Carlingford High School

Mathematics Extension 1

Year 12 Half Yearly Assessment Task

2014

Time allowed: 2 hours

Name: .... Class: 12MA1....

12MA11 (Ms Kellahan) 12MA12 (Mr White) 12MA13 (Mrs Lobejko) 12MA14 (Mr Fardouly)

Instructions

- Start each question in a new booklet
- Write on one side of the paper only, and not in columns
- Marks may be deducted for careless or badly arranged work
- Only calculators approved by the Board of Studies may be used
- All answers are to be completed in blue or black pen except graphs and diagrams
- No lending or borrowing

Outcomes and Marks

	Section A	Section B				Mark	
		Question 11	Question 12	Question 13	Question 14		
HE7	/10					/10	
HE4		/15			/7	/22	
H8			/15			/15	
H3				/15		/15	
HE2					/8	/8	
Total	/10	/15	/15	/15	/15	/70	%

Section A (Please use the attached multiple choice answer sheet)

1. $|9 - 5x| > 1$

A. $x < \frac{8}{5}$ B. $\frac{8}{5} < x < 2$ C. $x < \frac{8}{5}$ or $x > 2$ D. $x > 2$

2. If $tan\frac{2A}{3} = \sqrt{3}$, for $0° \leq A \leq 360°$, $A =$

A. 45° B. 90° or 360° C. 45° or 315° D. 90°

3. $\lim_{h\to\infty} \frac{3(x+h)^2 - 3x^2}{h}$

A. 0 B. $3x^2$ C. $3(x+h)^2$ D. $6x$

4. The Cartesian equation represented by the parametric equations $x = 3t$ and $y = t^2 - 2$ is

A. $x^2 = 9y + 18$ B. $y = t^2 + 3t - 2$ C. $y = \frac{x^2-2}{9}$ D. $x^2y = 9 - 2x^2$

5. If $3^{2x} - 10(3^x) + 9 = 0$, $x =$

A. 0 or 1 B. 1 or 2 C. 0 or 2 D. 1 or 3

6. The shortest distance between the lines $x + y + 1 = 0$ and (2, -1) is

A. $\frac{\sqrt{2}}{2}$ B. $\frac{2}{\sqrt{2}}$ C. 2 D. $\sqrt{2}$

7. If α, β and γ are the roots of $2x^3 + 4x^2 - x + 6$, the value of $\alpha^2 + \beta^2 + \gamma^2 =$

A. 3 B. 4 C. 5 D. 6

8. How many different ways can the letters of the word *EXAMINATION* be arranged?

A. 11! B. $\frac{11!}{2!}$ C. $\frac{11!}{2!2!}$ D. $\frac{11!}{2!2!2!}$

9. $\lim_{x\to\infty} \frac{x-1}{x+1} =$

A. 0 B. 1 C. -1 D. ∞

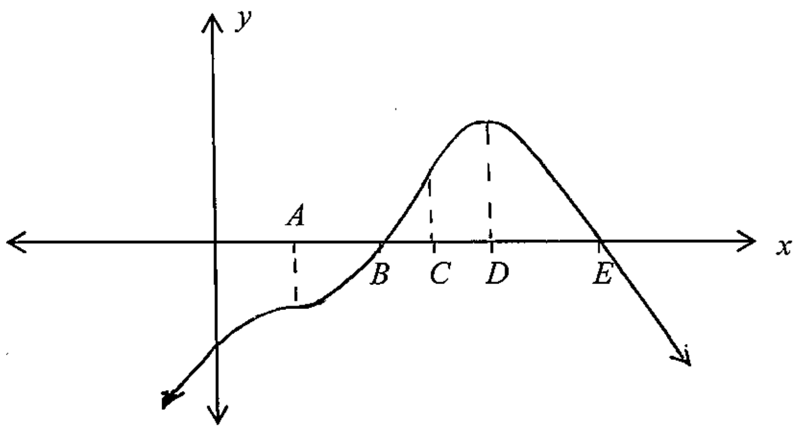
10. How many different ways can a committee of 4 people be selected from a group of 7 people?

A. 7_{C_4} B. 7_{P_4} C. 7!4! D. $\frac{7!}{4!}$

Section B

Question 11 (Please start a new booklet)

(a) Given this graph for the function $y = f(x)$ [2]



Draw the graph of $y = f'(x)$, showing any of the points A, B, C, D or E as required

(b) If $y = \frac{2}{x-1}$

(i) Show that $y \times \frac{dy}{dx} + \frac{d^2y}{dx^2} = 0$ [2]

(ii) For what values of x is the function

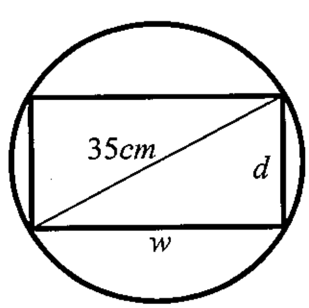
(α) decreasing? [1]

(β) concave upwards? [1]

(c) Sketch the graph of $y = \frac{2x}{x-1}$ showing any asymptotes and labelling at least two points on your graph. [2]

(d) A curve with equation $y = ax^3 - 4x + c$ has a turning point at $(1, 2)$. Find the values of a and c [2]

(e) The strength of a rectangular beam varies as the product of the width w and the square of its depth d, that is, $s = kwd^2$, for some constant k



(i) If a cylindrical log has diameter *35cm,* show that $s = kw(1225 - w^2)$ [1]

(ii) Find $\frac{ds}{dw}$ [1]

(iii) Find the dimensions of the strongest rectangular beam that can be cut from the log given in (i). (Leave your answers correct to the nearest *mm*) [3]

Question 12 (Please start a new booklet)

(a) (i) Evaluate $\int_{-1}^{2} \frac{x^2-2x+1}{5} dx$ [2]

(ii) Find $\int \frac{5}{x^2-2x+1} dx$ [2]

(b) (i) Sketch the graph of $y = \sqrt{x^2+1}$ [2]

(ii) Use two applications (4 sub-intervals) of the trapezoidal rule to find an approximation for the area enclosed by the graph of $y = \sqrt{x^2+1}$ and the x-axis, between $x = -1$ and $x = 3$ [2]
(Write your answer correct to 2 decimal places)

(iii) Find the volume of the solid formed by revolving the enclosed region in (ii) around the x-axis. (Leave your answer in terms of π) [2]

(c) (i) The graphs of $y = (2-x)^2$ and $y = (2-x)^3$ intersect at (1, 4) and one other point. Find the coordinates of the second point [1]

(ii) Expand and simplify $(2-x)^3$ [1]

(iii) Calculate the area enclosed by the graphs of $y = (2-x)^2$ and $y = (2-x)^3$ [3]

Question 13 (Please start a new booklet)

(a) Evaluate, correct to 2 decimal places

(i) $2e$ [1]

(ii) $\log_2 10$ [2]

(b) If $\log_a x = 10 \cdot 218$ and $\log_a y = 2 \cdot 109$, use the log laws to

(i) Evaluate $\log_a(\frac{x}{y^2})$ [2]

(ii) If $y = \frac{\sqrt{x}}{2}$, find the value of a, correct to 2 decimal places [2]

(c) Differentiate, with respect to x

(i) $3e^{4-x}$ [1]

(ii) $\frac{1}{\log_e x}$ [2]

(d) If $\frac{dy}{dx} = xe^{-x^2}$, and $y = e$ when $x = 1$. Write an expression for y in terms of x [2]

(e) (i) What value does e^{-x^2} approach as x approaches ∞? [1]

(iii) What value does e^{-x^2} approach as x approaches $-\infty$? [1]

(iv) What value does xe^{-x^2} approach as x approaches $\pm\infty$? [1]

Question 14 (Please start a new booklet)

(a) Given $2^k \geq k$ for any positive integer k, show that $2^{k+1} \geq k + 1$ [2]

(b) Use mathematical induction to prove that

(i) $1 + x + x^2 + \cdots + x^{n-1} = \frac{1-x^n}{1-x}$, for all positive integers n [3]

(ii) $9^{n+2} - 4^n = 5m$, for any integer m, for all integers n, $n \geq 1$ [3]

(c) For the graph of $y = (2x + 5)^{\frac{7}{3}}$

(i) Find all axes intercepts [2]

(ii) Find any stationary points, and state their nature [3]

(iii) Sketch its graph [2]

END OF TEST
(Now check your work!)

Section A (Multiple Choice) Answer Sheet
(Please detach)

Question				
1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

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

Section A (Multiple Choice) Answer Sheet
(Please detach)

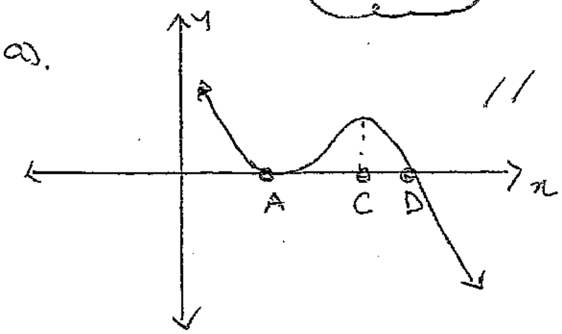
Question				
1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

YEAR 12 MATHEMATICS EXTENSION HALF YEARLY

EXAM SOLUTIONS

QUESTION 11 WHITE

(a).



//

(b) (i). $\frac{dy}{dx} = -\frac{2}{(x-1)^2}$

$\frac{d^2y}{dx^2} = \frac{4}{(x-1)^3}$ ✓

$y \times \frac{dy}{dx} + \frac{d^2y}{dx^2} = \frac{2}{x-1} \times \frac{-2}{(x-1)^2} + \frac{4}{(x-1)^3}$

$= \frac{-4}{(x-1)^3} + \frac{4}{(x-1)^3}$

$= 0$ ✓

(ii) (α) Decreasing for $\frac{dy}{dx} < 0$

$\frac{-2}{(x-1)^2} < 0$ for all x, $x \neq 1$ ✓

(β) Concave upwards when $\frac{d^2y}{dx^2} > 0$

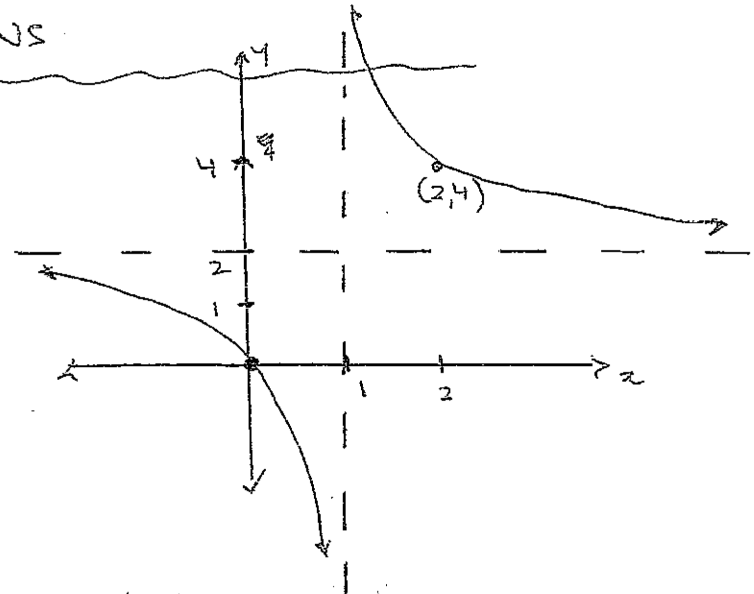
$\frac{4}{(x-1)^3} > 0$ for $x > 1$ ✓

(c). Asymptotes -

~~horizontal~~ vertical when $x = 1$

horizontal when

$y = \lim_{x \to 0} \frac{2}{1 - \frac{1}{x}}$



✓ for asymptotes

✓ for graph, including 2 pts.

(d). when $x = 1$, $y = 2$

$2 = a - 4 + c$

$\therefore a + c = 6$

$\frac{dy}{dx} = 3ax^2 - 4$ ✓

$\frac{dy}{dx} = 0$ when $x = 1$

$3a - 4 = 0$

$a = \frac{4}{3}$

$\therefore c = 6 - \frac{4}{3} = 4\frac{2}{3}$ ✓

(e) (i) $d^2 = 35^2 - w^2$ (Pythagoras') ✓

$\therefore s = kw(1225 - w^2)$

(ii). $\frac{ds}{dw} = 1225k - 3kw^2$ ✓

(iii). Let $\frac{ds}{dw} = 0$

$1225k - 3kw^2 = 0$

$k(1225 - 3w^2) = 0$

$k \neq 0 \therefore 3w^2 = 1225$

$w^2 = \frac{1225}{3}$

$\frac{d^2s}{dw^2} = -6kw$

$-6 \times k \times 20.2 < 0$ ✓

$\therefore$ Maximum strength when $w = 20.2$ cm

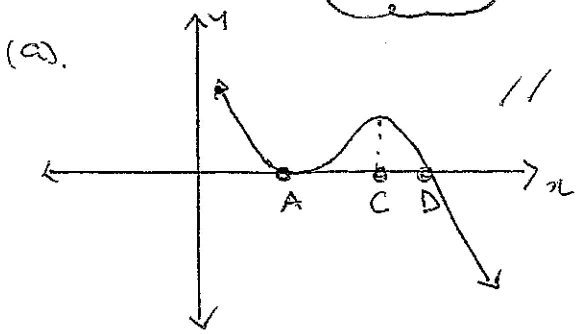
and $d = \sqrt{1225 - \frac{1225}{3}}$

YEAR 12 MATHEMATICS EXTENSION HALF YEARLY

EXAM SOLUTIONS

QUESTION 11 WHITE

(a).



(b) (i). $\frac{dy}{dx} = -\frac{2}{(x-1)^2}$

$\frac{d^2y}{dx^2} = \frac{4}{(x-1)^3}$ ✓

$y \times \frac{dy}{dx} + \frac{d^2y}{dx^2} = \frac{2}{x-1} \times \frac{-2}{(x-1)^2} + \frac{4}{(x-1)^3}$

$= \frac{-4}{(x-1)^3} + \frac{4}{(x-1)^3}$

$= 0$ ✓

(ii) (α) Decreasing for $\frac{dy}{dx} < 0$

$\frac{-2}{(x-1)^2} < 0$ for all x, $x \neq 1$ ✓

(β) Concave upwards when $\frac{d^2y}{dx^2} > 0$

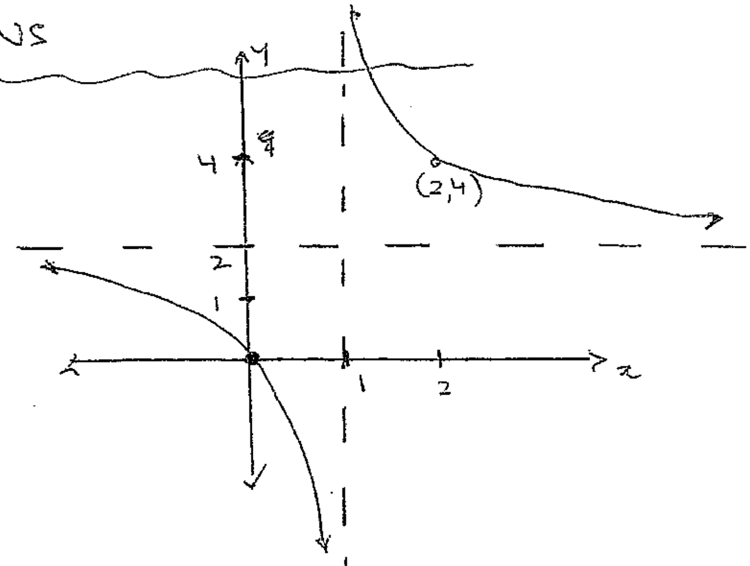
$\frac{4}{(x-1)^3} > 0$ for $x > 1$ ✓

(c). Asymptotes -

vertical ~~horizontal~~ when $x = 1$

horizontal when

$y = \lim_{x \to 0} \frac{2}{1 - \frac{1}{}}$



✓ for asymptotes

✓ for graph, including 2 pts.

(d). when $x = 1, y = 2$

$2 = a - 4 + c$

$\therefore a + c = 6$

$\frac{dy}{dx} = 3ax^2 - 4$ ✓

$\frac{dy}{dx} = 0$ when $x = 1$

$3a - 4 = 0$

$a = \frac{4}{3}$

$\therefore c = 6 - \frac{4}{3} = 4\frac{2}{3}$ ✓

(e) (i) $d^2 = 35^2 - w^2$ (Pythagoras') ✓

$\therefore s = kw(1225 - w^2)$

(ii). $\frac{ds}{dw} = 1225k - 3kw^2$ ✓

(iii). Let $\frac{ds}{dw} = 0$

$1225k - 3kw^2 = 0$

$k(1225 - 3w^2) = 0$

$k \neq 0 \therefore 3w^2 = 1225$

$w^2 = \frac{1225}{3}$

$\frac{d^2s}{dw^2} = -6kw$

$-6 \times k \times 20.2 < 0$ ✓

$\therefore$ Maximum strength when $w = 20.2$ cm

and $d = \sqrt{1225 - \frac{1225}{}}$

QUESTION 12 (KELLAHAN)

(a) (i) $\frac{1}{5}\left[\frac{x^3}{3}-x^2+x\right]_{-1}^{2}$

$= \frac{1}{5}\left[\left(\frac{8}{3}-4+2\right)-\left(-\frac{1}{3}-1-1\right)\right]$

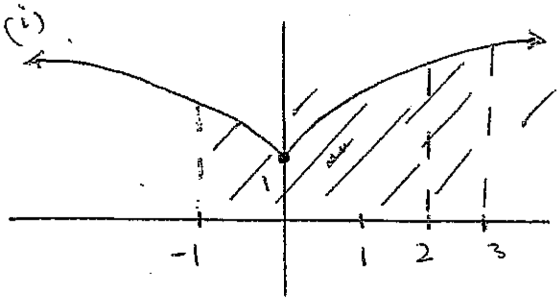
$= \frac{3}{5}$

(ii) $\int \frac{5}{(x-1)^2}\,dx = \int 5(x-1)^{-2}\,dx$

$= \frac{5(x-1)^{-1}}{-1}+c$

$= \frac{-5}{x-1}+c$

(b) (i)



(ii) $A \doteqdot \frac{1}{2}\left[f(-1)+2(f(0)+f(1)+f(2))+f(3)\right]$

$\doteqdot \frac{1}{2}\left[\sqrt{2}+2(1+\sqrt{2}+\sqrt{5})+\sqrt{10}\right]$

$\doteqdot \frac{1}{2}\left[3\sqrt{2}+2+2\sqrt{5}+\sqrt{10}\right)$

$\doteqdot 6.94$ units^2

(iii) $V = \pi\int_{-1}^{3}(x^2+1)\,dx$

$= \pi\left[\frac{x^3}{3}+x\right]_{-1}^{3}$

$= \pi\left[(9+3)-\left(-\frac{1}{3}-1\right)\right]$

$= \frac{40\pi}{3}$ units^3

(c) (i) when $x=2$,

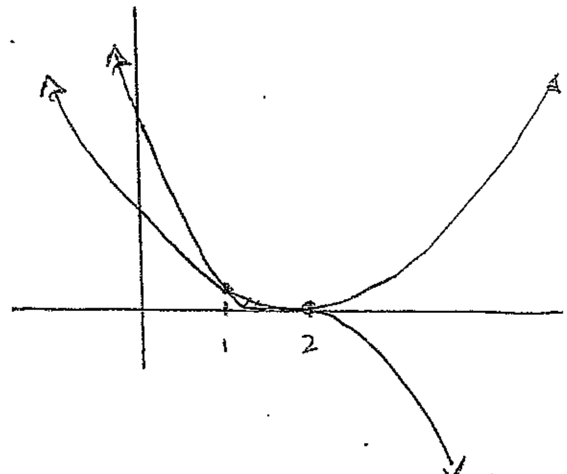
LHS = RHS = 0

$\therefore$ $(2,0)$

(ii) $2^3-3(2^2)x+3(2)x^2-x^3$

$= 8-12x+6x^2-x^3$

(iii)



(No marks for diagram)

$A = \int_1^2 (2-x)^2-(2-x)^3\,dx$

$= \int_1^2 (4-4x+x^2)-(8-12x+6x^2-x$ d

$= \int_1^2 (-4+8x-5x^2+x^3)\,dx$

$= \left[-4x+4x^2-\frac{5x^3}{3}+\frac{x^4}{4}\right]_1^2$

$= \left[\left(-8+16-\frac{40}{3}+4\right)-\left(-4+4-\frac{5}{3}+\right.\right.$

$= \frac{1}{12}$ units^2

QUESTION 13 (LOBSJKO)

(a). (i) 5.44 ✓

(ii). $\frac{\log 10}{\log 2}$ ✓ ~~= 3.32~~ ✓

(b) (i) $\log x - \log y^2$

$= \log x - 2\log y$ ✓

$= 10.218 - 2(2.109)$

$= 6$ ✓

(ii). $x = a^{10.218}$, $y = a^{2.109}$

$y = \frac{\sqrt{x}}{2}$

$a^{2.109} = \frac{(a^{10.218})^{1/2}}{2}$ ✓

$2 = \frac{a^{5.109}}{a^{2.109}}$

$2 = a^3$

$\therefore a = 1.26$ ✓

(c). (i). $-3e^{4-x}$ ✓

(ii). $\frac{d}{dx}(\log x)^{-1}$ ✓

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

$= \frac{-1}{(\log_e x)^2}$ ✓

(d) (i) $y = -\frac{1}{2}\int -2xe^{-x^2}\,dx$

$y = -\frac{1}{2}e^{-x^2} + c$ ✓

when $x = 1$, $y = e$

$e = -\frac{1}{2}e^{-1} + c$

$c = e + \frac{1}{2e}$

$\therefore y = -\frac{1}{2}e^{-x^2} + e + \frac{1}{2e}$ ✓

(e) (i). 0 ✓

(ii). 0 ✓

(iii) 0 ✓

QUESTION 12 (KELLAHAN)

(a) (i) $\frac{1}{5}\left[\frac{x^3}{3} - x^2 + x\right]_{-1}^{2}$

$= \frac{1}{5}\left[\left(\frac{8}{3} - 4 + 2\right) - \left(-\frac{1}{3} - 1 - 1\right)\right]$

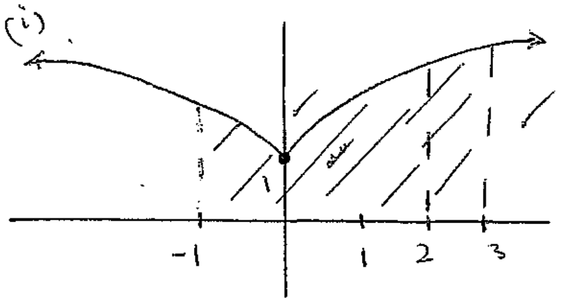
$= \frac{3}{5}$

(ii) $\int \frac{5}{(x-1)^2}\,dx = \int 5(x-1)^{-2}\,dx$

$= \frac{5(x-1)^{-1}}{-1} + c$

$= \frac{-5}{x-1} + c$

(b) (i)



(ii) $A \doteqdot \frac{1}{2}\left[f(-1) + 2(f(0) + f(1) + f(2)) + f(3)\right]$

$\doteqdot \frac{1}{2}\left[\sqrt{2} + 2(1 + \sqrt{2} + \sqrt{5}) + \sqrt{10}\right]$

$\doteqdot \frac{1}{2}\left[3\sqrt{2} + 2 + 2\sqrt{5} + \sqrt{10}\right)$

$\doteqdot 6.94$ units^2

(iii) $V = \pi \int_{-1}^{3} (x^2+1)\,dx$

$= \pi\left[\frac{x^3}{3} + x\right]_{-1}^{3}$

$= \pi\left[(9+3) - \left(-\frac{1}{3} - 1\right)\right]$

$= \frac{40\pi}{3}$ units^3

(c) (i) when $x = 2$,

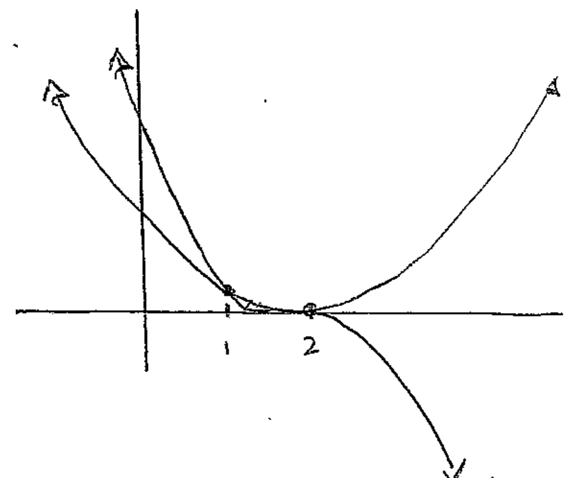
LHS = RHS = 0

$\therefore (2, 0)$

(ii) $2^3 - 3(2^2)x + 3(2)x^2 - x^3$

$= 8 - 12x + 6x^2 - x^3$

(iii)



(No marks for diagram)

$A = \int_1^2 (2-x)^2 - (2-x)^3\,dx$

$= \int_1^2 (4 - 4x + x^2) - (8 - 12x + 6x^2 - x$ ... d

$= \int_1^2 (-4 + 8x - 5x^2 + x^3)\,dx$

$= \left[-4x + 4x^2 - \frac{5x^3}{3} + \frac{x^4}{4}\right]_1^2$

$= \left[\left(-8 + 16 - \frac{40}{3} + 4\right) - \left(-4 + 4 - \frac{5}{3} + \right.\right.$ ...

$= \frac{1}{12}$ units^2

QUESTION 14 FARDOULY

(a). $2^k \geq k$

$\therefore 2 \times 2^k \geq 2k$

$2^{k+1} \geq 2k$

and $2k \geq k+1$ for $k \geq 1$

(b).(i). Prove true for $n=1$

LHS $= 1$

RHS $= \dfrac{1-x}{1-x} = 1$

$\therefore$ true for $n=1$

Assume true for $n=k$, that is

$1 + x + x^2 + \dots + x^{k-1} = \dfrac{1-x^k}{1-x}$

Hence prove true for $n=k+1$,

that is

$1 + x + x^2 + \dots + x^{k-1} + x^k = \dfrac{1-x^{k+1}}{1-x}$

or $\dfrac{1-x^k}{1-x} + x^k = \dfrac{1-x^{k+1}}{1-x}$

LHS $= \dfrac{1-x^k + (1-x)x^k}{1-x}$

$= \dfrac{1-x^k + x^k - x^{k+1}}{1-x}$

$= \dfrac{1-x^{k+1}}{1-x}$

$=$ RHS.

$\therefore$ if true for $n=k$, then true for $n=k+1$.

(ii). Prove true for $n=1$

LHS $= 9^3 - 4$

$= 725$

$= 5 \times 145$

$\therefore$ true for $n=1$

Assume true for $n=k$, that is

$9^{k+2} - 4^k = 5m$ (1)

Hence prove true for $n=k+1$,

that is, $9^{k+3} - 4^{k+1} = 5p$ (2)

From (1) $9^{k+2} = 5m + 4^k$

From (2) LHS $= 9 \times 9^{k+2} - 4 \times 4^k$

$= 9(5m + 4^k) - 4 \times 4^k$

$= 45m + 9 \times 4^k - 4 \times 4^k$

$= 45m + 5 \times 4^k$

$= 5(9m + 4^k)$

$\therefore$ if true for $n=k$, then true for $n=k+1$

If true ---

(c).(i). $x=0$, $y = 5^{7/3} = 42.7$

$y=0$, $x = -\frac{5}{2}$

(ii). $\dfrac{dy}{dx} = \frac{7}{3}(2x+5)^{4/3} \times 2$

$= \frac{14}{3}(2x+5)^{4/3}$

$\dfrac{dy}{dx} = 0$ when $x = -\frac{5}{2}$

$\therefore$ stationary point when $x = -\frac{5}{2}$

$$\frac{d^2y}{dx^2} = \frac{56}{9}(2x+5)^{1/3} \times 2$$

$$= \frac{112}{9}(2x+5)^{1/3}$$

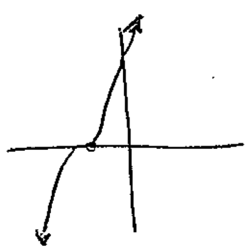
$$\frac{d^2y}{dx^2} = 0 \text{ when } x = -\frac{5}{2}$$

$\therefore$ possible stationary point of inflexion when $x = -\frac{5}{2}$ ✓

x	-3	$-\frac{5}{2}$	-2
$\frac{d^2y}{dx^2}$	$-\frac{112}{9}$	0	$\frac{112}{9}$

change of concavity $\therefore$ stationary point of inflexion at $(-\frac{5}{2}, 0)$ ✓

(iii).



✓ for intercepts
✓ for shape.

(a). $2^k \geq k$

$\therefore 2 \times 2^k \geq 2k$

$2^{k+1} \geq 2k$

and $2k \geq k+1$ for $k \geq 1$

(b).(i). Prove true for $n=1$

$LHS = 1$

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

$\therefore$ true for $n=1$

Assume true for $n=k$, that is

$1 + x + x^2 + \cdots + x^{k-1} = \frac{1-x^k}{1-x}$

Hence prove true for $n=k+1$,

that is

$1 + x + x^2 + \cdots + x^{k-1} + x^k = \frac{1-x^{k+1}}{1-x}$

or $\frac{1-x^k}{1-x} + x^k = \frac{1-x^{k+1}}{1-x}$

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

$= \frac{1-x^k + x^k - x^{k+1}}{1-x}$

$= \frac{1-x^{k+1}}{1-x}$

$= RHS.$

$\therefore$ if true for $n=k$, then true for $n=k+1$.

If true for $n=1$ then true for $n=2$, and so on, $\therefore$ the statement is true for $n \geq 1$

$LHS = \ldots$

$= 725$

$= 5 \times 145$

$\therefore$ true for $n=1$

Assume true for $n=k$, that is

$9^{k+2} - 4^k = 5m$ ①

Hence prove true for $n=k+1$,

that is, $9^{k+3} - 4^{k+1} = 5p$ ②

From ① $9^{k+2} = 5m + 4^k$

From ② $LHS = 9 \times 9^{k+2} - 4 \times 4^k$

$= 9(5m + 4^k) - 4 \times 4^k$

$= 45m + 9 \times 4^k - 4 \times 4^k$

$= 45m + 5 \times 4^k$

$= 5(9m + 4^k)$

$\therefore$ if true for $n=k$, then true for $n=k+1$

If true ---

(c).(i). $x=0$, $y = 5^{7/3} = 42.7$

$y=0$, $x = -\frac{5}{2}$

(ii). $\frac{dy}{dx} = \frac{7}{3}(2x+5)^{4/3} \times 2$

$= \frac{14}{3}(2x+5)^{4/3}$

$\frac{dy}{dx} = 0$ when $x = -\frac{5}{2}$

$\therefore$ stationary point when $x = -\frac{5}{2}$