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.

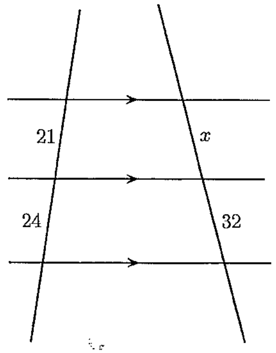
Section A

Marks

Question 1 (15 marks)

(a) Find a primitive of $1-2x$. [1]

(b) [2]



Find the value of x, stating reasons.

(c) Differentiate [4]

(i) $\cos 4x$,

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

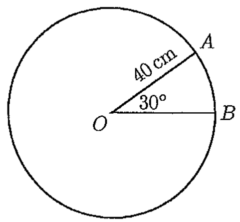
(iii) $\dfrac{\sin x}{x}$,

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

(d) Find x, correct to three significant figures, if $e^x = 4$. [1]

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

(f) [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 $0 \leqslant x \leqslant 2\pi$. [2]

(h) Find correct to two decimal places [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) $\displaystyle\int_0^{9} e^{\frac{x}{3}}\,dx$, $\boxed{1}$

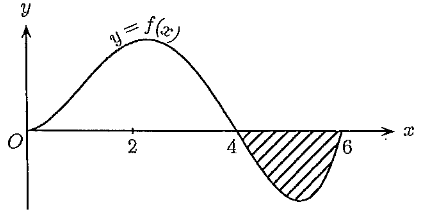
(iii) $\displaystyle\int_{\frac{1}{6}}^{\frac{1}{2}} \cos \pi x\,dx$. $\boxed{2}$

(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 $\dfrac{d^2B}{dt^2}$?

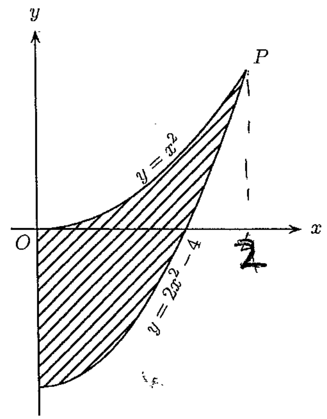
Section B

(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. $\boxed{1}$

(ii) Find the area of the shaded region. $\boxed{2}$

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

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

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

(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. $\boxed{2}$

(ii) Show that DE is parallel to BC. $\boxed{2}$

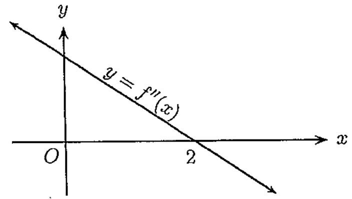
(iii) Find the lengths of DE and BC and hence show that $DE = 1/2 BC$. $\boxed{3}$

Marks

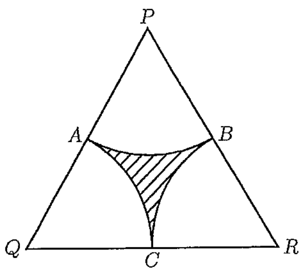
Question 4 (15 marks)

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

-3,4 max

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

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

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

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

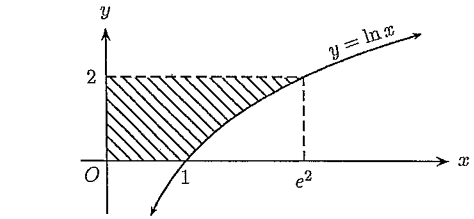
(d) If $f(x) = e^{-x^2}$, find

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

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

Question 6 (15 marks) Marks

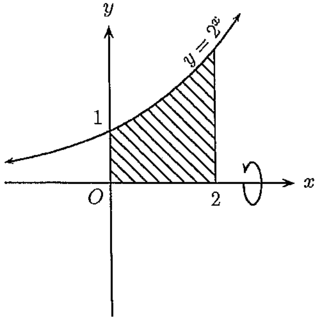
(a)



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

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

(b)

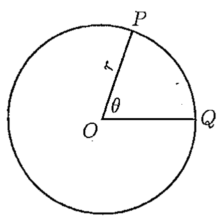


The area under the curve $y = 2^x$, between $x = 0$ and $x = 2$, is rotated about the x-axis.

(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

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

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

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

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

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

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

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

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

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

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

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

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

Q1. a) $\int 1 - 2x \, dx$

$= x - \frac{2x^3}{3} + c$ ✓

$\frac{86}{89} \approx 97\%$

TERRIFIC EFFORT

b) $\frac{21}{24} = \frac{x}{32}$ ✓

$x = 28$

intervals between intercepts of transversals on parallel lines are in equal ratio

Intercept theorem

c) i) $y = \cos 4x$

$y' = -4\sin 4x$ ✓

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

$y' = \frac{4}{4x+5}$ ✓

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

$v = x \quad u = \sin x$

$v' = 1 \quad u' = \cos x$

$y' = \frac{x\cos x - \sin x}{x^2}$ ✓

iv) $y = \cancel{e^{\frac{1}{2}x}} \; (e^x)^{1/2}$

$= e^{1/2 x}$

$y' = \frac{1}{2} e^{\frac{1}{2}x}$ ✓

d) $e^x = 4$

$x = \ln 4$

$x = \cancel{1.386}$

1.39 ✓ (to 3 s.f.)

e) $2\cos\frac{\pi}{4}$

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

f) $AB = 40 \times \frac{\pi}{6}$

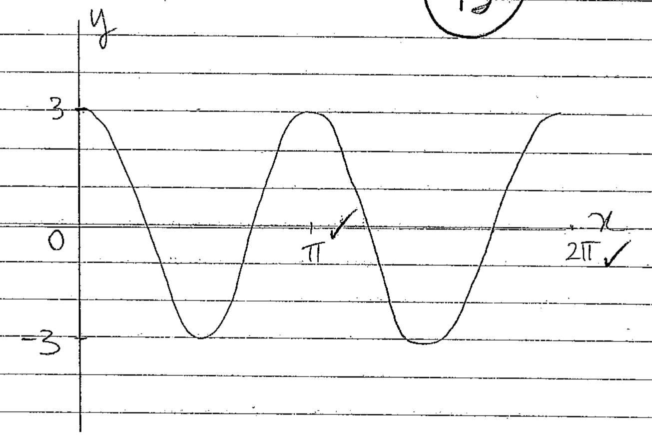
$= \frac{\cancel{40}^{20}\pi}{\cancel{6}_{3}}$ cm $= \frac{20\pi}{3}$ ✗

g) $T = \frac{2\pi}{2}$

$= \pi$

$a = 3$

$\frac{14}{15}$



h) i) 1.01 ✓

ii) 1.16 ✓

Q2. i) $\int_0^{16} x^{1/2} \, dx$

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

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

$= \frac{128}{3}$ ✓

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

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

$= 3e^3 - 3e^0$

$= 3e^3 - 3 \quad = 3(e^3 - 1)$ ✓

2d. $f(x) = \frac{3}{1+3x}$

$\int_0^1 \frac{3}{1+3x}\,dx$

$= \cancel{1/3}\ \cancel{\log} \left[\ln(1+3x)\right]_0^1$ ✓

$= \ln(1+3) - \ln(1)$

$= \ln 4 - \ln 1$

$= \ln 4$ ✓ $= 2\ln 2$

$\frac{14}{14}$

2e. i) $6u^2$ ✓

ii) -6 ✓

2f. $\frac{dB}{dt} > 0$ ✓ increase slope.

$\frac{d^2B}{dt^2} < 0$ ✓ concave down.

Q3. i) $y = x^2$

$y = 2x^2 - 4$

Solve sim., equate

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

$x^2 = 4$

$x = 2$. ✓

$y = 4$

$\therefore P(2, 4)$ ✓

ii)

$A = \int_0^2 x^2 - 2x^2 + 4\,dx$ ✓

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

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

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

$= \frac{1}{\pi}\left(\sin\frac{\pi}{2} - \sin\frac{\pi}{6}\right)$

$= \frac{1}{\pi}\left(1 - \frac{1}{2}\right)$

$= \frac{1}{2\pi}$ ✓

b) $f'(x) = 2x - 5$

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

$= \frac{2x^2}{2} - 5x + C$

$= x^2 - 5x + C$. ✓

sub $(2, -3)$.

where $y = f(x)$.

$-3 = 2^2 - 10 + C$.

$-3 = -6 + C$ ✓

$3 = C$.

$\therefore y = x^2 - 5x + 3$ ✓

c). $y = \ln x$

$y' = \frac{1}{x}$.

$m_{tang} = 1$

$m_{norm} = -1$ ✓

equation norm $y - 0 = -1(x - 1)$ ✓

$y = -x + 1$

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

$$= -\frac{8}{3} + 8 + \cancel{0} - \cancel{0}$$

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

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

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

$$= \frac{2}{3} \checkmark$$

c). $y = 4 + \tan 2x$

$y' = 8 \sec^2 2x \checkmark$

$m = 8 \sec^2 \frac{\pi}{3}$

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

$= 32 \checkmark$ slope of tang. is 32 ✓

$x = \pi/6$

$y = 4 \tan \pi/3$

$= 4\sqrt{3}$

$\therefore$ equ.

$y - 4\sqrt{3} = 32(x - \pi/6)$

$y - 4\sqrt{3} = 32x - \frac{32\pi}{6}$

Not needed!

$32x - y - \frac{32\pi}{6} + 4\sqrt{3} = 0$

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

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

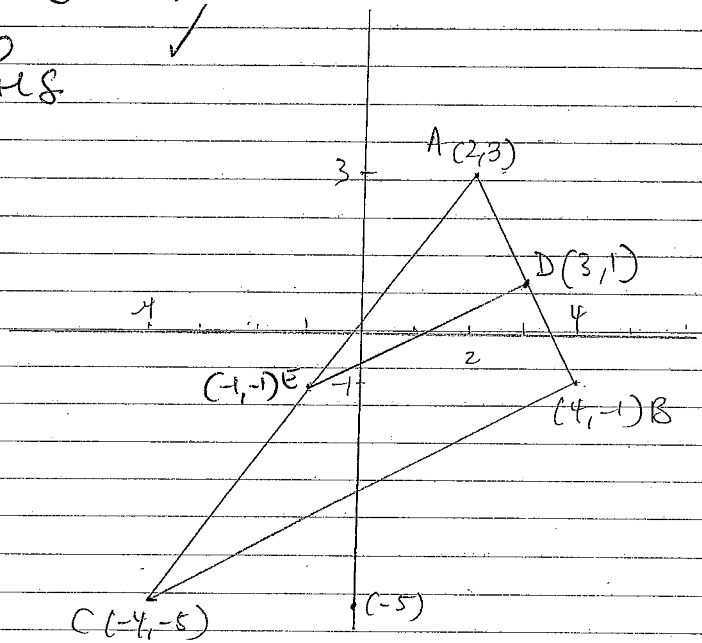
$\frac{15}{15}$

LHS $= 2e^{2x} - 2e^{2x} + 6 - 6$

$= 0 \checkmark$

$=$ RHS

3e.



D $(3, 1) \checkmark$ E $(-1, -1) \checkmark$

ii) intercept theorem

since E and D are both mid pts.

$\frac{CE}{EA} = 1 \checkmark$

$\frac{DB}{AD} = 1 \checkmark$

$\therefore \frac{CE}{EA} = \frac{DB}{AD}$ $\therefore$ intercepts / in equal ratio on ED and CB

$\therefore$ ED ∥ CB

iii) $DE = \sqrt{(4)^2 + (2)^2}$

$= \sqrt{16+4}$ ✓

$= \sqrt{20}$

$= 2\sqrt{5}$

$BC = \sqrt{8^2 + 4^2}$

$= \sqrt{64+16}$

$= \sqrt{80}$ ✓

$= 4\sqrt{5}$

$= 2 \times 2\sqrt{5}$

$= 2 \times DE$ ✓

$BC = 2DE$ ✓

$DE = \frac{1}{2} BC$.

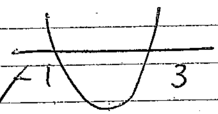
Q4. increasing $f'(x) > 0$

$f'(x) = \cancel{x} \; 3x^2 - 6x - 9$

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

$x^2 - 2x - 3 > 0$ ✓

$(x-3)(x+1) > 0$ ✓



$x < -1, \; x > 3$ ✓

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

turning pt $f'(x) = 0$.

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

solve $3ax^2 - 9 = 0$

$ax^2 - 3 = 0$

$x^2 = 3/a$ ✓

$x = \pm\sqrt{3/a}$

since $x = 1$

and $3/a > 0$

$x \neq -\sqrt{3/a}$

$x = \sqrt{3/a}$

$= 1$ ✓

$\sqrt{3/a} = 1$

$3/a = 1$ ✓

$3 = a$

Sub in to $y = 3\cancel{x}^3 - 9x + b$

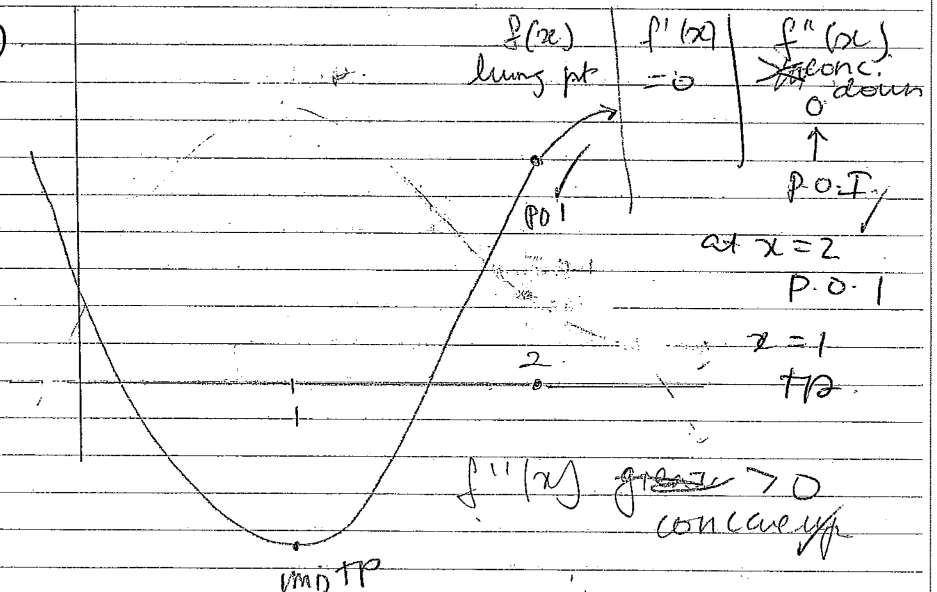
sub $(1, 7)$ to find b ✓

$7 = 3 - 9 + b$

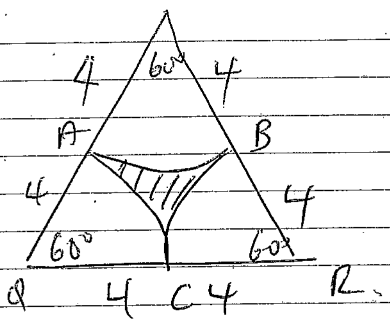
$7 = -6 + b$ ✓

$b = 13$ ✓

4c)



d)



$A(PQR) = \frac{1}{2} 8^2 \sin 60°$

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

$= 16\sqrt{3}\ u^2$

$A \text{ of circles} = \cancel{3}\,\frac{1}{2}\pi r^2$

$= \frac{1}{2}\pi \times 4^2$

$= 8\pi\ u^2$ ✓

$A(\text{shaded}) = 16\sqrt{3} - 8\pi\ u^2$ ✓

$= 2.58\ u^2$ ✓

e) ~~y~~ conc. down. $y'' < 0$.

$y = \cancel{x^4}\,(x+1)(x^2 - 4x + 4)$ ✓

$= x^3 - 4x^2 + \cancel{4x} + x^2 - \cancel{4x} + 4$

$= x^3 - 3x^2 + 4$ ✓

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

$y'' = 6x - 6$ ✓

$= 6(x-1)$ ✓

solve $6(x-1) < 0$

$x < 1$ ✓

$\frac{15}{15}$

f) $V = \pi \int_a^b y^2\,dx$

$= 4\pi \int_{\pi/6}^{\pi/3} \sec^2 x\,dx$ ✓

$\cancel{= 4\pi \left[\frac{1}{\cos\frac{\pi}{3}}\right]} = 4\pi \left[\tan x\right]_{\pi/6}^{\pi/3}$

$= 4\pi\left(\tan\frac{\pi}{3} - \tan\frac{\pi}{6}\right)$

$= 4\pi\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right)$ ✓

Q5 $y = \ln(1-x) - \ln(1+x)$

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

$= \frac{-1-x-1+x}{(1-x)(1+x)}$ ✓

$= \frac{-2}{1-x^2}$ ✓

$\int_0^{1/2} \frac{1}{1-x^2}\,dx$

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

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

$= -\frac{1}{2}\left[\ln\frac{1/2}{3/2} - \ln 1\right]$ ✓

$= -\frac{1}{2}\left[\ln\frac{1}{3}\right]$

$= -\frac{1}{2}(\ln 1 - \ln 3)$

$= -\frac{1}{2}(-\ln 3)$ ✓

$= \frac{\ln 3}{2}$ ✓

5b Stat pts. $y' = 0$.

$y = x^3 + 6x^2 + 9x + 4$

$y' = 3x^2 + 12x + 9$

$y'' = 6x + 12$

$y' = 0$ for stat pts

$x^2 + 4x + 3 = 0$

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

$x = -1, -3$

$y = 0, 4$

$(-1, 0)$ $(-3, 4)$

test nature

$y'' = -6 + 12$
$= 6$

min TP $(-1, 0)$

test nat.

$y'' = -18 + 12$
$= -6$

max TP $(-3, 4)$

(ii) solve $y'' = 0$ for p.o.i.

$6x = -12$

$x = -2$

$y = 2$

$(-2, 2)$

check concavity changes

$y'' = 6x + 12 = 6(x+2)$

x	-3	-2	-1
y''	-6	0	6
concav	$\cap$	$-$	$\cup$

∴ concav. changes

∴ $(-2, 2)$ is p.o.i.

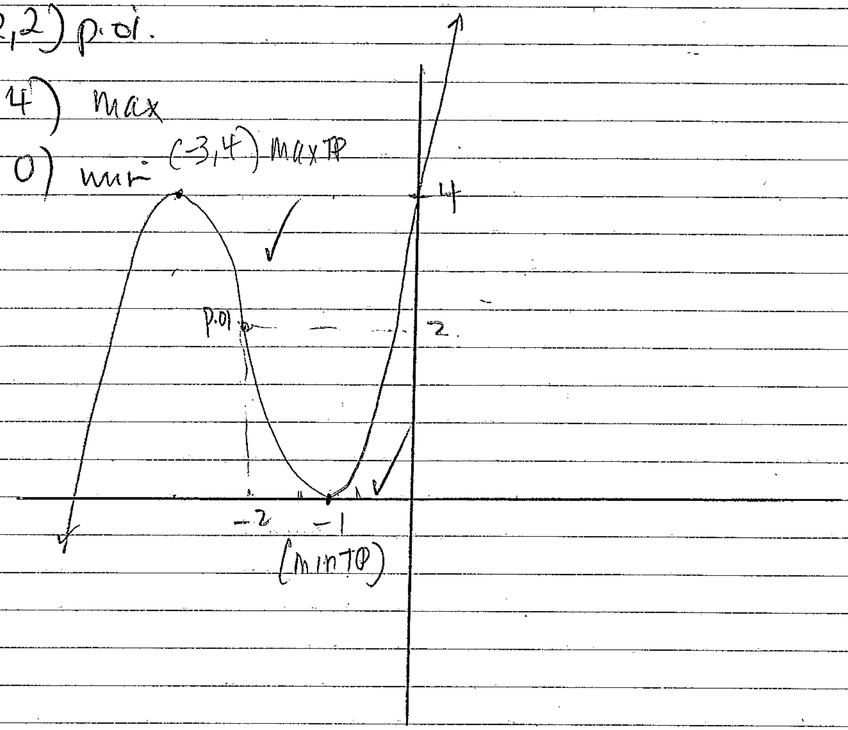
y int $x = 0$. $y = 4$

$(0, 4)$

$(-2, 2)$ p.o.i.

$(-3, 4)$ max

$(-1, 0)$ min



5c) $2\cos x = -1$

$\cos x = -\tfrac{1}{2}$

S	A
T	C

$x = \frac{4\pi}{3}, \frac{2\pi}{3}$

5d). $f(x) = e^{-x^2}$

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

$= -2x e^{-x^2}$ ✓

$f''(x) = vu' + uv'$

$v = e^{-x^2} \quad u = -2x$

$v' = -2xe^{-x^2}$ ✓ $\quad u' = -2$ ✓

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

$= \cancel{-2e}$

$= -2e^{-x^2}(1 - 2x^2)$ ✓

$\frac{15}{15}$

Q6. ~~non shaded $A = \int e^2$~~

ai) $y = \log_e x$

$\log_e x = y$

$x = e^y$ ✓

$A = \int_0^2 e^y \, dx$

$= \left[e^y\right]_0^2$ ✓

$= e^2 - 1 \; u^2$

aii) $\int^{e^2} \ln x \, dx$

$2e^2 - e^2 + 1$

$= e^2 + 1$ ✓

6a 6b

(ii)

i) $V = \pi \int_a^b y^2 \, dx$

$= \pi \int_0^2 4^x \, dx$ ✓

ii) $A = \frac{h}{3}$ (first + last + FOTE)

$y = 2^x$

x	0	0.5	1	1.5	2
y	1	$2^{0.5}$	2	$2^{1.5}$	4
W	1	4	2	4	1

✓

$h = 0.5$

$\frac{h}{3} = \frac{1}{6}$

$A = \frac{1}{6}\left(5 + 4(2^{0.5} + 2^{1.5}) + 4\right)$

$= \frac{1}{6}\left(9 + 4(2^{0.5} + 2^{1.5})\right)$

$= 4.3 \, u^2$ ✓

$V = \pi \int_0^2 4^x \, dx$

$\doteq 4.3\pi = \underline{13.5 \, u^3}$ (to 1dp)

c) let P = 6 cm

i) $P = 2r + r\theta$ ✓

$= r(2 + \theta)$

$6 = r(\theta + 2)$

$r = \frac{6}{\theta + 2}$ ✓

ii) ~~A = ...~~

6 c ii) ~~$A = \frac{\pi r^2}{\theta} = \frac{\pi\left(\frac{6}{\theta+2}\right)^2}{\theta} = \frac{36\pi}{(\theta+2)^2} \times \frac{1}{\theta} = \frac{36\pi}{\theta(\theta+2)^2}$~~

~~$A = \frac{\pi r^2}{\frac{360\,\theta}{2\pi}}$~~

$$A = \frac{\theta}{2\pi} \times \pi r^2$$

$$= \frac{\theta}{\cancel{2}\cancel{\pi}} \times \cancel{\pi}\left(\frac{\cancel{36}^{18}}{(\theta+2)^2}\right)$$

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

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

~~find A' $\quad u = 18\theta \quad v = (\theta+2)^2$~~

~~$u' = 18 \quad v' = 2(\theta+2)$~~

~~$A' = 32\theta(\theta+2) + 18(\theta+2)^2$~~

~~$= 2(\theta+2)(16\theta + 9(\theta+2))$~~

~~so $A' = 0$~~

~~$= 2(\theta+2)(16\theta + 9\theta + 18)$~~

~~$= 2(\theta+2)(25\theta+18)$~~

~~$A' = 0 \quad \theta = -2,\ -\frac{18}{25}$~~

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

$v = (\theta+2)^2 \quad u = 18\theta$

$v' = 2(\theta+2) \quad u' = 18$

$$A' = \frac{18(\theta+2)^2 - 36\theta(\theta+2)}{(\theta+2)^4}$$

$$= \frac{18(\theta+2)(\theta+2-2\theta)}{(\theta+2)^4}$$

$$= \frac{18(2-\theta)}{(\theta+2)^3}$$

Solve $A' = 0$ for stat pt

denominator $\neq 0$

$\theta = 2$.

Test for max.

i.e. $\theta=1 \mid \theta=2 \mid \theta=3$

$$A = \frac{36}{(4)^2}$$

$$= \frac{36}{16}$$

$$= 9/4\ u^2$$

$\frac{13}{15}$