Student Number: ____________________________

Hills Grammar

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION 2016

Year 12

MATHEMATICS

Time Allowed: Three Hours (plus five minutes reading time)

Teacher Responsible: Mitchell Parrish

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Board approved calculators may be used
- A reference sheet has been provided
- All necessary working must be shown
- Write your student number at the top of every page
- All questions should be attempted

Total marks - 100

Section A
Multiple Choice Questions - 10 marks
- **Answer on Multiple Choice Answer Sheet provided.**
- **Allow 15 minutes for this section.**

Section B
Short Answer Questions – 90 marks
- **Answer each question in the writing booklets provided.**
- **Allow 2 hours and 45 minutes for this section**

Section A	**Your Mark:**	**10**
Section B	**Your Mark:**	**90**
Total	**Your Mark:**	**100**

Students are advised that this is a Trial Examination only and cannot in any way guarantee the content or the format of the Higher School Certificate Examination.

Section I

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

Use the multiple-choice answer sheet for Questions 1-10.

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1 The value of $\dfrac{5.79+0.55}{\sqrt{4.32-3.28}}$ is closest to:

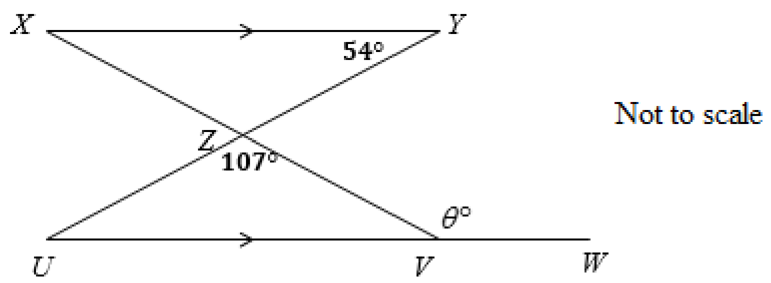
(A) 6.2

(B) 6.21

(C) 6.22

(D) 6.3

2 The diagram below shows XY parallel to UW, $\angle XYU = 54°$, $\angle UZV = 107°$ and $\angle ZVW = \theta°$.



The value of θ is:

(A) 161

(B) 19

(C) 54

(D) 107

3 What is the simultaneous solution to the equations $2x + y = 7$ and $x - 2y = 1$?

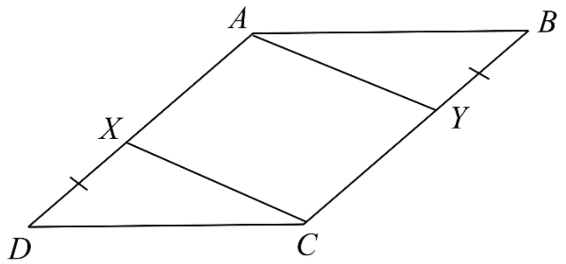
(A) $x = 3$ and $y = 1$

(B) $x = -1$ and $y = 9$

(C) $x = 2$ and $y = 3$

(D) $x = 5$ and $y = 1$

4 In the diagram below *ABCD* is a parallelogram and $BY = XD$.



Which test proves $\Delta ABY \equiv \Delta XCD$?

(A) SSS

(B) AAS

(C) SAS

(D) RHS

5 What are the values of *x* for which $|4 - 3x| < 13$?

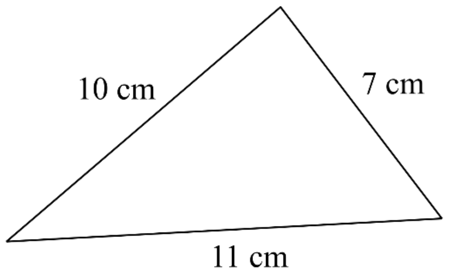
(A) $x < -3$ or $x < \frac{17}{3}$

(B) $x > -3$ or $x > \frac{17}{3}$

(C) $-3 < x < \frac{17}{3}$

(D) $\frac{17}{3} < x < -3$

6 The following triangle has sides 7 cm, 10 cm and 11 cm.



Not to scale

Angle A is the smallest angle. Which of the following expressions is correct for angle A?

(A) $\cos A = \dfrac{7^2 + 11^2 - 10^2}{2 \times 7 \times 11}$

(B) $\cos A = \dfrac{10^2 + 11^2 - 7^2}{2 \times 10 \times 11}$

(C) $\cos A = \dfrac{10^2 + 7^2 - 11^2}{2 \times 7 \times 10}$

(D) $\cos A = \dfrac{10^2 + 7^2 - 11^2}{2 \times 10 \times 11}$

7 For what values of x is the curve $f(x) = 2x^3 + x^2$ concave down?

(A) $x > 6$

(B) $x > -\dfrac{1}{6}$

(C) $x < -6$

(D) $x < -\dfrac{1}{6}$

8 What is the size of each interior angle in a regular octagon?

(A) $22.5°$

(B) $135°$

(C) $145°$

(D) $180°$

9 Which of the following is true for the equation $3x^2 - x - 2 = 0$?

(A) No real roots

(B) One real root

(C) Two real rational roots

(D) Two real irrational roots

10 Find the limiting sum of the geometric series:

$$1+\frac{\sqrt{2}}{\sqrt{2}+1}+\frac{2}{(\sqrt{2}+1)^2}+\frac{2\sqrt{2}}{(\sqrt{2}+1)^3}+.....$$

(A) $\sqrt{2}+1$

(B) $\sqrt{2}-1$

(C) $-\sqrt{2}-1$

(D) $\dfrac{1}{\sqrt{2}+1}$

Section II

90 marks
Attempt Questions 11-16
Allow about 2 hours and 45 minutes for this section

Answer each question in the appropriate writing booklet. Extra writing booklets are available.

In Question 11-16, your responses should include relevant mathematical reasoning and /or calculations.

Question 11 (15 marks) Start a new Writing Booklet for this question.

(a) Simplify $\frac{2}{x(x-3)} - \frac{1}{x}$. **2**

(b) Solve $x^2 - 3 = 3x + 1$. **2**

(c) Write $\frac{2}{2+\sqrt{3}}$ with a rational denominator. **2**

(d) Find the sum of the first ten terms of the arithmetic series $4\frac{1}{2} + 3 + 1\frac{1}{2} + \ldots$ **2**

(e) Factorise fully: $2 - 54x^3$. **2**

(f) Differentiate with respect to x:

(i) $y = x\sqrt{x}$ **1**

(ii) $f(x) = x\sin x$ **1**

(iii) $y = \left(1 + e^x\right)^5$ **1**

(g) Find:

(i) $\int \sec^2 5x \ \ dx$ **1**

(ii) $\int 2e^{-2y} dy$ **1**

End of Question 11

Question 12 (15 marks) Start a new Writing Booklet for this question..

(a) Evaluate, leaving as an exact answer where necessary:

(i) $\displaystyle\int_{-1}^{2}(x^2+1)dx$ **1**

(ii) $\displaystyle\int_{0}^{3}\frac{6x}{1+x^2}\,dx$ **2**

(b) Find the equation of the normal to the curve $y=\dfrac{2}{\sqrt{x}}$ at the point (1, 2). **2**

(c) Given that $\sin\theta=\dfrac{4}{7}$ and $\tan\theta<0$, find the exact value of $\cos\theta$. **2**

(d) Given the equation $3x^2+4x-3=0$ has roots α and β, find:

(i) $\alpha+\beta$ **1**

(ii) $\alpha\beta$ **1**

(iii) $\alpha^2+\beta^2$ **2**

(e) Solve the equation $(\cos x+2)(2\cos x+1)=0$ in the domain $0\leq x\leq 2\pi$. **2**

(f) Sketch the graph of the function $y=\dfrac{1}{x+1}$ showing its key features. **2**

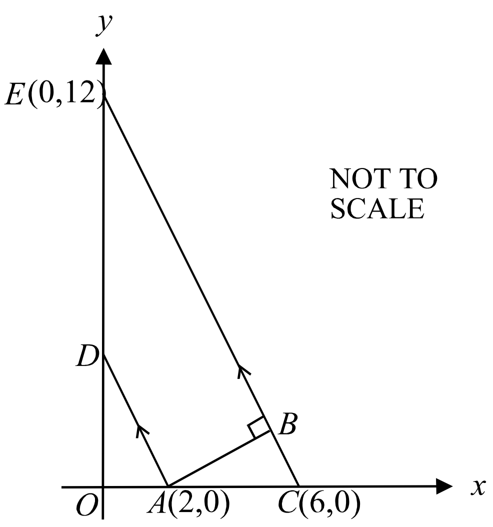
End of Question 12

Question 13 (15 marks) Start a new Writing Booklet for this question.

(a) For what values of k is $x^2 - 2kx + 6k$ positive definite? **2**

(b) Show that $\operatorname{cosec}\theta - \sin\theta = \cot\theta\cos\theta$. **2**

(c) In the diagram below, A, C and E are the points $(2,0)$, $(6,0)$ and $(0,12)$ respectively. The line AD is parallel to the line CE and the line AB is perpendicular to the lines AD and CE.



(i) Show that the equation of the line CE is $y = -2x + 12$. **1**

(ii) Find coordinates of the point D. **1**

(iii) Show that the length of AB is $\dfrac{8\sqrt{5}}{5}$. **1**

(iv) Find the coordinates of the point B. **2**

(v) Find the exact area of the trapezium $ACED$. **2**

(d) Find the volume obtained by rotating the area beneath the curve $y = e^x$ from $x = 0$ to $x = 2$ about the x-axis. Give your answer as an exact value. **2**

(e) Find the equation of the parabola whose vertex is at (2,0) and whose directrix is given by $x = 5$. **2**

End of Question 13

Question 14 (15 marks) Start a new Writing Booklet for this question.

(a) For the circle $x^2 + y^2 + 4x - 2y + 1 = 0$,

(i) find the centre and radius by completing the square. **2**

(ii) Hence sketch the circle. **2**

(b) The number of subscribers S, to a pay-TV company t years after its launch is given by $S = S_0 e^{kt}$, where S_0 and k are constants. Initially the pay TV company had 50 000 subscribers and after 3 years it had 200 000.

(i) Find the value of S_0. **1**

(ii) Find the exact value of k. **2**

(iii) After how many years will the number of subscribers first exceed one million? Express your answer correct to two decimal places. **2**

(iv) After 3 years, what is the rate at which the number of subscribers is increasing? **2**

(c) The depth D, in metres, of a liquid stored in a barrel at time t seconds is given by

$$D = \frac{t^2 + 1}{e^{2t}}, \qquad t \geq 0.$$

(i) What was the initial depth of the liquid in the barrel? **1**

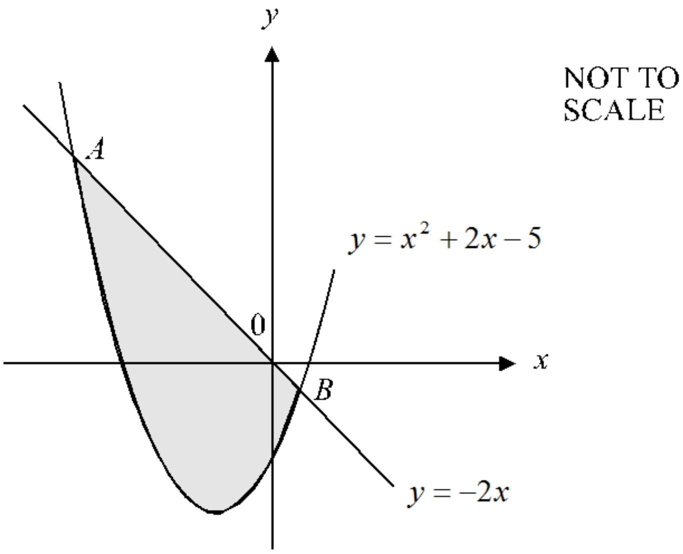
(ii) Find an expression for the rate at which the depth of the liquid changes. **2**

(iii) Hence explain whether the depth of the liquid was increasing or decreasing when $t = 10$. **1**

End of Question 14

Question 15 (15 marks) Start a new Writing Booklet for this question.

(a) The diagram below shows the graphs of $y = x^2 + 2x - 5$ and $y = -2x$.
These two graphs intersect at point A and point B.



(i) Find the x-coordinates of the points of intersection A and B. **1**

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

(b) A particle moves in a straight line so that its displacement x, in metres from the origin at time t seconds is given by:

$$x = \log_e(t+1), \qquad t \geq 0$$

(i) Find the initial position of the particle. **1**

(ii) Explain how many times the particle is at the origin. **1**

(iii) Find an expression for the velocity and the acceleration of the particle. **2**

(iv) Explain whether or not the particle is ever at rest. **1**

(c) (i) Use two applications of the trapezoidal rule to find an approximation for $\int_0^2 \sqrt{16-x^2}\,dx$. Give your answer correct to three significant figures. **2**

(ii) Explain whether this approximation is greater than or less than the exact value. **1**

(d) A closed water tank in the shape of a cylinder is to be constructed with a surface area of $54\pi\,\text{cm}^2$. The height of the cylinder is h cm and the base radius is r cm.

Surface Area of a cylinder $= 2\pi r^2 + 2\pi rh$

Volume of a cylinder = $\pi r^2 h$

i) Show that the volume V that can be contained in the tank is given by $V = 27\pi r - \pi r^3$. **2**

ii) Find the radius r cm which will give the cylinder its greatest possible volume. **2**

End of Question 15

Question 16 (15 marks) Start a new Writing Booklet for this question.

(a) The function $f(x) = e^{x} + e^{-x}$ is defined for all real values of x.

(i) Show that $f(x)$ is an even function. **1**

(ii) Find the y-intercept. **1**

(iii) Find the exact value of $f(-1)$. **1**

(iv) Find the stationary point and determine its nature. **2**

(v) Show that there are no points of inflection. **1**

(vi) Hence sketch the curve of $y = f(x)$. **2**

(b) Julian borrowed \$20 000 from a finance company to purchase a car. Interest on the loan is calculated quarterly at the rate of 2.5% per quarter and is charged immediately prior to Julian making his quarterly repayment of \$$M$.

Let A_n be the amount in dollars owing on the loan after the n^{th} repayment has been made.

(i) Show that $A_3 = 20\,000 \times 1\cdot025^3 - M\left(1 + 1\cdot025 + 1\cdot025^2\right)$. **1**

(ii) Show that $A_n = 20\,000 \times 1\cdot025^n - 40M\left(1\cdot025^n - 1\right)$. **2**

(iii) If the loan were to be paid out after 7 years what would the value of M be? Answer correct to the nearest cent. **2**

(iv) If Julian were to pay \$1000 per quarter in repayments, how long would it take to pay out his loan? **2**

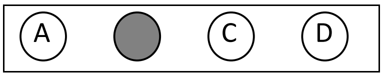
End of Examination

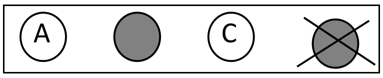
MATHEMATICS: MULTIPLE CHOICE ANSWER SHEET

Student:________________________ Teacher:_________________________

Select the alternative A, B, C or D that best answers the question. Fill in the response circle completely.

Sample: 2 + 4 = A. 2 B. 6 C. 8 D. 9





If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word correct and drawing an arrow towards the correct answer.

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

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Multiple Choice. 1) C 6) B 2) A 7) D 3) A 8) B 4) C 9) C 5) C 10) A Question 11 a) $\frac{2}{x(x-3)} - \frac{1}{x}$ $= \frac{2-(x-3)}{x(x-3)}$ $= \frac{2-x+3}{x(x-3)}$ $= \frac{5-x}{x(x-3)}$ b) $x^2-3 = 3x+1$ $x^2-3x-4=0$ $(x-4)(x+1)=0$ $x = 4, -1$ c) $\frac{2}{2+\sqrt{3}} = \frac{2}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}}$ $= 2(2-\sqrt{3})$	

Suggested Solutions, Marking Scheme and Markers' comments

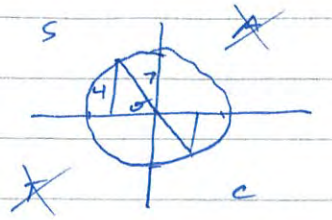
Suggested solution(s)	comments
d) $4\frac{1}{2} + 3 + 1\frac{1}{2} + \ldots$ AP with $a = 4\frac{1}{2}$, $d = -1\frac{1}{2}$ $T_n = a + (n-1)d$ $T_{10} = 4\frac{1}{2} + 9 \times -1\frac{1}{2}$ $= -9$ $S_n = \frac{n}{2}(a + l)$ $= 5(4\frac{1}{2} + -9)$ $= -22\frac{1}{2}$ e) $2 - 54x^3 = 2(1 - 27x^3)$ $= 2(1 - 3x)(1 + 3x + 9x^2)$ f) i) $y = x\sqrt{x} = x^{\frac{3}{2}}$ $y' = \frac{3}{2}x^{\frac{1}{2}} = \frac{3\sqrt{x}}{2}$ ii) $f(x) = x\sin x$ $= \sin x + \cos x \cdot x$ $= \sin x + x\cos x$ iii) $y = (1 + e^x)^5$ $= 5(1 + e^x)^4 \cdot e^x$ $= 5e^x(1 + e^x)^4$ g) i) $\int \sec^2 5x \, dx$ $= \frac{1}{5}\tan 5x + C$ ii) $\int 2e^{-2y} \, dy$ $= -e^{-2y} + C$	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Question 12 a) i) $\int_{-1}^{2}(x^2+1)\,dx$ $= \left[\frac{x^3}{3}+x\right]_{-1}^{2}$ $= \left(\frac{8}{3}+2\right)-\left(-\frac{1}{3}-1\right)$ $= 6$ ii) $\int_{0}^{3}\frac{6x}{1+x^2}\,dx$ $= 3\int_{0}^{3}\frac{2x}{1+x^2}\,dx$ $= 3\left[\ln(1+x^2)\right]_{0}^{3}$ $= 3(\ln 10 - \ln 1)$ $= 3\ln 10$ b) $y = \frac{2}{\sqrt{x}} = 2x^{-\frac{1}{2}}$ $y' = -x^{-\frac{3}{2}} = -\frac{1}{\sqrt{x^3}}$ $m_T = -1$ $\therefore m_N = 1$ eqn. of N: $y - y_1 = m(x - x_1)$ $y - 2 = 1(x-1)$ $y = x + 1$	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
c) $\sin\theta = \frac{4}{7}$, $\tan\theta < 0$	



$A = \sqrt{7^2 - 4^2} = \sqrt{49-16} = \sqrt{33}$

$\therefore \cos\theta = -\frac{\sqrt{33}}{7}$ //

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

i) $\alpha + \beta = -\frac{b}{a} = -\frac{4}{3}$ //

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

iii) $\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$

$= \frac{16}{9} + 2$

$= \frac{34}{9}$ //

e) $(\cos x + 2)(2\cos x + 1) = 0, 0 \le x \le 2\pi$

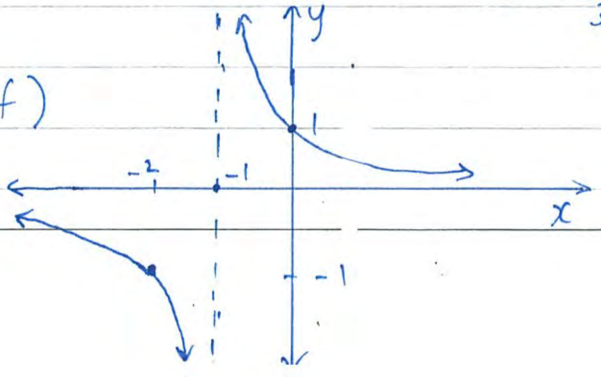
$\cos x = -2$, $\cos x = -\frac{1}{2}$

no soln.

$x = \pi - \frac{\pi}{3}, \pi + \frac{\pi}{3}$

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

f)



Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Question 13	
a) $\Delta < 0$ for pos. def.	
$\Delta = b^2 - 4ac$	
$= (-2k)^2 - (4 \times 1 \times 6k)$	
$= 4k^2 - 24k < 0$	
$4k(k-6) < 0$	
$0 < k < 6$	
b) $\operatorname{cosec}\theta - \sin\theta = \cot\theta\cos\theta$	
$LHS = \operatorname{cosec}\theta - \sin\theta$	
$= \dfrac{1}{\sin\theta} - \sin\theta$	
$= \dfrac{1-\sin^2\theta}{\sin\theta}$	
$= \dfrac{\cos^2\theta}{\sin\theta}$	
$= \cos\theta \times \dfrac{1}{\sin\theta}$	
$= \cot\theta\cos\theta$	
$=$ RHS as req'd.	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
c) i) $m_{CE} = -2$ eqn CE: $y - y_1 = m(x - x_1)$ $y - 0 = -2(x - 6)$ $y = -2x + 12$ ii) D is $(0, 4)$ (since $m_{AD} = m_{CE}$) iii) $d_{AB} = \dfrac{\lvert ax_1 + by_1 + c \rvert}{\sqrt{a^2 + b^2}}$ $= \dfrac{\lvert 2(2) + 0 + -12 \rvert}{\sqrt{2^2 + 1^2}}$ $= \dfrac{8}{\sqrt{5}}$ $= \dfrac{8\sqrt{5}}{5}$ iv) $m_{AB} = \frac{1}{2}$ eqn AB: $y - y_1 = m(x - x_1)$ $y - 0 = \frac{1}{2}(x - 2)$ $2y = x - 2$ $x - 2y - 2 = 0$ $x - 2y - 2 = 0 \quad \ldots (1) \quad (AB)$ $2x + y - 12 = 0 \quad \ldots (2) \quad (CE)$ $(2) \times 2: \; 4x + 2y - 24 = 0 \quad \ldots (2A)$ $(1) + (2A): \; 5x - 26 = 0$ $5x = 26$ $x = 5\frac{1}{5}$ $x = 5\frac{1}{5}$ into (2): $2(5\frac{1}{5}) + y - 12 = 0$ $y = 1$	

$\therefore$ B is at $(5\frac{1}{5}, 1)$

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments

v) $A = A_{\Delta EOC} - A_{\Delta DOA}$

$= \left(\frac{1}{2} \times 12 \times 6\right) - \left(\frac{1}{2} \times 4 \times 2\right)$

$= 32 u^2$

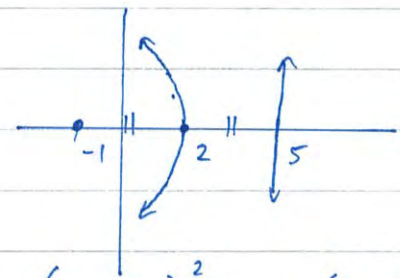
d) $V = \pi \int_0^2 y^2 \, dx$

$= \pi \int_0^2 e^{2x} \, dx$

$= \pi \left[\frac{1}{2} e^{2x}\right]_0^2$

$= \frac{\pi}{2}\left(e^4 - 1\right) u^3$

e)



$(y-k)^2 = -4a(x-h)$

$y^2 = -12(x-2)$

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments

Question 14

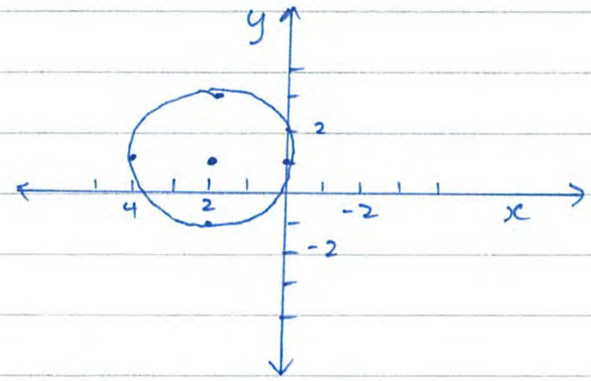
a) i) $x^2+y^2+4x-2y+1=0$

$x^2+4x+4+y^2-2y+1=-1+4+1$

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

$\therefore$ centre: $(-2, 1)$ radius $= 2$ units

ii)



b) i) $S_0 = 50\,000$

ii) $S = 50\,000e^{kt}$

$200\,000 = 50\,000e^{3k}$

$e^{3k} = 4$

$3k = \ln 4$

$k = \frac{\ln 4}{3}$

iii) i.e. find t when $S > 10^6$

$50\,000e^{kt} = 10^6$

$e^{kt} = 20$

$kt = \ln 20$

$t \doteqdot 6.48$

$\therefore$ after 6.48 years.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
iv) i.e. find $\frac{dS}{dt}$ when $t=3$ $\frac{dS}{dt} = kS$ $= k \times 50\,000e^{3k}$ $\doteq 92\,419$ sub. / yr. c) $D = \frac{t^2+1}{e^{2t}}$ i) $D = 1$ m ii) $\frac{dD}{dt} = \frac{2t \cdot e^{2t} - 2e^{2t} \cdot (t^2+1)}{e^{4t}}$ $= \frac{2e^{2t}(t - t^2 - 1)}{e^{4t}}$ $= -\frac{2(t^2 - t + 1)}{e^{2t}}$ m/s iii) $\frac{dD}{dt}(10) < 0$ i.e. depth decreasing when $t = 10$	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**

Question 15

a) i) $-2x = x^2 + 2x - 5$

$x^2 + 4x - 5 = 0$

$(x+5)(x-1) = 0$

$x = -5, 1$ are co-ords of A and B respectively.

ii) $A = \int_{-5}^{1} \left(-2x - (x^2 + 2x - 5)\right) dx$

$= \int_{-5}^{1} (-2x - x^2 - 2x + 5)\, dx$

$= \left[-\frac{4x^2}{2} - \frac{x^3}{3} + 5x\right]_{-5}^{1}$

$= \left(-2(1)^2 - \frac{1}{3} + 5\right) - \left(-2(5)^2 - \frac{5^3}{3} + 5(-5)\right)$

$= \frac{108}{3}\, u^2$

b) i) $x(0) = 0$ i.e at the origin

ii) Only once since $x > 0$ for all $t > 0$

iii) $v = \frac{1}{t+1}$ m/s

$a = -\frac{1}{(t+1)^2}$ m/s^2

iv) Never, since $v > 0$ for all $t \geq 0$

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
c) i) $\int_0^2 \sqrt{16-x^2}\,dx$ $\doteqdot \frac{1}{2}\left(\sqrt{16}+\sqrt{15}\right)+\frac{1}{2}\left(\sqrt{15}+\sqrt{12}\right)$ $\doteqdot 7.61\ (3sf)$ // d) i) $2\pi r^2 + 2\pi r h = 54\pi$ $r^2 + rh = 27$ $h = \frac{27-r^2}{r}$ $V = \pi r^2 h$ $= \pi r^2 \times \frac{27-r^2}{r}$ $= 27\pi r - \pi r^3$ // ii) $\frac{dV}{dr} = 27\pi - 3\pi r^2$ $27\pi - 3\pi r^2 = 0$ $3\pi(9-r^2) = 0$ $r^2 = 9$ $r = +3\ (r>0)$ $\frac{d^2V}{dr^2} = -6\pi r$ $\frac{d^2V}{dr^2}(3) = -18\pi < 0$ $\therefore\ r=3$ gives maximum V. //	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Question 16 a) $f(x) = e^{x} + e^{-x}$ i) $f(x)$ is even if $f(-x) = f(x)$ $f(-x) = e^{-x} + e^{x}$ $= f(x)$ as req'd. ii) $f(0) = 2$ iii) $f(-1) = e^{-1} + e$ $= \frac{1}{e} + e$ iv) SP's exist when $f'(x) = 0$ $f'(x) = e^{x} - e^{-x}$ $e^{x} - e^{-x} = 0$ $x = 0$ $f''(x) = e^{x} + e^{-x} = f(x)$ $f''(0) = 2 > 0$ (min) $\therefore$ $(0, 2)$ is a min. TP v) POI's exist when $f''(x)=0$ and concavity changes. $e^{x} + e^{-x} = 0$ $\downarrow$ no soln. $\therefore$ There are no POI's.	

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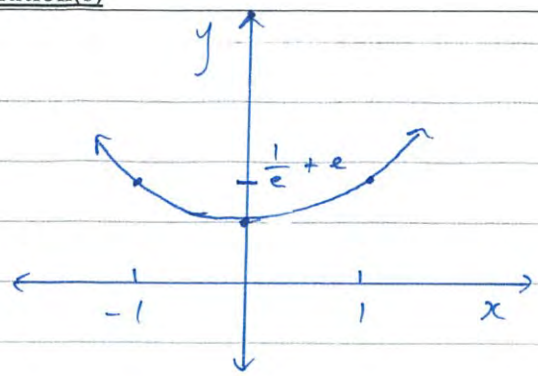
vi)



b) i) $A_n = (\text{Principal} + \text{Interest}) - (\text{Repayments} + \text{Interest})$

$\therefore A_3 = 20\,000(1.025)^3 - \left(M(1.025)^2 + M(1.025)^1 + M\right)$

$= 20\,000(1.025)^3 - M(1 + 1.025 + 1.025^2)$

ii) $A_n = 20\,000(1.025)^n - \left(M + M(1.025)^1 + \cdots + M(1.025)^{n-1}\right)$

$= 20\,000(1.025)^n - \dfrac{M(1.025^n - 1)}{0.025}$

$= 20\,000(1.025)^n - 40M(1.025^n - 1)$

iii) i.e. find M when $A_{28} = 0$

$20\,000(1.025)^{28} - 40M(1.025^{28} - 1) = 0$

$M = \dfrac{-20\,000(1.025)^{28}}{-40(1.025^{28} - 1)}$

$= \$1001.76$ (nearest cent)

iv) i.e. find n when $A_n = 0$ and $M = 1000$

$20{,}000(1.025)^n - 40{,}000(1.025^n - 1) = 0$

$20{,}000(1.025)^n - 40{,}000(1.025)^n + 40{,}000 = 0$

$20{,}000\left(1.025^n - 2(1.025)^n\right) = -40{,}000$

$-(1.025)^n = -2$

$\ln 1.025^n = \ln 2$

$n \doteqdot 28.07$

i.e. 29 quarters.