iii) Find the lengths of DE and BC and hence show that $DE = {}^{1}/_{2}BC$. **3**

Marks

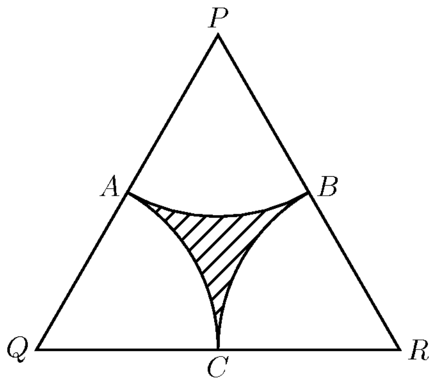
Question 4 (15 marks)

(a) For what values of x is $f(x) = x^3 - 3x^2 - 9x + 2$ an increasing function? $\boxed{2}$

(b) The curve $f(x) = ax^3 - 9x + b$ has a turning point at $(1, 7)$. Find a and b. $\boxed{3}$

(c) 

The diagram shows the graph of $y = f''(x)$. Given that $f(2) = 0$ and $f'(1) = 0$, draw a possible sketch of $y = f(x)$. $\boxed{2}$

(d) 

PQR is an equilateral triangle with sides 8 cm. A, B and C are the mid-points of its sides. AB, AC and BC are circular arcs, centres P, Q and R. Calculate in cm^2, correct to two decimal places, the shaded region bounded by the arcs. $\boxed{3}$

(e) Find the values of x for which the curve $y = (x+1)(x-2)^2$ is concave down. $\boxed{3}$

(f) Find the volume of the solid of revolution when the area bounded by the curve $y = 2\sec x$ and the x-axis between $x = {}^{\pi}/_{6}$ and $x = {}^{\pi}/_{3}$ is rotated about the x-axis. Answer in simplified exact form. $\boxed{2}$

Section C

(Use a separate writing booklet.)

Marks

Question 5 (15 marks)

(a) If $y = \ln\left(\dfrac{1-x}{1+x}\right)$, show that $\dfrac{dy}{dx} = \dfrac{-2}{1-x^2}$. $\boxed{3}$

Hence evaluate $\displaystyle\int_0^{\frac{1}{2}} \frac{dx}{1-x^2}$.

(b) For the curve $y = x^3 + 6x^2 + 9x + 4$:

(i) Find the coördinates of the stationary points and determine their nature. $\boxed{3}$

(ii) Find the coördinates of any points of inflexion. $\boxed{2}$

(iii) Sketch the curve, showing essential features, including the y-intercept. $\boxed{2}$

(c) Solve $2\cos x = -1$ for $0 \leqslant x \leqslant 2\pi$. $\boxed{2}$

(d) If $f(x) = e^{-x^2}$, find

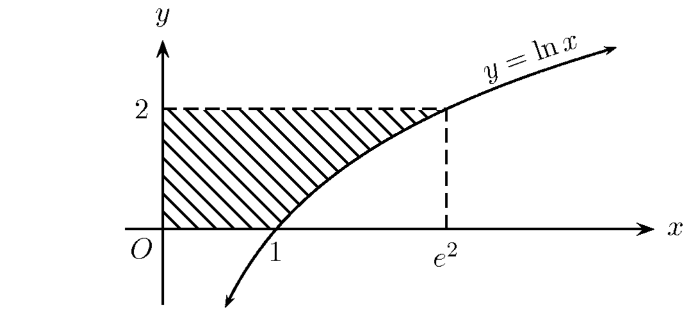
(i) $f'(x)$, $\boxed{1}$

(ii) $f''(x)$. $\boxed{2}$

Marks

Question 6 (15 marks)

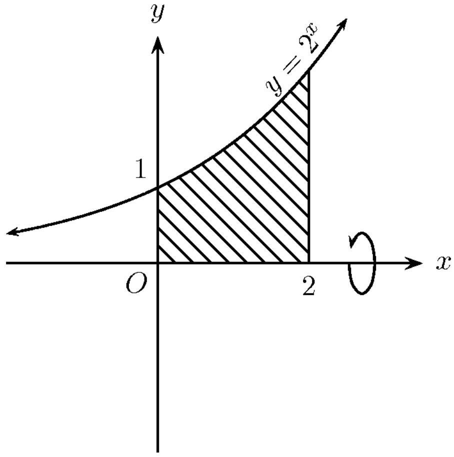
(a)



(i) Find the shaded area. $\boxed{2}$

(ii) Hence or otherwise find $\displaystyle\int_1^{e^2} \ln x\, dx$. $\boxed{2}$

(b)

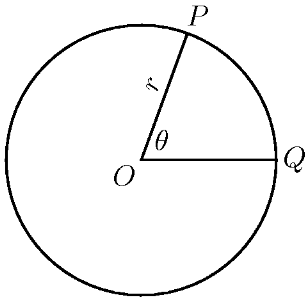


The area under the curve $y = 2^x$, between $x = 0$ and $x = 2$, is rotated about the x-axis.

(i) Show that the volume of the resulting solid is given by $\pi \displaystyle\int_0^2 4^x\, dx$. $\boxed{2}$

(ii) Using Simpson's rule with five function values, find the volume of the solid correct to one decimal place. $\boxed{3}$

(c)



The arc PQ of circle centre O and radius r cm subtends an angle of θ radians at O. The perimeter of the sector POQ is 6 cm.

(i) Show that $r = \dfrac{6}{\theta + 2}$. $\boxed{1}$

(ii) Hence show that the area $A\,\text{cm}^2$ is given by $\dfrac{18\theta}{(\theta+2)^2}$. $\boxed{2}$

(iii) Hence find the maximum area of the sector. $\boxed{3}$

End of Paper

STANDARD INTEGRALS

$$\begin{aligned}
\int x^n dx &= \frac{1}{n+1}x^{n+1}, \quad n \neq -1; \quad x \neq 0, \text{ if } n < 0 \\
\int \frac{1}{x} dx &= \ln x, \quad x > 0 \\
\int e^{ax} dx &= \frac{1}{a}e^{ax}, \quad a \neq 0 \\
\int \cos ax dx &= \frac{1}{a}\sin ax, \quad a \neq 0 \\
\int \sin ax dx &= -\frac{1}{a}\cos ax, \quad a \neq 0 \\
\int \sec^2 ax dx &= \frac{1}{a}\tan ax, \quad a \neq 0 \\
\int \sec ax \tan ax dx &= \frac{1}{a}\sec ax, \quad a \neq 0 \\
\int \frac{1}{a^2+x^2} dx &= \frac{1}{a}\tan^{-1}\frac{x}{a}, \quad a \neq 0 \\
\int \frac{1}{\sqrt{a^2-x^2}} dx &= \sin^{-1}\frac{x}{a}, \quad a > 0, \quad -a < x < a \\
\int \frac{1}{\sqrt{x^2-a^2}} dx &= \ln\left(x + \sqrt{x^2-a^2}\right), \quad x > a > 0 \\
\int \frac{1}{\sqrt{x^2+a^2}} dx &= \ln\left(x + \sqrt{x^2+a^2}\right)
\end{aligned}$$

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

Section A

Question 1

a) $\int 1 - 2x \ dx$

$= x - \frac{2x^2}{2} + c$

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

- c can be any number

b) $\frac{21}{24} = \frac{x}{32}$

When 2 (or more) transversals cut a series of parallel lines, the ratios of their intercepts are equal. (1)

ie $x = \frac{21 \times 32}{24}$

$= 28$ (1)

c) i) $\cos 4x$

$\frac{d}{dx} = -4\sin 4x$ (1)

ii) $\ln(4x+5)$

$\frac{d}{dx} = \frac{4}{4x+5}$ (1)

iii) $\frac{\sin x}{x}$ $\frac{u}{v}$

$u = \sin x \qquad u' = \cos x$

$v = x \qquad v' = 1$

$\frac{d}{dx} = \frac{x\cos x - \sin x}{x^2}$ (1)

iv) $\sqrt{e^x} = (e^x)^{1/2}$

$= e^{x/2}$

$\frac{d}{dx} = \frac{1}{2}e^{x/2}$

$= \frac{\sqrt{e^x}}{2}$ (1)

d) $e^x = 4$

$\ln e^x = \ln 4$

$x \ln e = \ln 4$

$x = \ln 4$

$= 1.386294361$ (1)

$= 1.39$ (3 sig fig)

e) $2\cos \pi/4$

$= 2 \times \frac{1}{\sqrt{2}} = \frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$

$= \frac{2\sqrt{2}}{2} = \sqrt{2}$ (1)

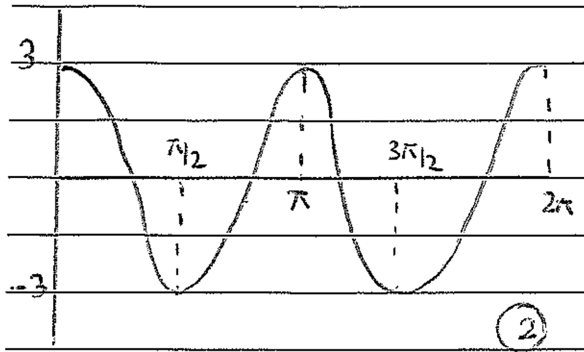
f) $l = r\theta$

$= 40 \times 30 \times \frac{\pi}{180}$ (1)

$= \frac{20\pi}{3}$ (1)

$= 20.94395102$

g) $y = 3\cos 2x$
for $0 \le x \le 2\pi$



2

h) i) $\log_e 11/4$

$= 1.011600912$

$= 1.01$ (2dp) 1

ii) $\tan 4^c$

$= 1.157821282$

$= 1.16$ 1

Question 2

a) i $\int_0^{16} \sqrt{x}\, dx$

$= \int_0^{16} x^{1/2}\, dx$

$= \left[\frac{x^{3/2}}{3/2}\right]_0^{16}$

$= \left[\frac{2}{3}x^{3/2}\right]_0^{16}$

$= \frac{2}{3} \times 16^{3/2} - \frac{2}{3} 0^{3/2}$

$= \cancel{\frac{4096}{3}}$ ~~or 1365⅓~~ 1 $\frac{128}{3}$ $42\frac{2}{3}$

ii) $\int_0^9 e^{x/3}\, dx$

$= \left[\frac{1}{1/3} e^{x/3}\right]_0^9$

$= \left[3e^{9/3}\right] - \left[3e^0\right]$

$= 3e^3 - 3$

$= 3(e^3 - 1)$

$= 57.25661077$

$= 57.26$ (2dp) 1

iii) $\int_{1/6}^{1/2} \cos \pi x\, dx$

$= \left[\frac{1}{\pi}\sin \pi x\right]_{1/6}^{1/2}$

$= \left[\frac{1}{\pi}\sin\frac{\pi}{2}\right] - \left[\frac{1}{\pi}\sin\frac{\pi}{6}\right]$

$= \left[\frac{1}{\pi}\right] - \left[\frac{1}{2\pi}\right]$

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

$= 0.159154943$

$= 0.20$ (2dp)

b) $f'(x) = 2x - 5$
point $(2, -3)$

$\int (2x - 5)\, dx$

$y = \frac{2x^2}{2} - 5x + c$ 1/2

$-3 = \frac{2 \times 4}{2} - 10 + c$

$-3 = 4 - 10 + c$

$-3 = -6 + c$

$c = 3$ (1)

$\therefore \; y = x^2 - 5x + 3$ (1/2)

c) $y = \ln x \quad pt\,(1, 0)$

$y' = \dfrac{1}{x}$ (1/2)

at $x = 1 \quad y' = 1$ (1/2)

grad. of normal $= -1$ (1/2)

$y - 0 = -1(x - 1)$

$y = -x + 1$

(1/2)

$x + y - 1 = 0$.

d) $\displaystyle\int_0^1 \frac{3}{1+3x}$

$= \Big[\ln(1+3x)\Big]_0^1$ (1)

$= \Big[\ln(1+3)\Big] - \Big[\ln(1+0)\Big]$

$= \ln 4 - \ln 1$

$= \ln 4$

$= 1.386294361$ (1)

$= 1.39$ (2 dp)

e) i $\left|\displaystyle\int_6^4 f(x)\right|$

$= |9 - 15| = |-6|$

$= 6$ (1)

ii $\displaystyle\int_4^6 f(x)\,dx = -6$ (1)

f) $\dfrac{dB}{dt} > 0$ (1)

$\dfrac{d^2B}{dt^2} < 0$ (1)

Section B 2 unit Task 3 July 2009 $\frac{}{15}$

3 (a) (i) $y = x^2$ and $y = 2x^2 - 4$

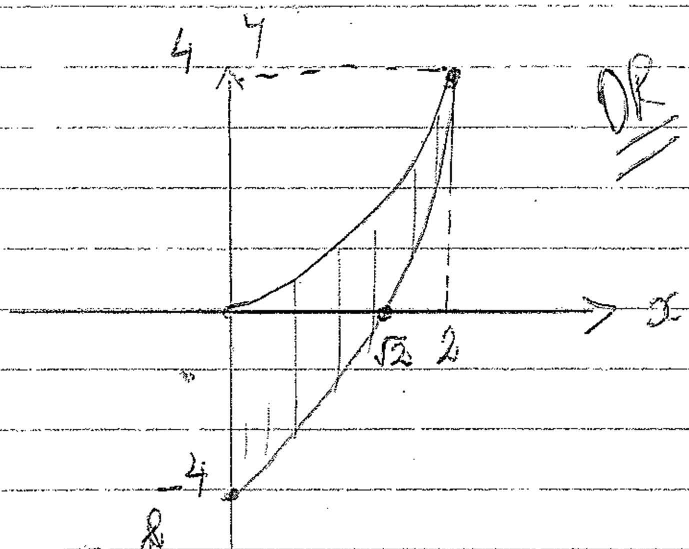
$2x^2 - 4 = x^2$

$x^2 = 4$

$x = \pm 2$

If $x = 2$, $y = 4$ $P(2,4)$ (1)

(ii)



$A = \int (x^2 - 2x^2 + 4)\,dx$

$= \int_0^2 (-x^2 + 4)\,dx$

$= \left[-\frac{x^3}{3} + 4x\right]_0^2$

$= -\frac{8}{3} + 8$

$= \frac{16}{3}\,u^2$

OR area $= \int_0^2 x^2\,dx - \int_{\sqrt{2}}^2 (2x^2 - 4)\,dx + \left|\int_0^{\sqrt{2}} (2x^2 - 4)\,dx\right|$

$= \left.\frac{x^3}{3}\right]_0^2 - \left(\left.\frac{2x^3}{3} - 4x\right]_{\sqrt{2}}^2\right) + \left|\left.\frac{2x^3}{3} - 4x\right]_0^{\sqrt{2}}\right|$

$= \frac{8}{3} - \left[\left(\frac{16}{3} - 8\right) - \left(\frac{4\sqrt{2}}{3} - 4\sqrt{2}\right)\right] + \left|\left(\frac{4\sqrt{2}}{3} - 4\sqrt{2}\right)\right|$

$= \frac{8}{3} - \left[-\frac{8}{3} - -\frac{8\sqrt{2}}{3}\right] + \left|-\frac{8\sqrt{2}}{3}\right|$

$A = \frac{8}{3} + \frac{8}{3} - \frac{8\sqrt{2}}{3} + \frac{8\sqrt{2}}{3} = \frac{16}{3}\,u^2$ (2)

3 (b) $\lim_{x \to 0} \frac{\sin 2x}{3x}$

$\frac{2}{3} \lim_{x \to 0} \frac{\sin 2x}{2x}$

$= \frac{2}{3} \times 1 = \frac{2}{3}$ 1

(c) $y = 4\tan 2x$

$y' = 4 \times \sec^2 2x \times 2$

$= 8\sec^2 2x$

at $x = \frac{\pi}{6}$, $m = 8 \times \sec^2\left(2 \times \frac{\pi}{6}\right)$

$= 8\sec^2\left(\frac{\pi}{3}\right)$

$= 8 \times \frac{1}{\cos^2\left(\frac{\pi}{3}\right)}$

$= 8 \times \frac{1}{\left(\frac{1}{2}\right)^2} = 8 \times \frac{1}{\frac{1}{4}} = 32$ 2

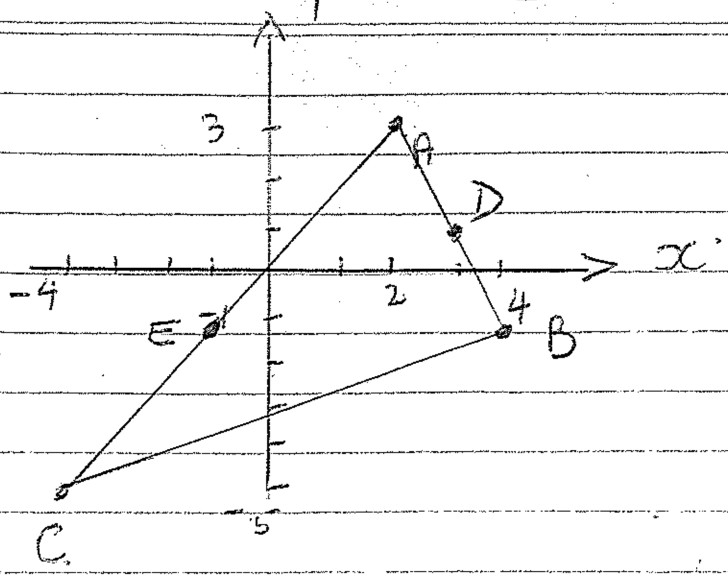
(d) $y = e^{2x} - 3$

$\frac{dy}{dx} = 2e^{2x}$

now $\frac{dy}{dx} - 2y - 6 = 2e^{2x} - 2\left(e^{2x} - 3\right) - 6$

$= \cancel{2e^{2x}} - \cancel{2e^{2x}} + \cancel{6} - \cancel{6} = 0$ 2

(e)



(i) midpt AB $D\left(\frac{2+4}{2}, \frac{3-1}{2}\right) = D(3,1)$ ①

midpt AC $E\left(\frac{2-4}{2}, \frac{3-5}{2}\right) = E(-1,-1)$ ①

(ii) m of DE $\frac{-1-1}{-1-3} = \frac{-2}{-4} = \frac{1}{2}$

m of BC $\frac{-5--1}{-4-4} = \frac{-4}{-8} = \frac{1}{2}$ $DE \parallel BC$ ②

(iii) dist DE $\sqrt{(-1-3)^2+(-1-1)^2} = \sqrt{16+4} = \sqrt{20} = 2\sqrt{5}$

dist BC $\sqrt{(-4-4)^2+(-5--1)^2} = \sqrt{64+16} = \sqrt{80} = 4\sqrt{5}$

so $DE = \frac{1}{2}BC$ $2\sqrt{5} = \frac{1}{2}\times 4\sqrt{5}$

③

4 $\quad$ /15.

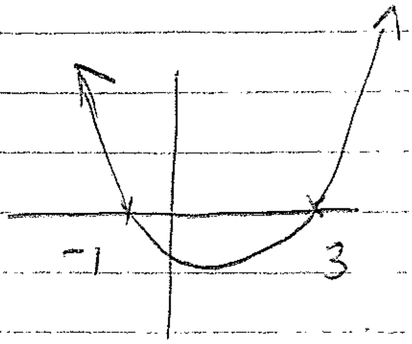
Q4/ (a) $f(x) = x^3 - 3x^2 - 9x + 2$

$f'(x) = 3x^2 - 6x - 9$

let $3x^2 - 6x - 9 > 0$

$3(x^2 - 2x - 3) > 0$

$x^2 - 2x - 3 > 0$



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

So $x < -1$ and $x > 3$. $\quad$ 2

(b) $f(x) = ax^3 - 9x + b$

$f'(x) = 3ax^2 - 9$

when $x = 1$, $f'(x) = 0$. So $3a - 9 = 0$

$3a = 9$

$a = 3$ //

So $f(x) = 3x^3 - 9x + b$

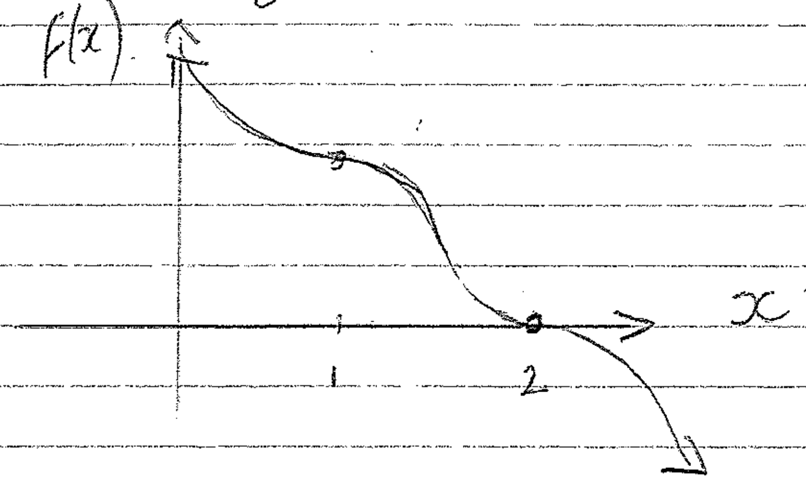
(1, 7) on curve, So $7 = 3 - 9 + b$

$7 = -6 + b$

$b = 13$ // $\quad$ 3

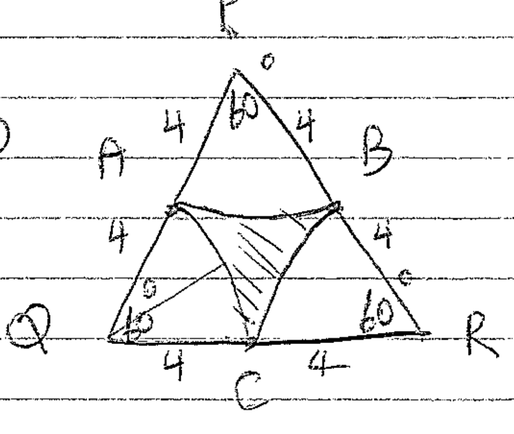
(c) diagram tells us that at $x<2$, curve is concave up. At $x>2$ curve is concave down at $x=2$ point of inflexion

Also $f(2)=0 \Rightarrow (2,0)$ on curve.
$f'(1)=0 \Rightarrow$ tangent is horizontal at $x=1$



(2)

(d)



area $\triangle PQR = \frac{1}{2} \times 8 \times 8 \times \sin 60$

$= 32 \times \frac{\sqrt{3}}{2} = 16\sqrt{3}$

area each sector $A = \frac{1}{2} \times \frac{\pi}{3} \times 4^2 = \frac{8\pi}{3}$

$3 \times$ sectors $= 3 \times \frac{8\pi}{3} = 8\pi$

$\therefore$ shaded area $= (16\sqrt{3} - 8\pi)$ cm^2

$= 2.58$ cm^2 //

(3)

6

(e) $y = (x+1)(x-2)^2$

$= (x+1)(x^2-4x+4)$

$= x^3-4x^2+4x+x^2-4x+4$

$= x^3-3x^2+4$

$y' = 3x^2-6x$

$y'' = 6x-6$

concave down when $y''<0$, $6x-6<0$

$6x<6$

$x<1$ (3)

(f) $V = \pi\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} 4\sec^2 x\, dx$

$= 4\pi\left[\tan x\right]_{\frac{\pi}{6}}^{\pi/3} = 4\pi\left[\tan\frac{\pi}{3}-\tan\frac{\pi}{6}\right]$

$= 4\pi\left[\frac{\sqrt{3}}{1}-\frac{1}{\sqrt{3}}\right]$

$= 4\pi\left[\frac{3-1}{\sqrt{3}}\right]$

$= 4\pi\times\frac{2}{\sqrt{3}}\times\frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{8\pi\sqrt{3}}{3}\ u^3$ (2)

$(14.51\ u^3\ \ 2DP)$

Question 5

(a) $y = \ln\left(\frac{1-x}{1+x}\right)$

ie $y = \ln(1-x) - \ln(1+x)$

$$\frac{dy}{dx} = \frac{-1}{1-x} - \frac{1}{1+x} \quad 1\tfrac{1}{2}$$

$$= \frac{-(1+x)-(1-x)}{1-x^2}$$

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

$$\therefore \int_0^{\frac{1}{2}} \frac{dx}{1-x^2} = -\frac{1}{2}\ln\left[\frac{1-x}{1+x}\right]_0^{\frac{1}{2}}$$

$$= -\frac{1}{2}\left[\ln\left(\tfrac{1}{3}\right) - \ln 1\right] \quad 1\tfrac{1}{2}$$

$$= -\frac{1}{2}\ln\frac{1}{3} \text{ or } \frac{1}{2}\ln 3$$

(b) $y = x^3 + 6x^2 + 9x + 4$

(i) St. pts $y' = 3x^2 + 12x + 9 = 0$

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

at $x = -3$ or $x = -1$ 1

$y'' = 6x + 12$

When $x = -3$, $y'' = -6 < 0 \Rightarrow$ MAX T.P 1 at $(-3, 4)$

When $x = -1$, $y'' = 6 > 0 \Rightarrow$ MIN T.P. 1 at $(-1, 0)$

(ii) $y'' = 6x + 12 = 0$ when $x = -2$

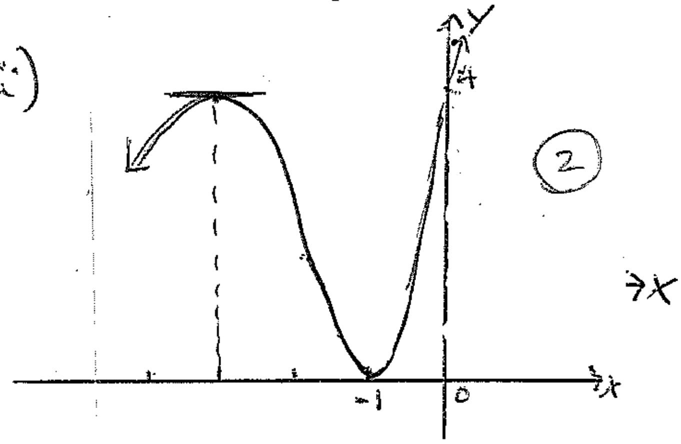
$\therefore$ Possible inflexion

x	$<$	-2	$>$
y''	$+$	0	$-$

2

Change of concavity $\Rightarrow$ P.O.I. at $(-2, 2)$

(iii)



2

(c) $2\cos x = -1 \Rightarrow \cos x = -\frac{1}{2}$

2

(d) $f(x) = e^{-x^2}$

(i) $f'(x) = -2xe^{-x^2}$ 1

(ii) $f''(x) = -2x \cdot e^{-x^2} \cdot -2x + -2e^{-x^2}$

$= 2e^{-x^2}(1 - 2x^2)$

2

$f''(x) = 4x^2e^{-x^2} - 2e^{-x^2}$

Question 6

(a) (i) $\text{Area} = \int_0^2 e^y \, dy$ 2

$= \left[e^y\right]_0^2$

$= (e^2 - 1) \text{ units}^2$ 2

(ii) $\int_1^{e^2} \ln x \, dx = 2e^2 - (e^2 - 1)$

$= e^2 + 1$ 2

(b) (i) $V = \pi \int_0^2 y^2 \, dx = \pi \int_0^2 (2^x)^2 \, dx = \pi \int_0^2 4^x \, dx$ 2

(ii) $\pi \int_0^2 4^x \, dx \doteqdot \pi \left[\frac{1-0}{6}\left(4^0 + 4.4^{0.5} + 4^1\right) + \frac{2-1}{6}\left(4^1 + 4.4^{1.5} + 4^2\right) \right]$ 3

ie $\doteqdot \pi \left[\frac{1}{6}(13) + \frac{1}{6}(52) \right] \doteqdot \frac{65\pi}{6} \doteqdot 34.0$

(c) (i) Perimeter $= r + r + r\theta$

ie $6 = 2r + r\theta \implies 6 = r(2+\theta)$

$\therefore r = \frac{6}{2+\theta}$ 1

(ii) $A = \frac{1}{2} r^2 \theta = \frac{1}{2}\left(\frac{6}{2+\theta}\right)^2 \theta$

$= \frac{1}{2} \cdot \frac{36}{(2+\theta)^2} \cdot \theta$ 2

$= \frac{18\theta}{(\theta+2)^2}$

(iii) $\frac{dA}{d\theta} = \frac{(\theta+2)^2 . 18 - 18\theta . 2(\theta+2)}{(\theta+2)^4} = \frac{18(\theta+2)(2-\theta)}{(\theta+2)^4} = \frac{18(2-\theta)}{(\theta+2)^3}$ 1

Stat. pt when $\theta = 2$ $\frac{1}{2}$

Using 1st derivative to prove max when $\theta = 2$ 1

θ	1.9	2	2.1
$\frac{dA}{d\theta}$	+	0	−

$\therefore A_{max} = \frac{18(2)}{(2+2)^2} = \frac{36}{16} = 2\frac{1}{4} \text{ cm}^2$ $\frac{1}{2}$