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. Which of the following is equal to $\dfrac{x^2-36}{x-6}$?

(A) $x-6$

(B) $x+6$

(C) $x-3$

(D) $x+3$.

2. What are the solutions to $3x^2-7x-1=0$?

(A) $x=\dfrac{-7\pm\sqrt{37}}{6}$

(B) $x=\dfrac{-7\pm\sqrt{61}}{6}$

(C) $x=\dfrac{7\pm\sqrt{37}}{6}$

(D) $x=\dfrac{7\pm\sqrt{61}}{6}$.

3. What are the exact solutions of $2\cos x=-\sqrt{3}$ for $0\le x\le 2\pi$?

(A) $\dfrac{\pi}{6}$ and $\dfrac{11\pi}{6}$

(B) $\dfrac{5\pi}{6}$ and $\dfrac{7\pi}{6}$

(C) $\dfrac{\pi}{3}$ and $\dfrac{5\pi}{3}$

(D) $\dfrac{2\pi}{3}$ and $\dfrac{4\pi}{3}$.

4. Which of the following define the domain and range of the function $f(x)=\log_e x$?

(A) Domain: all real *x* and Range: all real *y*.

(B) Domain: $x>0$ and Range: $y>0$

(C) Domain: all real *x* and Range: $y>0$

(D) Domain: $x>0$ and Range: all real *y*.

5. What is the derivative of $\left(e^{3x}+1\right)^{-2}$?

(A) $-2e^{3x}\left(e^{3x}+1\right)^{-3}$

(B) $-2e^{3x}\left(e^{3x}+1\right)^{-1}$

(C) $-6e^{3x}\left(e^{3x}+1\right)^{-3}$

(D) $-6e^{3x}\left(e^{3x}+1\right)^{-1}$.

6. What is the perpendicular distance of the point (4,5) from the line $3x-2y+10=0$?

(A) $\frac{12}{\sqrt{13}}$

(B) $\frac{17}{\sqrt{13}}$

(C) $\frac{2}{\sqrt{5}}$

(D) $\frac{12}{\sqrt{41}}$.

7. What is the solution of $5^x=20$?

(A) $\log_4 5$

(B) $\log_5 4$

(C) $1+\log_4 5$

(D) $1+\log_5 4$.

8. A parabola has a focus (3,1) and directrix $x = 5$. What is the equation of the parabola?

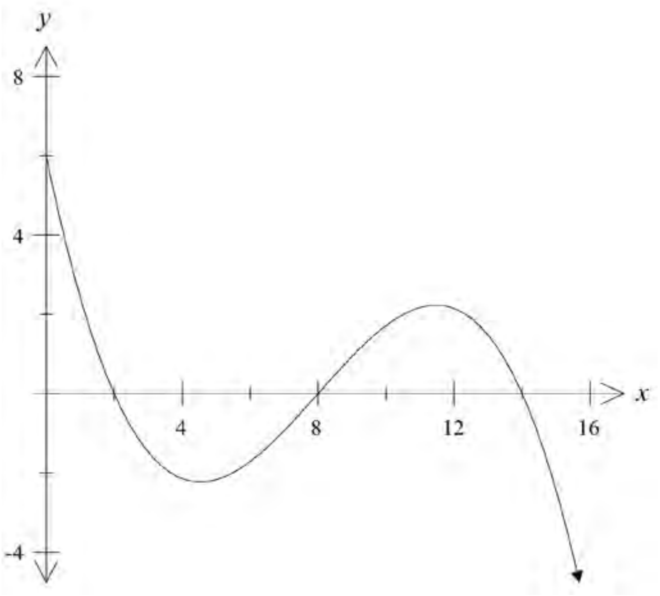
(A) $(y-1)^2 = -4(x-4)$

(B) $(y-1)^2 = 8(x-3)$

(C) $(x-3)^2 = -8(y-3)$

(D) $(x-3)^2 = -16(y-1)$.

9. The diagram below shows the graph $y = f(x)$.



Where is the function increasing, at a decreasing rate?

(A) $(2,0)$

(B) $(6,-1.8)$

(C) $(10,1.8)$

(D) $(14,0)$.

10. What is the value of $\int_3^5 4x^3 dx$

(A) 192

(B) 408

(C) 544

(D) 706.

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)

a) Evaluate $\frac{\ln 5}{3}$ correct to three significant figures. **1**

b) Evaluate $\lim\limits_{x\to 3}\frac{x^3-3x^2}{x-3}$ **2**

c) Differentiate $(1+\tan x)^4$ **2**

d) Differentiate $x\ln x$ **2**

e) Find $\int 4xe^{x^2+1}dx$ **2**

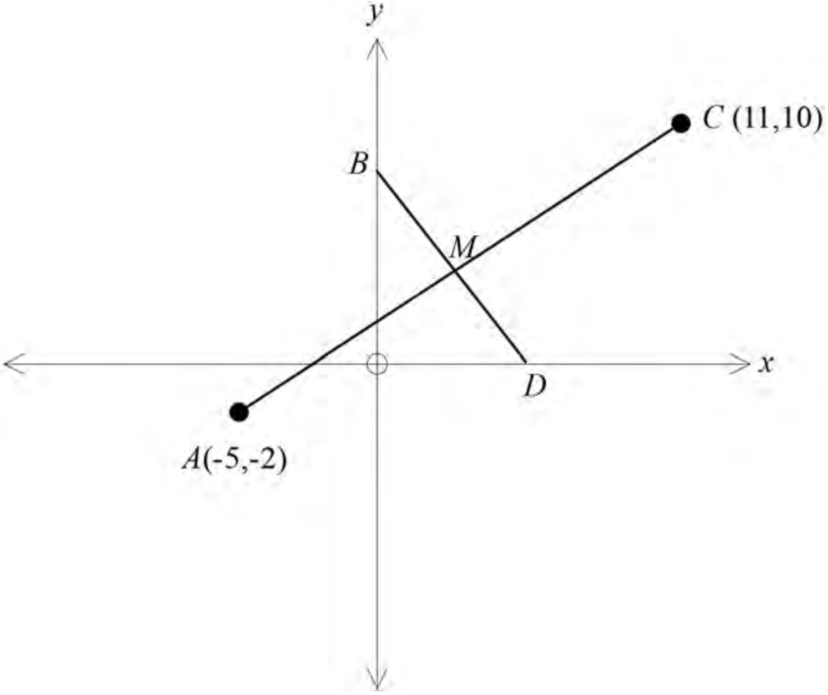
f) Evaluate $\int_0^2 \frac{3x}{x^2+1}dx$ **3**

g) Sketch the region defined by $x^2+(y-1)^2 \ge 9$ **3**

Question 12 (15 marks) Start a new booklet.

a) Given that $\int_0^4 kx + 2dx = 12$, and k is a constant, find the value of k. **2**

b) $A(-5,-2)$ and $C(11,10)$ are two points on the number plane.
M is the midpoint of AC and the perpendicular bisector of AC meets the x axis at D and the y axis at B.



i. Find the coordinates of M. **1**

ii. Show that the equation of the perpendicular bisector of AC,
i.e. line BMD, is $4x + 3y - 24 = 0$ **2**

iii. Hence find the coordinates of the points B and D. **2**

iv. Show that the quadrilateral $ABCD$ is a rhombus. **2**

c) Chairs are arranged in rows in front of a stage in a concert hall, so the row closest to the stage is the first row. Each row has two more chairs than the row in front of it. There are forty-two chairs in the tenth row.

i. How many chairs are in the first row? **2**

ii. The seating arrangement has a total of 680 chairs. **3**
How many rows of chairs are in the concert hall?

iii. How many chairs are in the last row? **1**

Question 13 (15 marks) Start a new booklet.

a) The population $P(t)$ of turtles in a conservation park is given by:

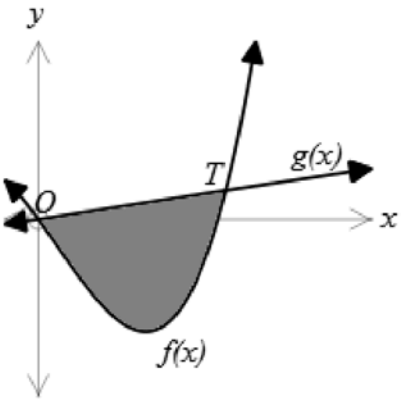
$$P(t) = 200 - 75\sin\left(\frac{\pi t}{3}\right).$$

where t is time in months.

i. Find all times during the first 12 months when the population equals 275 turtles. **2**

ii. Sketch the graph of $P(t)$ for $0 \le t \le 12$. **2**

b) The diagram shows the graphs of the function $g(x) = 3x$ and $f(x) = 5x^3 - 5x^2 - 27x$
The graphs meet at O and T.



i. Find the x-coordinate of T. **1**

ii. Find the area of the shaded region between the graphs of the functions. **3**

c) Tina borrows \$5000 at 1.5% per month reducible interest and pays the loan off in equal monthly instalments. Tina is to repay the loan in 3 years.
Calculate the value of each monthly instalment. **3**

d) The diagram shows two quadrants, centre *O*.
$OA = 3$ cm, $OD = 2$ cm, $\angle AOP = \theta$ radians.

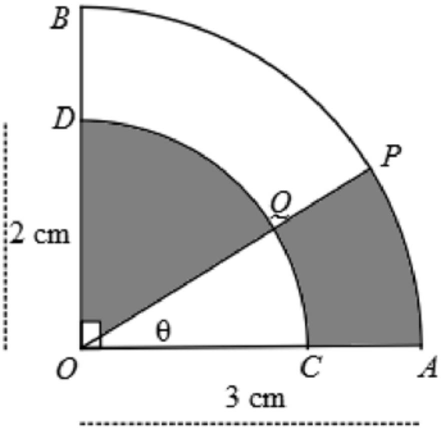


Diagram is NOT drawn to scale.

i. Show that $\frac{5}{2}\theta$ is an expression for the area of the shaded region *APQC*. **1**

ii. If the area of the shaded region *APQC* is $\frac{5\pi}{6}$ squared centimetres.
Find the size of $\angle AOP$. **1**

iii. Hence find the exact area of shaded sector *OQD*. **2**

Question 14 (15 marks) Start a new booklet.

a) A particle travels so that its displacement (*x* metres), after t seconds is given by:
$x = 12t - 3t^2$.

i. Where is the particle 3 seconds after it starts? **1**

ii. When does the particle turn around? **1**

iii. How far does the particle travel during the first 5 seconds? **2**

iv. Find the greatest speed during the first 5 seconds. **1**

b) A cylinder is to be cut from a solid sphere.
The diagram below shows a cross section of the sphere and cylinder.
The sphere has a diameter of 8 cm. The cylinder has a height of *h* cm and a radius of *r* cm.

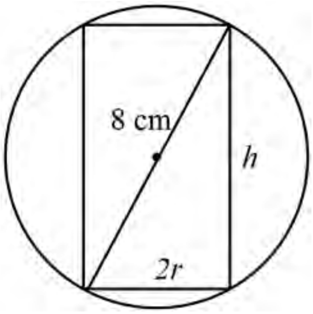


Diagram is NOT drawn to scale.

i. Show that the volume (V) of the cylinder is given by: **2**

$$V = \pi\left(\frac{64 - h^2}{4}\right)h$$

ii. Find the value of h such that the volume of the cylinder is a maximum. **3**

c) On an island, the population P after t years is given by: $P = P_0e^{kt}$.
The initial population of the island is halved in 25 years.

i. Show that $k = \dfrac{\ln 0.5}{25}$ **1**

ii. How long will it take for the population to reduce from 5000 people to 2000 people ? **2**

iii. What percentage of the original population will be present after 75 years? **2**

Question 15 (15 marks) Start a new booklet.

a) i. Copy this table and complete it, leave your answers as fractions. **1**

x	1	2	3	4	5
$\dfrac{2}{x(x+1)}$					

ii. Use the 5 functional values from part i, and Simpson's rule, to find an approximation to **2**

$\displaystyle\int_1^5 \frac{2}{x(x+1)}\,dx$. Write your approximation using two decimal places.

iii. Show that $\dfrac{2}{x}-\dfrac{2}{x+1}=\dfrac{2}{x(x+1)}$. **2**

iv. Deduce the value of the integral in part ii, correct to two decimal places. **2**

b) In the diagram, *ABCD* is a quadrilateral and *BD* is a diagonal.
CB = 8 cm, *AB* = 9 cm, *AD* = 6 cm and *BD* = 12 cm. ∠ *DAB* = ∠ *CBD*.

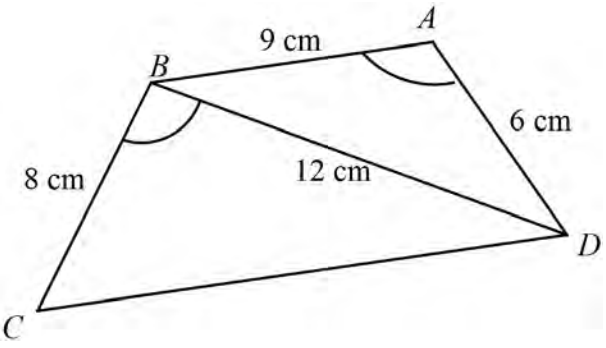


Diagram is NOT drawn to scale.

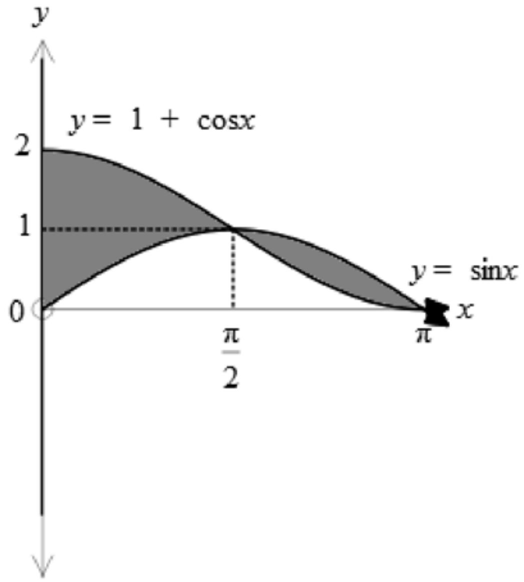
i. Prove triangle *ABD* and *BDC* are similar. **2**

ii. Find the length of *CD*. **2**

iii. Prove that *AB* and *CD* are parallel **1**

c) The graphs of $y = \sin x$ and $y = 1 + \cos x$ are shown intersecting at $x = \frac{\pi}{2}$ and $x = \pi$ **3**

Calculate the total area of the two shaded regions.



Question 16 (15 marks) Start a new booklet.

a) The region bounded by the curve $y = \sec x$, the lines $x = \frac{\pi}{4}$ and $x = \frac{\pi}{3}$ is rotated through one complete revolution about the x axis. **3**

Find the volume of the solid of revolution. Give your answer in exact form.

b) The acceleration of a particle is given by:

$$\ddot{x} = -12e^{-2t}$$

where x is displacement in metres and t is time in seconds.
Initially its velocity is 7 ms^{-1} and its displacement is 4 m.

i. Show that the velocity of the particle is given by: $\dot{x} = 6e^{-2t} + 1$ **2**

ii. Graph the velocity with respect to time. **2**

iii. Find the displacement when $t = 3$ seconds. **2**

c) Consider the function $y = 1 + 3x - x^3$, for $-2 \le x \le 3$.

i. Find all stationary points and determine their nature. **3**

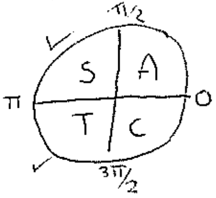
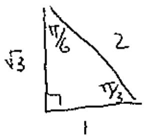
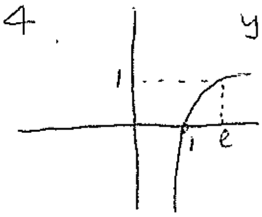
ii. Find the point of inflexion. **1**

iii. Sketch the curve for $-2 \le x \le 3$. Do not find the *x*- intercepts. **1**

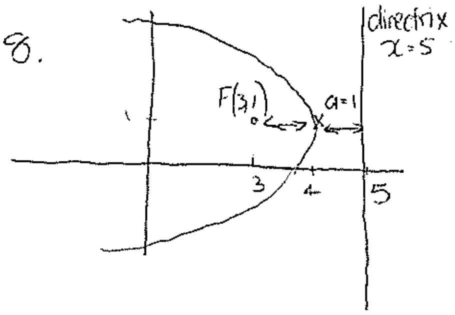
iv. What is the minimum value for the curve over the stated domain? **1**

END OF THE EXAMINATION

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Multiple Choice Q1 Factorise, then simplify $\frac{(x+6)\cancel{(x-6)}}{\cancel{(x-6)}} = x+6$ Ⓑ	
Q2 Quadratic Formula $a=3 \quad b=-7 \quad c=-1$ $x = \frac{--7 \pm \sqrt{(-7)^2-4(3)(-1)}}{2(3)}$ $x = \frac{7 \pm \sqrt{49+12}}{6} = \frac{7 \pm \sqrt{61}}{6}$ Ⓓ	
Q3. Solve, using the 4 quadrants. $2\cos x = -\sqrt{3}$ $\cos x = -\frac{\sqrt{3}}{2}$  2nd +3rd Quadrants $x = \pi - \pi/6$ and $\pi + \pi/6$ $x = \frac{5\pi}{6}$ and $\frac{7\pi}{6}$  Ⓑ	
Q4.  $y=f(x)=\log_e x$ domain: $x 7 0$ range: all real y Ⓓ	

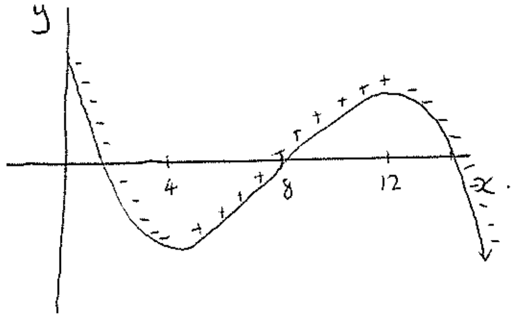
Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q5. Function of a Function - Chain Rule $y = (e^{3x}+1)^{-2}$ $\frac{dy}{dx} = -2(e^{3x}+1)^{-3} \times 3e^{3x}$ $\frac{dy}{dx} = -6e^{3x}(e^{3x}+1)^{-3}$ Ⓒ	
Q6. $\overset{x,\,y}{(4,5)}$ $\overset{a=3 \quad b=-2 \quad c=10}{3x-2y+10=0}$ $d = \frac{\lvert ax+by+c \rvert}{\sqrt{a^2+b^2}} = \frac{\lvert 3(4)-2(5)+10 \rvert}{\sqrt{(3)^2+(-2)^2}}$ $d = \frac{12}{\sqrt{13}}$ Ⓐ	
Q7. change index form to log form $\log_5 20 = x$ $\log_5(5\times4) = x$ $\log_5 5 + \log_5 4 = x$ $1 + \log_5 4$ Ⓓ	
Q8.  $(y-h)^2 = -4a(x-k)$ $(y-1)^2 = -4(x-4)$ vertex $(4,1)$ Ⓐ	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments

Q9.



gradient indicated by + & - signs.

"approximate" due to scale.

function is increasing between $x = $ "4" and $x = $ "12"

rate is increasing between $x = $ "4" and $x = $ "8"

rate is decreasing between $x = $ "8" and $x = $ "12"

Ⓒ

Q10.

$$\int_3^5 4x^3\,dx = \left[\frac{4x^4}{4}\right]_3^5$$

$$5^4 - 3^3 = 544$$

Ⓒ

Q11. a) 0.536 (3.S.F)

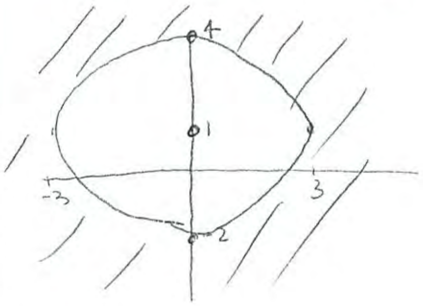
b) $\lim_{x \to 3} \frac{x^2(x-3)}{(x-3)} = \lim_{x \to 3} x^2 = 9$ ① ①

c) $y = (1+\tan x)^4$

$$\frac{dy}{dx} = 4(1+\tan x)^3 \times \sec^2 x$$ ①

$$\frac{dy}{dx} = 4\sec^2 x\,(1+\tan x)^3$$ ①

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q11d) $y = x\ln x$ $\frac{dy}{dx} = (1)\ln x + x\left(\frac{1}{x}\right)$ ① $\frac{dy}{dx} = \ln x + 1$ ① e) $\int 4xe^{x^2+1}\,dx = \underset{①}{2e^{x^2+1}} + \underset{①}{C}$ f) $\int_0^2 \frac{3x}{x^2+1}\,dx = \left[\frac{3}{2}\ln(x^2+1)\right]_0^2$ ① log function $\frac{3}{2}\ln 5 - \underset{①}{\frac{3}{2}\ln 1} = \frac{3}{2}\ln 5$ ① ↑ correct substitution g) circle centre $(0,1)$ ① radius 3 ①  test $(0,0)$ $0^2 + 1^2 \le 9$ ∴ outside of circle required ①	Do not write $\frac{4x\,e^{(x^2+1)}}{2x}$ You will be penalised in HSC. Students did not check answers by differentiating after finding integral.
Q12 a) $\left[\frac{kx^2}{2} + 2x\right]_0^4 = 12$ ① $(8k+8) - (0+0) = 12$ $8k = 4$ $k = 1/2$ ①	Need to distinguish constants from x variables. Constants are not changed by differentiation or integration

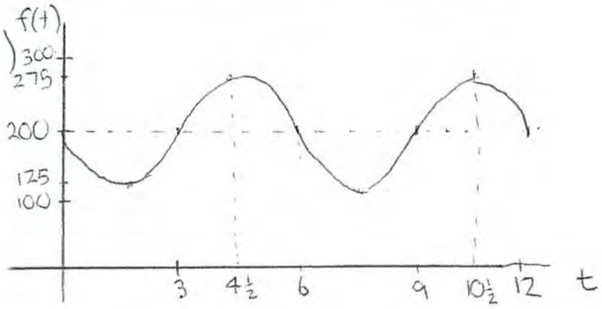
Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Q12 b) (i) Midpoint of AC $= \left(\frac{-5+11}{2}, \frac{-2+10}{2}\right)$ $M = (3, 4)$ ① (ii) gradient of AC $= \frac{10--2}{11--5} = \frac{12}{16} = \frac{3}{4}$ gradient of BD $= -\frac{4}{3}$ $(m_1 \times m_2 = -1)$ ① using $(3,4)$ and $m = -\frac{4}{3}$ $y - 4 = -\frac{4}{3}(x-3)$ $3y - 12 = -4x + 12$ ① $4x + 3y - 24 = 0$ (iii) cuts x axis when $y = 0$ $4x - 24 = 0$ $x = 6$ D$(6,0)$ ① cuts y axis when $x = 0$ $3y - 24 = 0$ $y = 8$ B$(0,8)$ ① (iv) midpoint of BD $= \left(\frac{6+0}{2}, \frac{0+8}{2}\right)$ $(3,4)$ ① Since diagonals bisect each other at 90°, ABCD is a rhombus ①	Some students calculated the sides to be equal.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q12 c) $a, a+2, a+4 \ldots$ A.P (i) $T_n = a+(n-1)d$ $42 = a + 9(2)$ ① $a = 42 - 18 = 24$ chairs ① (ii) $S_n = 680$ $S_n = \frac{n}{2}(2a+(n-1)d)$ $680 = \frac{n}{2}\left(2(24)+(n-1)2\right)$ ① $680 = n(24+n-1)$ $680 = n(n+23)$ $n^2+23n-680=0$ ① $(n+40)(n-17)=0$ $n \neq -40$ $n = 17$ rows ① (iii) $T_{17} = 24 + 16(2)$ $T_{17} = 24+32 = 56$ chairs ①	Well done. Some students did not get whole number answers. This indicates an error.
Q13 a) $P(t)=275$ $200 - 75\sin\left(\frac{\pi}{3}t\right) = 275$ $\sin\left(\frac{\pi}{3}t\right) = -1$ ① $\frac{\pi}{3}t = \frac{3\pi}{2}, \frac{7\pi}{2}, \ldots$ $t = 9/2, 21/2$ ① 4.5 and 10.5 months.	Many students could not solve this.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Q13a (ii)  ②	Curve oscillates about 200. Need labels and scales
b) (i) $g(x) = 3x$ $f(x) = 5x^3 - 5x^2 - 27x$ $g(x) = f(x)$ at point of intersection T $5x^3 - 5x^2 - 27x = 3x$ $5x^3 - 5x^2 - 30x = 0$ $5x(x^2 - x - 6) = 0$ $5x(x - 3)(x + 2) = 0$ $x = 3$ $\quad x \neq -2$ in domain shown. When $x = 3$ $\quad y = 9$ $\quad (3, 9)$ ①	
(ii) $g(x)$ is above $f(x)$ $\int_0^3 3x - 5x^3 + 5x^2 + 27x \, dx$ $\int_0^3 -5x^3 + 5x^2 + 30x \, dx$ ① $\left[\frac{-5x^4}{4} + \frac{5x^3}{3} + \frac{30x^2}{2}\right]_0^3$ ①	The curve underneath is subtracted in the integral.

$$\left(-\frac{5(3)^4}{4} + \frac{5(3)^3}{3} + \frac{30(3)^2}{2}\right) - 0 = 78.75 \text{ squared units}$$

①

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Q13 c) 1st month $= 5000(1\cdot015) - R$	See alternative method in Cambridge Text
2nd month $= 5000(1\cdot015)^2 - R(1+1\cdot015)$	
① mark 3rd month $= 5000(1\cdot015)^3 - R(1+1\cdot015+1\cdot015^2)$	Missing steps
$\vdots$	GP $\frac{1\cdot015^{36}-1}{1\cdot015-1} = \frac{1\cdot015^{36}-1}{\cdot015}$
36th month $= 5000(1\cdot015)^{36} - R(1+1\cdot015+1\cdot015^2+\dots+1\cdot015^{35})$	
After 36th month loan has been repaid	① mark
$\therefore \quad R = \frac{5000(1\cdot015)^{36}}{(1+1\cdot015+1\cdot015^2+\dots+1\cdot015^{35})}$	$= \frac{5000(1\cdot015)^{36} \times \cdot015}{(1\cdot015^{36}-1)}$
$R = \$180\cdot76$ ① mark	
d)(i) shaded region APQC	
$=$ Sector OPA $-$ sector OQC	
$= \frac{1}{2}(3)^2\theta - \frac{1}{2}(2)^2\theta$	
$= \frac{1}{2}5\theta = \frac{5}{2}\theta$ ①	
(ii) $\frac{5}{2}\theta = \frac{5\pi}{6}$	
$\theta = \frac{5\pi}{6} \div \frac{5}{2} = \frac{\pi}{3}$ ①	
(iii) $\angle DOQ = \frac{\pi}{2} - \frac{\pi}{3} = \frac{\pi}{6}$ ①	
Sector DOQ $= \frac{1}{2} \times 2^2 \times \frac{\pi}{6} = \frac{\pi}{3}\text{ cm}^2$ ①	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)

Q14 a) (i) $x = 12(3) - 3(3)^2$

$x = 9$ metres from the origin ①

(ii) $\dot{x} = 0$ whilst turning

$\dot{x} = 12 - 6t$

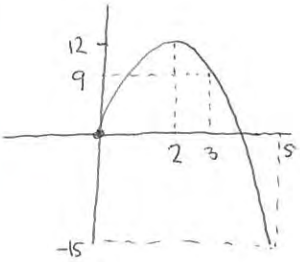
$12 - 6t = 0$ when $t = 2$ seconds ①

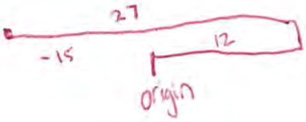
(iii) when $t = 0$ $x = 0$ ①

when $t = 2$ $x = 12(2) - 3(2)^2 = 12$m

when $t = 5$ $x = 12(5) - 3(5)^2 = -15$m

total distance = 12 + 27 = 39 m ①





(iv) greatest speed occurs when the gradient is steepest.

test $\dot{x}$ when $t = 0$ $\dot{x} = 6ms^{-1}$

test $\dot{x}$ when $t = 5$ $\dot{x} = 12 - 6(5) = -18ms^{-1}$

greatest speed occurs when $t = 5$ ①

comments

- very few people graphed the displacemen
- people who did graph managed more correct responses

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q14 b. (i) Using Pythagoras' theorem and the diagram provided $(2r)^2 + h^2 = 8^2$ $(2r)^2 = 8^2 - h^2$ $4r^2 = 64 - h^2$ $r^2 = \frac{64-h^2}{4}$ ①	Many students missed the Pythagoras Application.
Given Volume of cylinder $V = \pi r^2 h$ ← $V = \pi\left(\frac{64-h^2}{4}\right)h$ ① $V = 16\pi h - \frac{\pi}{4}h^3$	Some used incorrect formula here
(ii) max occurs when $V' = 0$ and $V'' < 0$ $V' = 16\pi - \frac{3\pi}{4}h^2$ ① $V' = 0$ when $h = \sqrt{16\pi \div \frac{3\pi}{4}}$ $h = \sqrt{64/3} = \frac{8}{\sqrt{3}}$ $\doteqdot 4.6cm$ $V'' = -\frac{6\pi}{4}h < 0$ ∴ maximum ①	test for maximum Volume is required. either $V'' < 0$ or $\begin{array}{c\|c\|c\|c} h & 4 & 4.6 & 5 \\ \hline V' & + & 0 & - \end{array}$
volume occurs when $h = \frac{8}{\sqrt{3}}$ cm ①	4.62cm also accepted.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q14 c (i) $P_{25} = \frac{1}{2}P_0$ $\frac{1}{2}P_0 = P_0 e^{k25}$ $\frac{1}{2} = e^{k25}$ $\ln\frac{1}{2} = k25$ $k = \frac{\ln(0.5)}{25}$ ① (ii) $2000 = 5000e^{\frac{\ln 0.5}{25}t}$ $0.4 = e^{\frac{\ln 0.5t}{25}}$ ① $\ln(0.4) = \frac{\ln(0.5)}{25}t$ $t = \ln(0.4) \div \frac{\ln(0.5)}{25}$ $t = 33$ years ① (iii) $P = 5000e^{\frac{\ln 0.5}{25}\times 75}$ $P = 5000e^{3\ln 0.5}$ $P = 625$ ① % of original $= \frac{625}{5000}\times 100$ % of original $= 12\frac{1}{2}\%$ ①	Rounding wasn't penalised.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q15 a(i) $\begin{array}{c\|c\|c\|c\|c\|c} x & 1 & 2 & 3 & 4 & 5 \\ \hline \frac{2}{x(x+1)} & 1 & \frac{1}{3} & \frac{1}{6} & \frac{1}{10} & \frac{1}{15} \end{array}$ ①	
(ii) $A \doteqdot \frac{1}{3}\left(1+\frac{4}{3}+\frac{1}{6}\right)+\frac{1}{3}\left(\frac{1}{6}+\frac{4}{10}+\frac{1}{15}\right)$ ① $A \doteqdot \frac{47}{45} = 1.04$ (2dp) ①	using a formula incorrectly for multiple applications.
(iii) $\text{LHS} = \frac{2}{x} - \frac{2}{x+1}$ $= \frac{2(x+1)-2x}{x(x+1)}$ ① $= \frac{2}{x(x+1)}$ $= \text{RHS}$ ①	
(iv) $\int_1^5 \frac{2}{x(x+1)}\,dx = \int_1^5 \frac{2}{x} - \frac{2}{x+1}\,dx$ $= \left[2\ln x - 2\ln(x+1)\right]_1^5$ ① $= (2\ln 5 - 2\ln 6) - (2\ln 1 - 2\ln 2)$ $= 2\ln 5 - 2\ln 6 + 2\ln 2$ $= 1.02$ (2dp) ①	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	**comments**
Q15b) (i) In $\triangle ABD$ and $\triangle BDC$ $\angle DAB = \angle CBD$ (given) ① $AB : BD$ $(9:12 = 3:4)$ $AD : BC$ $(6:8 = 3:4)$ $\therefore \triangle ABD \,///\, \triangle BDC$ ① Two sides in same proportion and included angles are equal	the abbreviations SAS is only appropriate for congruent triangles.
(ii) since $\triangle ABD \,|||\, \triangle BDC$ Then $DB : CD$ $(3:4)$ $3 : 4$ $DB = 12$ $12 : CD$ $\therefore CD = \frac{12 \times 4}{3} = 16$ cm ① Corresponding sides on similiar triangles have the same ratio ①	
(iii) since $\triangle ABD \,|||\, \triangle BDC$ then $\angle ABD = \angle BDC$ alternate angles are equal therefore AB is parallel to CD ①	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q15c) Area = $\int_0^{\pi/2} 1+\cos x - \sin x \, dx$ + $\int_{\pi/2}^{\pi} \sin x - (1+\cos x)\,dx.$ ① $\left[x+\sin x+\cos x\right]_0^{\pi/2} + \left[-\cos x - x \ -\sin x\right]_{\pi/2}^{\pi}$ ① $\left[\left(\pi/2+\sin\pi/2+\cos\pi/2\right)-\left(0+\sin 0+\cos 0\right)\right]+\left[\left(-\cos\pi-\pi-\sin\pi\right)-\left(-\cos\pi/2-\pi/2-\sin\pi/2\right)\right]$ $\left[\left(\pi/2+1+0\right)-\left(0+0+1\right)\right] + \left[\left(1-\pi-0\right)-\left(0-\pi/2-1\right)\right]$ $= \pi/2 + 2 - \pi/2$ $= 2 \ \text{unit}^2$ ①	

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments

Q16 a) $V = \pi \int_{\pi/4}^{\pi/3} \sec^2 x \; dx$ ①

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

$= \pi \left(\tan \pi/3 - \tan \pi/4 \right)$

$= \pi \left(\sqrt{3} - 1 \right)$ cubic units

①

b) (i) $\ddot{x} = -12e^{-2t}$

$\dot{x} = \int -12e^{-2t} \, dt$

$\dot{x} = \frac{-12e^{-2t}}{-2} + c$

$\dot{x} = 6e^{-2t} + c$ ①

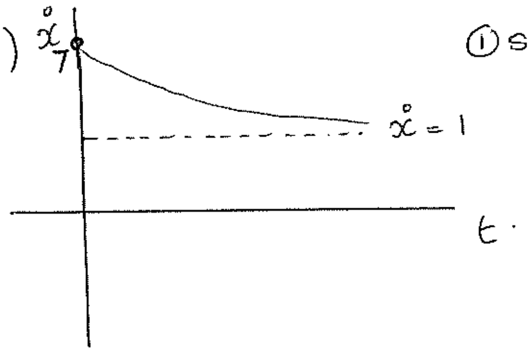
when $t = 0$ $\dot{x} = 7$

$\dot{x} = 6e^{0} + c = 7$

$c = 1$

$\dot{x} = 6e^{-2t} + 1$ ①

(ii)



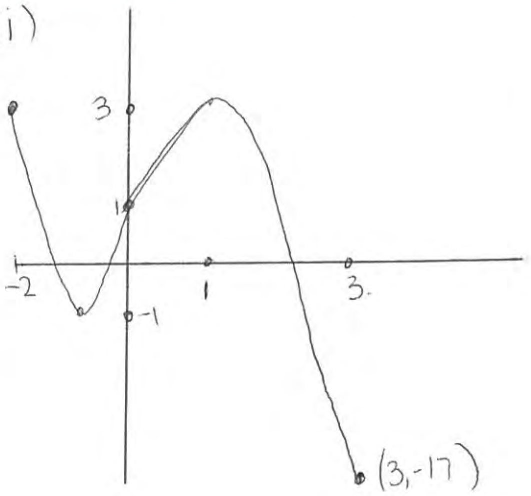
① shape (0,7)

① asymptote.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
Q16 b (iii) $x = \int 6e^{-2t} + 1 \, dt$ $x = \frac{6e^{-2t}}{-2} + t + c$ $x = -3e^{-2t} + t + c$ when $t = 0$, $x = 4$ $x = -3e^{0} + 0 + c = 4$ $c = 7$ $x = -3e^{-2t} + t + 7$ ① when $t = 3$ $x = -3e^{-6} + 3 + 7$ $x = 10 - 3e^{-6}$ ① Q16c (i) $y = 1 + 3x - x^3$ $y' = 3 - 3x^2$ $y'' = -6x$ ① st pnt occur when $y' = 0$ $3 - 3x^2 = 0$ $3(1 - x^2) = 0$ when $(1, 3)$ and $(-1, -1)$ when $x = 1$ $y = 3$ $y'' = -6$ $(1, 3)$ max ① when $x = -1$ $y = -1$ $y'' = 6$ $(-1, -1)$ min. ① (ii) $y'' = 0$ when $x = 0$ $\begin{array}{c\|c\|c\|c} x & 0^- & 0 & 0^+ \\ \hline y'' & + & 0 & - \end{array}$ change of sign $\therefore$ $(0, 1)$ is a point of inflexion. ①	change of sign test often omitted.

Suggested Solutions, Marking Scheme and Markers' comments

Suggested solution(s)	comments
(iii)  when $x=-2, y=3$ when $x=3$ $y=-17$ ①	one mark was awarded for the shape of curve with tp + st pnt. students over looked the domain $-2 \leq x \leq 3$
(iv) Minimum value in the domain $-2 \leq x \leq 3$ is -17 ①	By over looking the domain the minimum value of -17 was often missed.