St George Girls High School

Trial Higher School Certificate Examination

2012

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Begin each question in a new booklet
- Write your student number on each booklet.
- Board-approved calculators may be used.
- A table of standard integrals is provided at the back of this paper. Detach.
- Multiple choice Answer sheet is at the back of this paper. Detach.
- Show all necessary working in Questions 11 – 16.
- Diagrams are not to scale.
- The mark allocated for each question is listed at the side of the question.

Total Marks – 100

Section I – Pages 2 – 4
10 marks

- Attempt Questions 1 – 10
- Allow about 15 minutes for this section

Section II – Pages 5 – 12
90 marks

- Attempt Questions 11 – 16
- Allow about 2 hours 45 minutes for this section

Students are advised that this is a Trial Examination only and does not necessarily reflect the content or format of the Higher School Certificate Examination.

TABLE OF 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 I – (10 marks)

Marks

Answer this section on the answer sheet provided at the back of this paper.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

1. The angle which the straight line $3x + 5y + 2 = 0$ makes with the positive direction of the x-axis is closest to:

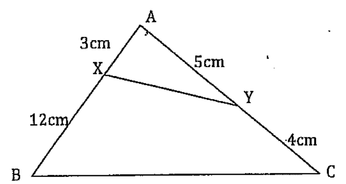
   A. $31°$ B. $59°$ C. $121°$ D. $149°$

2. Janet works out the sum of n terms of a given arithmetic series. Her answer, which is correct, could be:

   A. $S_n = 2(2^n - 1)$
   B. $S_n = 9 - 2n$
   C. $S_n = 8n - n^2$
   D. $S_n = 7 \times 2^{n-1}$

3. The values of x for which $y = 2x^3 - 12x^2 + 18x + 7$ is increasing are:

   A. $x < 2$ B. $x > 2$ C. $1 < x < 3$ D. $x < 1$ or $x > 3$

4. 

   If ΔABC has area 36 cm² then the area of ΔAXY is:

   A. 4 cm² B. 8 cm² C. 12 cm² D. 16 cm²

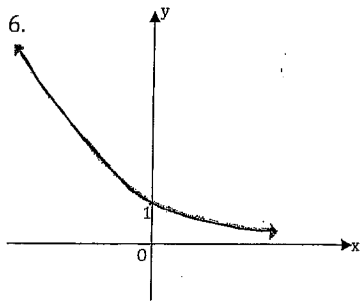
5. When the curve of equation $y = e^x$ is rotated about the x-axis between $x = -2$ and $x = 2$ the volume of the solid generated is given by:

   A. $\pi \int_{-2}^{2} e^x \, dx$ B. $2\pi \int_0^2 e^{x^2} \, dx$

   C. $\pi \int_{-2}^{2} e^{x^2} \, dx$ D. $\pi \int_{-2}^{2} e^{2x} \, dx$

Section I (cont'd)

Marks

6. 

   The graph illustrated could be:

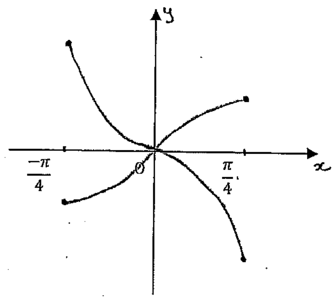
   A. $y = 2^x$
   B. $y = (-2)^x$
   C. $y = \left(\frac{1}{2}\right)^x$
   D. $y = \left(-\frac{1}{2}\right)^x$

7. The quadratic function, $Q(x) = 5x^2 - 4x + 3$, has roots for $Q(x) = 0$ of α and β. Hence, $\alpha^2 + \beta^2 =$

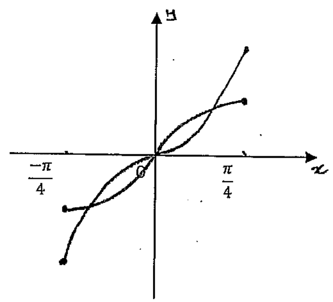
   A. $\frac{46}{25}$ B. $\frac{29}{25}$ C. $\frac{-11}{25}$ D. $\frac{-14}{25}$

8. The graphs of $y = \sin x$ and $y = \tan x$ for $\frac{-\pi}{4} \le x \le \frac{\pi}{4}$ are represented in:

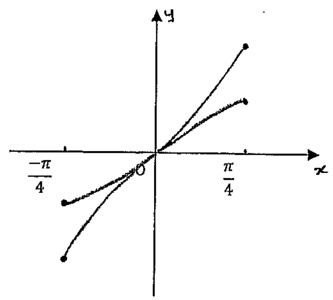
A.



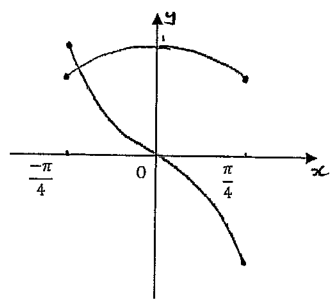
B.



C.

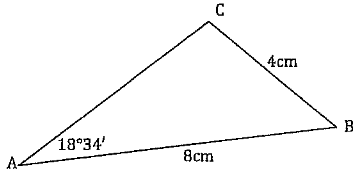


D.



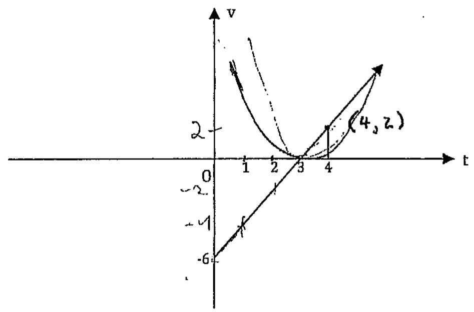
Section I (cont'd) Marks

9. A possible answer to the size of $\angle C$ in the triangle below is:



A. $140°27'$ B. $0°10'$ C. $37°8'$ D. None of these answers

10.



The graph shows velocity expressed as a function of time. The distance travelled by the particle in the first 4 seconds is:

A. 8 units B. 10 units C. $4\sqrt{5}$ units D. 12 units

Section II – Show all working

Question 11 – Start A New Booklet – (15 marks) Marks

a) Write the answer to $\sqrt{\dfrac{4.83\times10.86}{17.83-5.92}}$ correct to 3 significant figures. 2

b) Solve $|2x-3| \le 5$ 2

c) If $\log_a 2 = 0.36$ and $\log_a 5 = 0.83$ evaluate $\log_a\sqrt{10}$ 2

d) Differentiate each of the following with respect to x

(i) $\cos 7x$ 1

(ii) $\sqrt{e^{2x}+4}$ 2

(iii) $x\ln x$ 2

e) Find:

(i) $\int (3-2x)^4\,dx$ 1

(ii) $\int \frac{1}{\sqrt{x}}\,dx$ 1

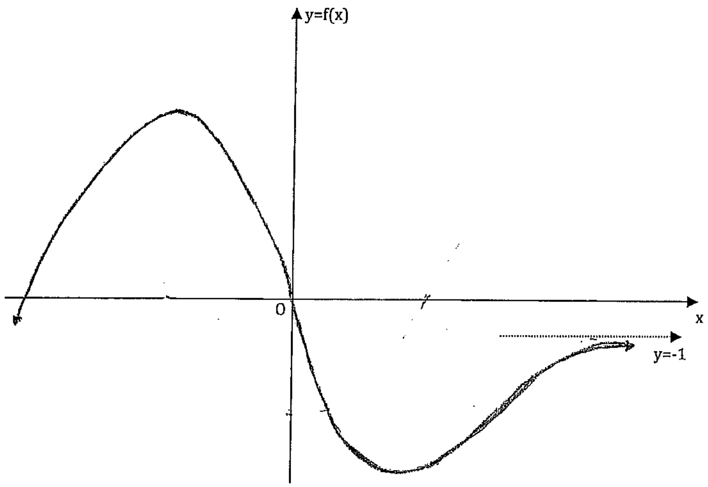
(iii) $\int \cos x°\,dx$ 2

Question 12 – Start A New Booklet – (15 marks) **Marks**

a) Graph the region on the number plane given by $y > \log_e(x-1)$ 2

b) Copy this graph carefully onto your own paper. The graph shows $y = f(x)$.

On your graph draw the graph of $y = f'(x)$ making it clear which graph is your answer. 2

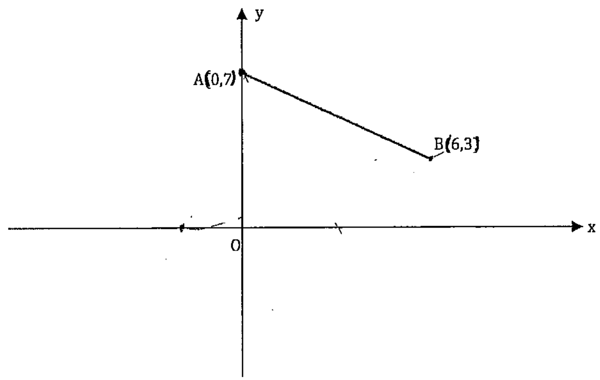


c) Initially a particle, travelling in straight line, is at rest at the origin. It is given an acceleration of $(6t + 4)$ cm/sec². 3

Find the motion equation for displacement.

Question 12 – (cont'd) **Marks**

d)



$A(0,7)$ and $B(6,3)$ are points on the number plane and the equation of AB is $2x + 3y - 21 = 0$

(i) Find the length of AB 1

(ii) Find the gradient of AB 1

(iii) Show that the equation of the perpendicular from $D(-2,0)$ to AB is $3x - 2y + 6 = 0$ 2

(iv) Find the perpendicular distance from D to AB. 2

(v) Find the coordinates of C such that $ABCD$ is a parallelogram. 1

(vi) Find the area of parallelogram $ABCD$. 1

Question 13 – Start A New Booklet – (15 marks) Marks

a) $20 + 10 + 5 + \cdots$ is a geometric series. Find which term of the series will be just less than 0.0001. **3**

b) If $\cos\theta = \frac{-8}{17}$ and $\tan\theta < 0$, find the exact value for $\sin\theta$. **2**

c) Sketch the graph of $y = -3\sin 2x$ for $0 \le x \le 2\pi$ **3**

d) Copy the table of values into your writing booklet and supply the missing numbers, for $f(x) = x\sin x$, writing each correct to 3 decimal places. **3**

x	1	1.5	2	2.5	3
$f(x) = x\sin x$	0.841				

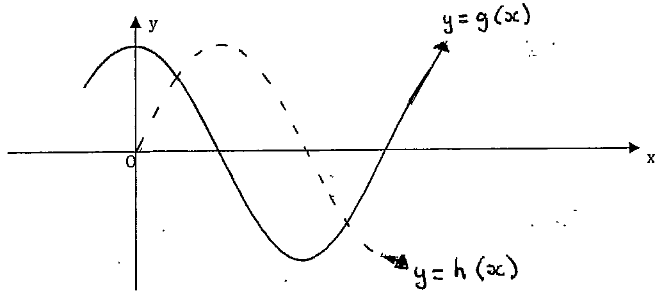
Use Simpson's Rule with 5 function values to find an approximation for

$$\int_1^3 x\sin x\,dx$$

e) Find the volume formed when the area enclosed between $y = x^2$ and $y = 4x - x^2$ is rotated about the x-axis. **4**

Question 14 – Start A New Booklet – (15 marks) Marks

a)



A, B, C, D, E, F and G are the areas of the regions in which they are given.

Using these letters, write an expression for:

(i) $\int_0^4 h(x)\,dx$ (ii) $\int_1^4 g(x)\,dx$ **1,2**

b) Solve $\tan 3\theta = 1$ for $0 \le \theta \le 2\pi$ **3**

c) Find the equation of the parabola with vertex $(-1, 1)$ and focus $(-3, 1)$ **3**

d) (i) Differentiate **2**

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

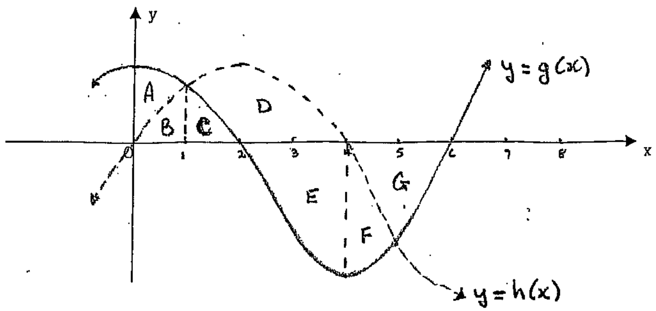
(ii) Hence, or otherwise, find **1**

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

e) Given $y = -4x - 20$ is the equation of a tangent to $y = x^3 - 4x^2 - 7x + 10$ and $x > 0$, find the coordinates of the point of contact. **3**

Question 14 – Start A New Booklet – (15 marks) **Marks**

a)



A, B, C, D, E, F and G are the areas of the regions in which they are given.

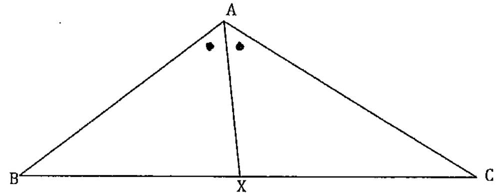
** This is the diagram to be used for Q 14 (a)

Question 15 – Start A New Booklet – (15 marks) **Marks**

a) Simplify: 2

$$\frac{\sin^2\theta}{\tan\theta\,\sin(90-\theta)}$$

b)



Copy the diagram carefully onto your paper.

X is a point on the side BC of ΔABC and AX bisects $\angle BAC$.

(i) Draw the line through X parallel to BA to meet AC at L.

This construction gives $\dfrac{BX}{XC} = \dfrac{AL}{LC}$ 1

(ii) Prove that ΔALX is isosceles. 2

(iii) Given that $\Delta CAB \,|||\, \Delta CLX$ (Do not prove this) prove that $\dfrac{BX}{XC} = \dfrac{AB}{AC}$ 2

c) The equation of motion of a particle is $x = te^{-t}$
where x is in centimetres
t is in seconds.

(i) Find the time when the particle is at rest. 3

(ii) Find the equation of motion for acceleration and the acceleration when $v = 0$. 2

(iii) Find the time when acceleration is zero. 1

(iv) Using the answers from parts (i) to (iii) and other necessary information, sketch the displacement-time function $x = te^{-t}$. Show all important features clearly. 2

Question 16 – Start A New Booklet – (15 marks)

Mark

a) An open cone, of radius r cm, and height, h cm is made from a sector of a circle. The area of the sector used is 300 cm^2.

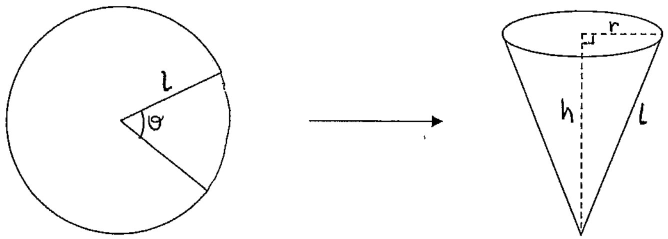


Fig I Fig II

(i) Show from Figure I that slant height l is given by $l^2 = \dfrac{450}{\pi}$ 2

(ii) Show from Figure II that $h = \sqrt{l^2 - r^2}$ 1

(iii) Hence or otherwise show that the volume of the cone is given by 1

$$V = \frac{1}{3}r^2\sqrt{450\pi - \pi^2 r^2}$$

(iv) Show that $\dfrac{dv}{dr} = \dfrac{300\pi r - \pi^2 r^3}{\sqrt{450\pi - \pi^2 r^2}}$ 2

(v) Find the value of r for the volume of the cone to be a maximum. 2

Question 16 – (cont'd)

Marks

b) Kando, the mathematical kangaroo always hops (i.e. jumps) according to mathematical rules. One day, Kando decides to go hopping according to the following rules:

- The length of odd number hops (1st, 3rd, 5th hop etc), in metres, is given by the arithmetic series $t_n = 4 - (n - 1)$, where $n = 1, 3, 5, \ldots$ is an odd number;
- The length of even number hops (2nd, 4th, 6th hop etc), in metres, is given by the geometric series $T_N = \frac{192}{63}\left(\frac{1}{2}\right)^{\frac{N-2}{2}}$, where $N = 2, 4, 6, \ldots$ is an even number;
- If the length of a hop is negative according to the relevant series, Kando hops the prescribed distance *backwards.*

(i) Write down the first term and common difference for the series t_n. 1

(ii) Write down the first term and common ratio for the series T_n. 1

(iii) Find where Kando is relative to her starting point after 12 hops. 3

(iv) Find the total distance travelled backwards in the first 16 hops. 2

End of Paper

ST GEORGE G.H.S

Mathematics Trial 2012 Solutions

Multiple Choice

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

Question 11

(a) $\sqrt{\dfrac{4.83 \times 10.86}{17.83 - 5.92}} = 2.0986$

$= 2.10$

(b) $|2x-3| \leq 5$

$-5 \leq 2x-3 \leq 5$

$-2 \leq 2x \leq 8$

$-1 \leq x \leq 4$

(c) $\log_a \sqrt{10} = \log_a 10^{\frac{1}{2}}$

$= \frac{1}{2}\log_a 10$

$= \frac{1}{2}(\log_a 5 + \log_a 2)$

$= \frac{1}{2}(0.83 + 0.36)$

$= 0.595$

(d) (i) $y = \cos 7x$

$y' = -7\sin 7x$

(ii) $y = \sqrt{e^{2x}+4}$

$y = (e^{2x}+4)^{\frac{1}{2}}$

$y' = \frac{1}{2}(e^{2x}+4)^{-\frac{1}{2}} \times 2e^{2x}$

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

(iii) $y = x\ln x$

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

$= \ln x + 1$

(e) (i) $\int (3-2x)^4\,dx = \dfrac{(3-2x)^5}{-2\times 5} + C$

$= -\frac{1}{10}(3-2x)^5 + C$

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

$= \dfrac{x^{\frac{1}{2}}}{\frac{1}{2}} + C$

$= 2\sqrt{x} + C$

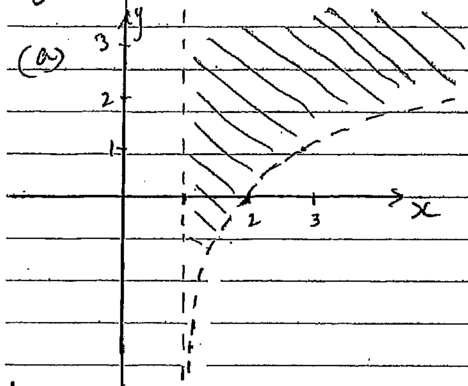
(iii) $\int \cos x^\circ\,dx = \int \cos\frac{\pi x}{180}\,dx$

$= \dfrac{1}{\frac{\pi}{180}}\sin\frac{\pi x}{180} + C$

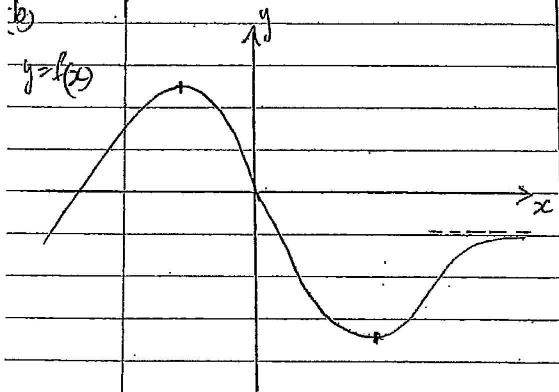
$= \frac{180}{\pi}\sin\frac{\pi x}{180} + C$

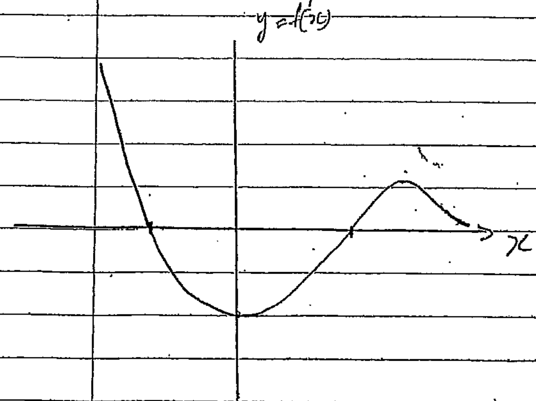
Question 12

(a)



(b)





(c) $t=0 \quad v=0 \quad x=0 \quad \therefore c=0$

$a = 6t+4$

$v = \int 6t+4\,dt$

$v = 3t^2+4t$

$x = \int 3t^2+4t\,dt$

$x = t^3+2t^2$

(d) (i) $d = \sqrt{(6-0)^2+(3-7)^2}$

$= \sqrt{36+16}$

$= \sqrt{52}$

(ii) $m = \dfrac{3-7}{6-0}$

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

(iii) $m = \frac{3}{2} \quad (-2,0)$

$y - 0 = \frac{3}{2}(x+2)$

$2y = 3x+6$

$3x - 2y + 6 = 0$

(iv) $d = \dfrac{|2x_1+3y_1-21|}{\sqrt{2^2+3^2}}$

$= \dfrac{|2.-2+3.0-21|}{\sqrt{13}}$

$= \dfrac{25}{\sqrt{13}}$

(v) $C = (4, -4)$

(vi) Area $=$ base $\times$ height

$= \sqrt{52} \times \frac{25}{\sqrt{13}}$

$= \sqrt{4} \times 25$

$= 50$ sq units.

Question 13

$a = 20 \quad r = 0.5$

$T_n = ar^{n-1}$

$\therefore 20(0.5)^{n-1}$

$20(0.5)^{n-1} < 0.0001$

$(0.5)^{n-1} < 0.000005$

$(n-1)\log(0.5) < \log(0.000005)$

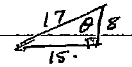
$(n-1) > \dfrac{\log(0.000005)}{\log(0.5)}$

$n-1 > 17.6$

$n > 18.6$

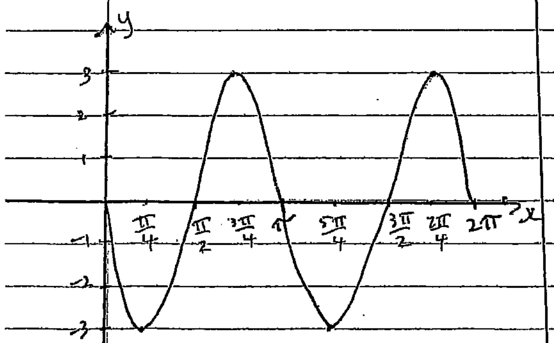
$\therefore$ 19th term

i) $\cos\theta = \dfrac{-8}{17}$



2nd Quadrant.

$\therefore \sin\theta = \dfrac{15}{17}$



x	1	1.5	2	2.5	3
$\sin x$	0.841	1.496	1.819	1.496	0.423

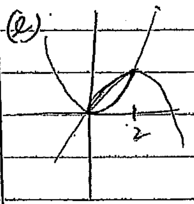
$h = 0.5$

$\int_1^3 x\sin x\,dx \approx \dfrac{0.5}{3}\{0.841 + 4\times1.496 + 1.819\}$

$+ \dfrac{0.5}{3}\{1.819 + 4\times1.496 + 0.423\}$

≈ 2.812

(e)



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

$0 = 4x - 2x^2$

$0 = 2x - x^2$

$0 = x(2-x)$.

$x = 0, 2$.

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

$= \pi\int_0^2 16x^2 - 8x^3 + x^4\,dx - \pi\int_0^2 x^4\,dx$

$= \pi\int_0^2 16x^2 - 8x^3 + x^4 - x^4\,dx$.

$= \pi\int_0^2 16x^2 - 8x^3\,dx$

$= \pi\left[\dfrac{16x^3}{3} - \dfrac{8x^4}{4}\right]_0^2$

$= \pi\left[\left(\dfrac{16\cdot2^3}{3} - \dfrac{8\cdot2^4}{4}\right) - (0)\right]$

$= \pi\cdot\dfrac{32}{3}$

$= \dfrac{32\pi}{3}$

Question 14

(a) (i) $\int_0^4 h(x)\,dx = B + C + D$

(ii) $\int_1^4 g(x)\,dx = C - E$

b) $\tan 3\theta = 1 \qquad 0 \le \theta \le 2\pi$

$0 \le 3\theta \le 6\pi$

Q_1 & Q_3

$3\theta = \dfrac{\pi}{4}, \dfrac{5\pi}{4}, \dfrac{9\pi}{4}, \dfrac{13\pi}{4}, \dfrac{17\pi}{4}, \dfrac{21\pi}{4}$

$\theta = \dfrac{\pi}{12}, \dfrac{5\pi}{12}, \dfrac{9\pi}{12}, \dfrac{13\pi}{12}, \dfrac{17\pi}{12}, \dfrac{21\pi}{12}$

(c) Vertex $= (-1, 1)$ focus $= (-3, 1)$

$a = -2 \qquad x^2 = 4ay$.

$(x+1)^2 = 4\cdot-2(y-1)$

$(x+1)^2 = -8(y-1)$

(d) (i) $y = \ln\dfrac{(x-1)}{(x+1)}$

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

$y' = \dfrac{1}{x-1}\cdot1 - \dfrac{1}{x+1}\cdot1$

$y' = \dfrac{1}{x-1} - \dfrac{1}{x+1}$

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

$= \dfrac{1}{2}\ln\dfrac{(x-1)}{(x+1)} + C$

(e)

$y = x^3 - 4x^2 - 7x + 10$

$y' = 3x^2 - 8x - 7$

$m = -4$

$\therefore -4 = 3x^2 - 8x - 7$

$0 = 3x^2 - 8x - 3$

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

$x > 0 \quad \therefore x = 3$

$y = 3^3 - 4\cdot3^2 - 7\cdot3 + 10$

$= -20$.

$(3, -20)$

Question 15

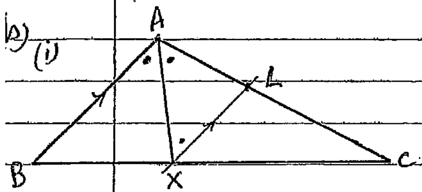
a)

$$\frac{\sin^2\theta}{\tan\theta\sin(90-\theta)} = \frac{\sin^2\theta}{\frac{\sin\theta}{\cos\theta}\cdot\cos\theta}$$

$$= \frac{\sin^{\cancel{2}}\theta}{\cancel{\sin\theta}}$$

$$= \sin\theta$$ (2)

b) (i)



(1)

i) $B\hat{A}X = A\hat{X}L$ (alternate angles on parallel lines)

$\therefore \triangle ALX$ isosceles (base angles equal)

$\therefore AL = LX$ (2)

ii) $\triangle CAB \parallel\!\mid \triangle CLX$

$$\therefore \frac{AB}{LX} = \frac{AC}{LC}$$

$$\frac{AB}{AC} = \frac{LX}{LC}$$

$$\therefore \frac{AB}{AC} = \frac{AL}{LC} \quad (AL = LX)$$

but $\frac{AL}{LC} = \frac{BX}{XC}$ (given)

$$\therefore \frac{AB}{AC} = \frac{BX}{XC}$$ (2)

(c) $x = te^{-t}$

$$\dot{x} = 1.e^{-t} + t.e^{-t}$$

$$= e^{-t}(1-t)$$

(i) $\dot{x} = 0$

$$(1-t)e^{-t} = 0$$

$$1-t = 0$$

$$t = 1$$ (3)

(ii) $\ddot{x} = -e^{-t}(1-t) + -1.e^{-t}$

$$= e^{-t}(-(1-t)-1)$$

$$= (t-2)e^{-t}$$

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

$$= -e^{-1}$$

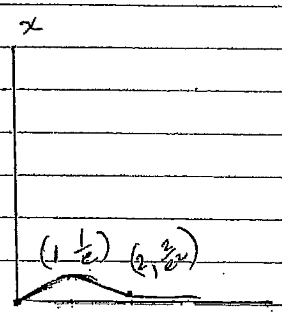
$$= -\frac{1}{e}$$ (2)

(iii) $\ddot{x} = 0$

$$(t-2)e^{-t} = 0$$

$$t = 2$$ (1)

(iv)



(2)

Question 16

(a)

(i) $A = \frac{1}{2}r^2\theta$ $\quad \theta = 2\pi - \frac{2\pi}{3} = \frac{4\pi}{3}$

$$\therefore 300 = \frac{1}{2}l^2\frac{4\pi}{3}$$

$$900 = 2\pi l^2$$

$$\frac{450}{\pi} = l^2$$

$\therefore 300 = \frac{1}{2}l^2\theta$, $600 = l^2\theta$, $l^2 = \frac{600}{\theta}$ full mks.

(ii) $r^2 + h^2 = l^2$

$$h^2 = l^2 - r^2$$

$$h = \sqrt{l^2 - r^2}$$

(iii) $V = \frac{1}{3}\pi r^2 h$

$$= \frac{1}{3}\pi r^2\sqrt{l^2 - r^2}$$

$$= \frac{1}{3}\pi r^2\sqrt{\frac{450}{\pi} - r^2}$$

$$= \frac{1}{3}r^2\sqrt{\pi^2\left(\frac{450}{\pi} - r^2\right)}$$

$$= \frac{1}{3}r^2\sqrt{450\pi - \pi^2 r^2}$$

(iv) $V = \frac{1}{3}r^2(450\pi - \pi^2r^2)^{\frac{1}{2}}$

$$V' = \frac{2}{3}r(450\pi - \pi^2r^2)^{\frac{1}{2}} + \frac{1}{2}(450\pi - \pi^2r^2)^{-\frac{1}{2}}\cdot -2\pi^2 r\cdot\frac{1}{3}r^2$$

$$= \frac{2}{3}r(450\pi - \pi^2r^2)^{\frac{1}{2}} - \frac{\pi^2}{3}r^3(450\pi - \pi^2r^2)^{-\frac{1}{2}}$$

$$= \frac{\frac{2}{3}r(450\pi - \pi^2r^2)}{(450\pi - \pi^2r^2)^{\frac{1}{2}}} - \frac{\frac{\pi^2}{3}r^3}{(450\pi - \pi^2r^2)^{\frac{1}{2}}}$$

$$= \frac{300r\pi - \frac{2}{3}\pi^2r^3 - \frac{1}{3}\pi^2r^3}{(450\pi - \pi^2r^2)^{\frac{1}{2}}}$$

$$= \frac{300\pi r - \pi^2 r^3}{\sqrt{450\pi - \pi^2r^2}}$$

(v) $V' = 0$

$$\frac{300\pi r - \pi^2r^3}{\sqrt{450\pi - \pi^2r^2}} = 0$$

$$300\pi r - \pi^2r^3 = 0$$

$$300r - \pi r^3 = 0$$

$$r(300 - \pi r^2) = 0$$

$$r(\sqrt{300} + \sqrt{\pi}r)(\sqrt{300} - \sqrt{\pi}r)$$

$\therefore r = 0, -\sqrt{\frac{300}{\pi}}, \sqrt{\frac{300}{\pi}}$

$0, -\sqrt{\frac{300}{\pi}}$ are not valid solutions

$\therefore r = \sqrt{\frac{300}{\pi}}$

r	9	$\sqrt{\frac{300}{\pi}}$	10
V'	37.8	0	−13.4
	+	0	−

$\therefore r = \sqrt{\frac{300}{\pi}}$ gives max. volume.

Question 16.

(i) $T_n = 4-(n-1)$

$T_1 = 4 \quad \therefore a = 4$

$T_2 = 2 \quad d = -2$

$T_3 = 0$

ii) $T_N = \frac{192}{63}\left(\frac{1}{2}\right)^{\frac{N-2}{2}}$

$T_1 = \frac{192}{63}\cdot\left(\frac{1}{2}\right)^0$

$= \frac{192}{63}$

$T_2 = \frac{192}{63}\cdot\left(\frac{1}{2}\right)^1$

$= \frac{192}{63}\cdot\frac{1}{2}$

$T_3 = \frac{192}{63}\cdot\left(\frac{1}{2}\right)^2$

$\therefore a = \frac{192}{63} \quad r = \frac{1}{2}$

(ii) $S_n + S_N \quad n=6 \quad N=6$

$a=4 \quad d=-2$

$S_6 = \frac{6}{2}(2\times4 + 5\times-2)$

$= 3(8-10)$

$= -6$

$a = \frac{192}{63} \quad r = \frac{1}{2} \quad S_n = \frac{a(1-r^n)}{1-r}$

$S_6 = \frac{\frac{192}{63}\cdot\left(1-\frac{1}{2}^6\right)}{1-\frac{1}{2}}$

$= \frac{\frac{192}{63}\cdot\left(1-\frac{1}{2^6}\right)}{\frac{1}{2}}$

$= \frac{384}{63}\left(1-\frac{1}{64}\right)$

$= \frac{384}{63}\cdot\frac{63}{64}$

$= \frac{384}{64}$

$= 6.$

$S_n + S_N$

$= -6 + 6$

$= 0$

$\therefore$ Kando is at the starting point.

(iv) Total distance backwards

is $-2 -4 - 6 - 8 - 10 = -30$

$\therefore$ 30 metres backwards.