

Section I: Objective response

Mark your answers on the multiple choice sheet provided.

Marks

1. What is the value of $|-8| - |10|$? **1**
 (A) 2 (B) 1 (C) -1 (D) -2

2. What is the sum of the exterior angles of a polygon? **1**
 (A) 90° (B) 180° (C) 360° (D) none of these

3. Which conditions make the quadratic $y = ax^2 + bx + c$ positive definite? **1**
 (A) $a < 0, \Delta < 0$ (B) $a < 0, \Delta > 0$ (C) $a > 0, \Delta < 0$ (D) $a > 0, \Delta > 0$

4. Which of the following is *not* a condition for congruent triangles? **1**
 (A) SSS (B) AAA (C) SAS (D) AAS

5. What is 1.9926 to two significant figures? **1**
 (A) 2.0 (B) 1.9 (C) 2.09 (D) 2.01

6. Which of the following is the locus of a point that is equidistant from a fixed point and a fixed line? **1**
 (A) a parabola (B) a hyperbola (C) a circle (D) an ellipse

7. Evaluate $\lim_{x \rightarrow \infty} \frac{3x^5 - 2x^2 + 7x - 3}{6x^5 - 3x + 7}$. **1**
 (A) ∞ (B) 0 (C) $\frac{1}{2}$ (D) 2

8. Which of the following conditions for $\frac{dP}{dt}$ and $\frac{d^2P}{dt^2}$ describe the slowing growth of a variable P ? **1**
 (A) $\frac{dP}{dt} > 0$ and $\frac{d^2P}{dt^2} > 0$. (C) $\frac{dP}{dt} > 0$ and $\frac{d^2P}{dt^2} < 0$.
 (B) $\frac{dP}{dt} < 0$ and $\frac{d^2P}{dt^2} < 0$. (D) $\frac{dP}{dt} < 0$ and $\frac{d^2P}{dt^2} > 0$.

9. If $a > b$, which of the following is always true? **1**
 (A) $a^2 > b^2$ (B) $\frac{1}{a} > \frac{1}{b}$ (C) $-a > -b$ (D) $2^a > 2^b$

10. What is the exact value of b if the area beneath the curve $y = \frac{2}{x}$ between $x = 1$ and $x = b$ ($b > 1$) is equal to 3 units²? **1**
 (A) $e^{\frac{3}{2}}$ (B) e^2 (C) $e^{\frac{5}{2}}$ (D) e^3

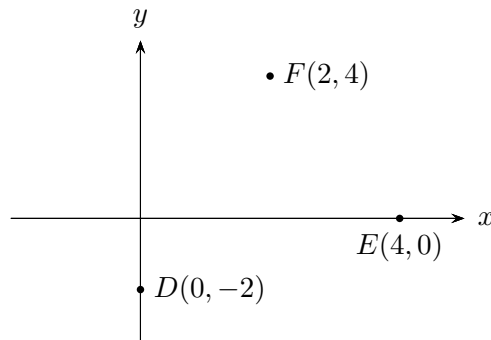
Section II: Short answer

Question 11 (15 Marks)

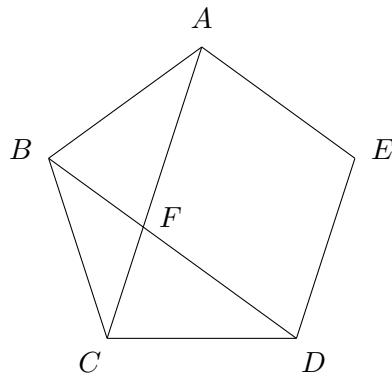
Commence a NEW page.

Marks

- (a) Solve the equation $x^2 + \frac{9}{x^2} = 10$. **3**
- (b) $D(0, -2)$, $E(4, 0)$ & $F(2, 4)$ are three points on the number plane.



- i. Calculate the length of the interval DF . **1**
 - ii. Calculate the gradient of DF . **1**
 - iii. Write the equation of the line DF in general form. **1**
 - iv. Calculate the perpendicular distance from E to the line DF . **2**
 - v. Calculate the area of $\triangle DEF$. **2**
- (c) $ABCDE$ is a regular pentagon. The diagonals AC and BD intersect at F .



Copy or trace this diagram into your writing booklet. By giving full reasons for your answer,

- i. Prove that $\angle ABC = 108^\circ$. **2**
 - ii. Find the size of $\angle BAC$. **1**
- (d) Find the exact value of $3 \tan 210^\circ + 2 \sin 300^\circ$. **2**

- Question 12** (15 Marks) Commence a NEW page. **Marks**
- (a) Find the values of p , $p > 0$ for which the roots of the equation $x^2 - px + p = 0$ are
- i. opposite in sign. **1**
 - ii. real **2**
- (b) i. Sketch the parabola with equation **2**
- $$(y - 2)^2 = 2(x + 2)$$
- Show the vertex of the parabola on your sketch.
- ii. Find the coordinates of the focus and the equation of the directrix of the parabola. **2**
- (c) The sum to n terms of a sequence of numbers is given by $S_n = 102n - 2n^2$.
- i. Find an expression for T_n , the n -th term of the sequence. **2**
 - ii. What type of a sequence is this? **1**
- (d) Differentiate the following expressions:
- i. $\frac{2}{x^3}$ **1**
 - ii. $3 \cos 4x$ **2**
 - iii. $\log_e(2x)$ **2**

- Question 13** (15 Marks) Commence a NEW page. **Marks**
- (a) For the curve $y = x^3(4 - x)$
- i. Find the stationary point(s) and determine their nature. **3**
 - ii. Find the point(s) of inflexion. **2**
 - iii. Draw a neat sketch of the curve showing the intercepts with the coordinate axes, any stationary points and any point(s) of inflexion. **3**
- (b) Find $f(x)$ if $f'(x) = 2x + \frac{1}{x^2}$ and the curve passes through the point $(1, 2)$. **3**
- (c) Find the primitive of
- i. $\sqrt[3]{x}$ **2**
 - ii. $3 \sec^2 \frac{x}{3}$ **2**

Question 14 (15 Marks)

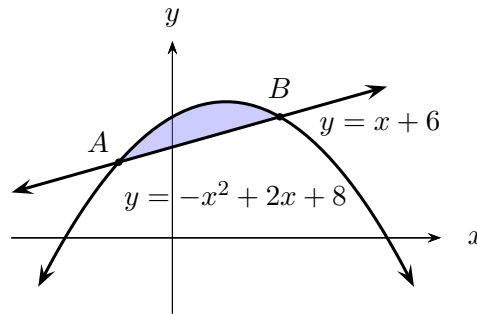
Commence a NEW page.

Marks

- (a) Use Simpson's Rule with five function values to evaluate $\int_1^3 f(x) dx$ given the following table: **2**

x	1	1.5	2	2.5	3
$f(x)$	0	3	5	2	1

- (b) The diagram below shows the graphs of $y = -x^2 + 2x + 8$ and $y = x + 6$.



- i. Show that the x coordinate of A and B are $x = -1$ and $x = 2$ respectively. **2**
 - ii. Hence or otherwise, find the shaded area bounded by the curves and the straight line. **3**
- (c)
- i. State the period and amplitude of $y = 3 \sin 2x$. **2**
 - ii. Draw a neat sketch of $y = 3 \sin 2x$, where $0 \leq x \leq 2\pi$. **3**
 - iii. Hence or otherwise, state the number of solutions to the equation **1**

$$3 \sin 2x = \frac{2}{3}$$

within the domain $0 \leq x \leq 2\pi$.

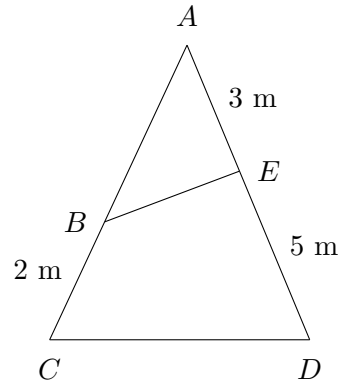
- (d) Find the angle subtended at the centre of the circle of sector with radius 4 cm and area 20 cm^2 . Give your answer correct to the nearest degree. **2**

Question 15 (15 Marks)

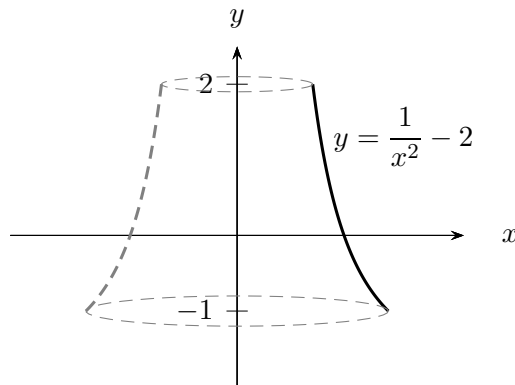
Commence a NEW page.

Marks

- (a) Solve $8^x = 16^{x+1} \times 4^{-x}$. **2**
- (b) In this diagram, $\angle BCD + \angle BED = 180^\circ$.



- i. Prove that $\triangle ABE$ is similar to $\triangle ADC$. **3**
- ii. Given that $AE = 3$ m, $ED = 5$ m and $BC = 2$ m, calculate the length of AB . **3**
- (c) i. Evaluate $\frac{d}{dx}(\log_e(\sin x))$. **1**
- ii. Hence or otherwise, find $\int \cot x \, dx$. **2**
- (d) A liquor bottle is obtained by rotating about the y axis the part of the curve $y = \frac{1}{x^2} - 2$ between $y = -1$ and $y = 2$. **4**



Find the exact volume of the bottle.

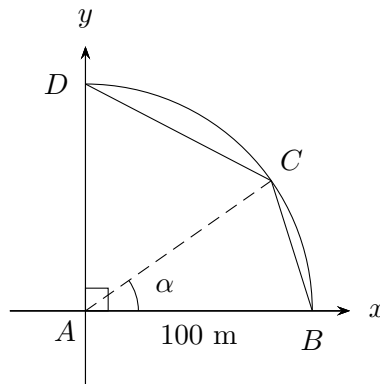
Examination continues overleaf...

Question 16 (15 Marks)

Commence a NEW page.

Marks

- (a) $ABCD$ is a quadrilateral inscribed in a quarter of a circle centred at A with radius 100 m. The points B and D lie on the x and y axes and the point C moves on the circle such that $\angle CAB = \alpha$ as shown in the diagram below.



- i. Solve the equation $\sin(x + 15^\circ) = \cos 24^\circ$. **1**
 - ii. Show that the area of the quadrilateral $ABCD$ can be expressed as **3**

$$A = 5\,000(\sin \alpha + \cos \alpha)$$
 - iii. Show that the maximum area of this quadrilateral is $5\,000\sqrt{2}$ m². **4**
- (b)
- i. Sketch the curve $y = 4e^{-2x}$. **2**
 - ii. Consider the series $2e^x + 8e^{-x} + 32e^{-3x} + \dots$.
 - α) Show that this series is geometric. **1**
 - β) Find the values of x for which this series has a limiting sum. **2**
 - γ) Find the limiting sum of this series in terms of x . **2**

End of paper.

STANDARD INTEGRALS

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

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

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

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

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

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

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

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

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

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

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

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

Answer sheet for Section I

Mark answers to Section I by fully blackening the correct circle, e.g “●”

STUDENT NUMBER:

Class (please ✓)

12M2A – Mr Berry

12M3C – Ms Ziazaris

12M3D – Mr Lowe

12M3E – Mr Lam

- 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

Section I

(Lowe) **1.** (D) **2.** (C) **3.** (D) **4.** (B) **5.** (A)
6. (A) **7.** (C) **8.** (C) **9.** (D) **10.** (A)

Question 11 (Lowe)

(a) (3 marks)

- ✓ [1] for quartic.
- ✓ [1] for final solutions.

$$\begin{aligned} x^2 + \frac{9}{x^2} &= \frac{10}{x^2} \\ x^4 + 9 &= 10x^2 \\ x^4 - 10x^2 + 9 &= 0 \\ (x^2 - 9)(x^2 - 1) &= 0 \\ \therefore x &= \pm 1, \pm 3 \end{aligned}$$

(b) i. (1 mark)

$$\begin{aligned} DF &= \sqrt{(2-0)^2 + (4-(-2))^2} \\ &= \sqrt{2^2 + 6^2} = \sqrt{40} \\ &= 2\sqrt{10} \end{aligned}$$

ii. (1 mark)

$$m_{DF} = \frac{6}{2} = 3$$

iii. (1 mark)

$$\begin{aligned} \frac{y-4}{x-2} &= 3 \\ y-4 &= 3x-6 \\ 3x-y-2 &= 0 \end{aligned}$$

iv. (2 marks)

- ✓ [1] for correctly recalling perpendicular dist formula.
- ✓ [1] for final answer.

$$\begin{aligned} d_{\perp} &= \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}} \\ &= \frac{|3(4) + (-1)(0) - 2|}{\sqrt{3^2 + 1^2}} \\ &= \frac{10}{\sqrt{10}} = \sqrt{10} \end{aligned}$$

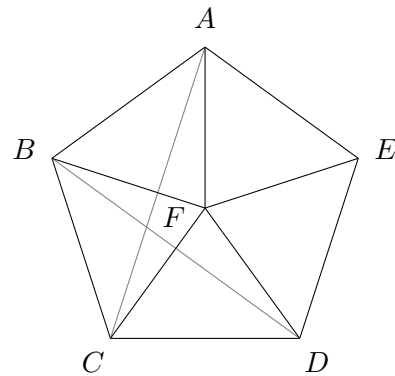
v. (2 marks)

- ✓ [1] for using parts (iii) & (iv)
- ✓ [1] for final answer.

$$\begin{aligned} A &= \frac{1}{2} \times DF \times d_{\perp} \\ &= \frac{1}{2} \times 2\sqrt{10} \times \sqrt{10} \\ &= 10 \text{ units}^2 \end{aligned}$$

(c) i. (2 marks)

- Divide pentagon into five equilateral triangles.



- Apex angle of one of the triangles $\frac{360^\circ}{5} = 72^\circ$.
- Angle sum of the two base angles is thus

$$180^\circ - 72^\circ = 108^\circ$$

ii. (1 mark)

- $\triangle BAC$ is isosceles.
- $\therefore \angle BAC = \frac{180^\circ - 108^\circ}{2} = 36^\circ$.

(d) (2 marks)

$$\begin{aligned} &3 \tan 210^\circ + 2 \sin 300^\circ \\ &= 3 \times \left(\frac{1}{\sqrt{3}} \right) + 2 \times \left(-\frac{\sqrt{3}}{2} \right) \\ &= \frac{3}{\sqrt{3}} - \sqrt{3} = 0 \end{aligned}$$

Question 12 (Lowe)

(a) i. (1 mark)

$$\begin{aligned}x^2 - px + p &= 0 \\ \alpha &= -\beta \\ \therefore \alpha + \beta &= 0 = -\frac{b}{a} = p \\ \therefore p &= 0\end{aligned}$$

But as $p > 0$, therefore there are no real solutions.

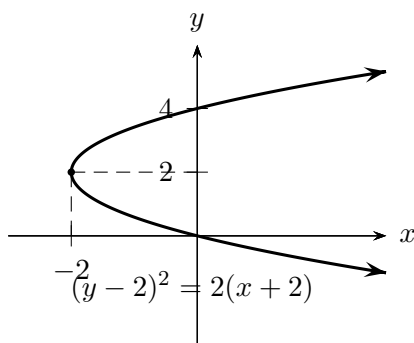
ii. (2 marks)

- ✓ [1] for $p \leq 0$ or $p \geq 4$.
- ✓ [1] justify why $p \geq 4$ only.

$$\begin{aligned}\Delta &\geq 0 \\ \therefore b^2 - 4ac &= p^2 - 4p \geq 0 \\ p(p - 4) &\geq 0 \\ \therefore p &\leq 0 \text{ or } p \geq 4\end{aligned}$$

But as $p > 0$, hence $p \geq 4$ only.

(b) i. (2 marks)



ii. (2 marks)

$$\begin{aligned}4a &= 2 \\ \therefore a &= \frac{1}{2} \\ S &\left(-\frac{3}{2}, 2\right)\end{aligned}$$

Directrix is $x = -\frac{5}{2}$.

(c) i. (2 marks)

$$\begin{aligned}S_n &= 102n - 2n^2 \\ T_n &= S_n - S_{n-1} \\ &= 102n - 2n^2 \\ &\quad - \left(102(n-1) - 2(n-1)^2\right) \\ &= \cancel{102n} - 2n^2 \\ &\quad - (\cancel{102n} - 102 - 2(n^2 - 2n + 1)) \\ &= \cancel{-2n^2} + 102 + \cancel{2n^2} - 4n + 2 \\ &= 104 - 4n\end{aligned}$$

ii. (1 mark)

$$\begin{aligned}T_1 &= 104 - 4(1) = 100 \\ T_2 &= 104 - 4(2) = 96 \\ T_3 &= 104 - 4(3) = 92 \\ T_3 - T_2 &= T_2 - T_1\end{aligned}$$

Arithmetic sequence.

(d) i. (1 mark)

$$\frac{d}{dx}(2x^{-3}) = -6x^{-4}$$

ii. (2 marks)

$$\frac{d}{dx}(3 \cos 4x) = -12 \sin 4x$$

iii. (2 marks)

$$\frac{d}{dx}(\log_e 2x) = \frac{d}{dx}(\log_e 2 + \log_e x) = \frac{1}{x}$$

Question 13 (Berry)

(a) i. (3 marks)

$$y = 4x^3 - x^4 = x^3(4 - x)$$

$$\frac{dy}{dx} = 12x^2 - 4x^3$$

Stationary pts occur when $\frac{dy}{dx} = 0$:

$$4x^2(3 - x) = 0$$

$$\therefore x = 0, 3$$

x	0		3		
$\frac{dy}{dx}$	+	0	+	0	-
y	0		27		

Hence $(0, 0)$ is a horizontal point of inflexion and $(3, 27)$ is a local maximum.

ii. (2 marks)

Points of inflexion occur when $\frac{d^2y}{dx^2} = 0$:

$$\frac{d^2y}{dx^2} = 24x - 12x^2 = 12x(2 - x)$$

$$\therefore x = 0, 2$$

x	0		2		
$\frac{d^2y}{dx^2}$	-	0	+	0	-
	∩		∪		∩

When $x = 2$,

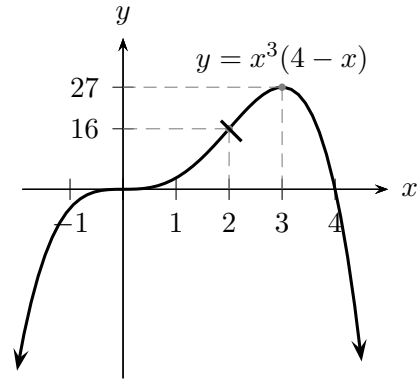
$$y = x^3(4 - x) \Big|_{x=2}$$

$$= 2^3(4 - 2) = 16$$

Hence points of inflexion occur at $(0, 0)$ and $(2, 16)$ as concavity changes at these two pts.

iii. (3 marks)

✓ [-1] for each omission from requirements of the question, provided graph is correct.



(b) (3 marks)

- ✓ [1] for correct integral.
- ✓ [1] for correct value of C .
- ✓ [1] for final answer.

$$f(x) = \int (2x + x^{-2}) dx = x^2 - x^{-1} + C$$

$$f(1) = 1 - 1^{-1} + C = 2$$

$$\therefore C = 2$$

$$\therefore f(x) = x^2 - \frac{1}{x} + 2$$

(c) i. (2 marks)

- ✓ [-1] if missing arbitrary constant.

$$\int x^{\frac{1}{3}} dx = \frac{3}{4}x^{\frac{4}{3}} + C$$

ii. (2 marks)

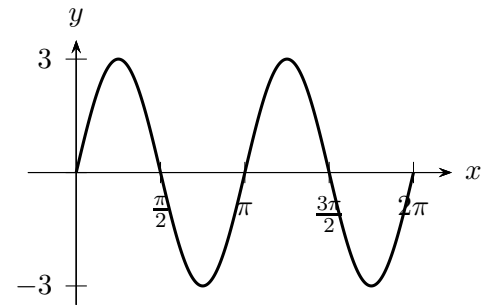
- ✓ [-1] if missing arbitrary constant.

$$\int 3 \sec^2 \frac{x}{3} dx = 9 \tan \frac{x}{3} + C$$

Question 14 (Berry)

(a) (2 marks)

$$\begin{aligned} \int_1^3 f(x) dx &= \frac{h}{3} (y_0 + 4 \sum y_{\text{odd}} + 2 \sum y_{\text{even}} + y_l) \\ &= \frac{1}{3} (0 + 1 + 4(3 + 2) + 2(5)) \\ &= \frac{31}{6} \end{aligned}$$



iii. (1 mark)
4 solutions.

(b) i. (2 marks)

$$\begin{cases} y = -x^2 + 2x + 8 \\ y = x + 6 \end{cases}$$

Solve by equating,

$$\begin{aligned} -x^2 + 2x + 8 &= x + 6 \\ x^2 - x + 2 &= 0 \\ (x - 2)(x + 1) &= 0 \\ \therefore x &= -1, 2 \end{aligned}$$

(d) (2 marks)

- ✓ [1] for answer in radians.
- ✓ [1] for answer in degrees.

$$A = \frac{1}{2} r^2 \theta$$

$$20 = \frac{1}{2} \times 4^2 \times \theta$$

$$\theta = \frac{5}{4} = \frac{5}{4} \times \frac{180^\circ}{\pi} \approx 71^\circ$$

ii. (3 marks)

$$\begin{aligned} A &= \left| \int_{-1}^2 (x^2 - x + 2) dx \right| \\ &= \left| \left[-\frac{1}{3}x^3 + \frac{1}{2}x^2 + 2x \right]_{-1}^2 \right| \\ &= \left| -\frac{1}{3}(2^3 - (-1)^3) \right. \\ &\quad \left. + \frac{1}{2}(2^2 - (-1)^2) \right. \\ &\quad \left. + 2(2 - (-1)) \right| \\ &= \left| -3 + \frac{3}{2} + 6 \right| = \frac{9}{2} \end{aligned}$$

(c) i. (2 marks)

$$T = \frac{2\pi}{2} = \pi \quad a = 3$$

ii. (3 marks)

- ✓ [1] for shape.
- ✓ [1] for correct period.
- ✓ [1] for amplitude.

Question 15 (Ziaziaris)

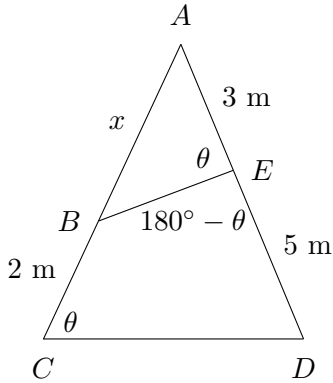
(a) (2 marks)

- ✓ [1] for resolving into powers of 2.
- ✓ [1] for final answer.

$$\begin{aligned} 8^x &= 16^{x+1} \times 4^{-x} \\ (2^3)^x &= (2^4)^{x+1} \times (2^2)^{-x} \\ 2^{3x} &= 2^{4x+4} \times 2^{-2x} \\ 2^{3x} &= 2^{2x+4} \\ 3x &= 2x + 4 \\ x &= 4 \end{aligned}$$

(b) i. (3 marks)

- ✓ [1] for each correct reason.

In $\triangle ABE$ and $\triangle ADC$ 

- $\angle CAD$ (common)
- Let $\angle BCD = \theta$. From the information,

$$\angle BED = 180^\circ - \theta$$

Hence $\angle AEB = \theta$ (supplementary),
and $\angle ACD = \angle AEB$.

- $\therefore \angle ABE = \angle ADC$
(remaining \angle)

Hence $\triangle ABE \parallel \triangle ADC$ (equiangular)

ii. (3 marks)

- ✓ [1] for ratio of lengths.
- ✓ [1] for setting up quadratic.
- ✓ [1] for final answer.

Let $AB = x$. As the ratio of the side lengths of corresponding sides

are equal,

$$\begin{aligned} \frac{AB}{AD} &= \frac{AE}{AC} \\ \frac{x}{8} &= \frac{3}{x+2} \\ x(x+2) &= 24 \\ x^2 + 2x - 24 &= 0 \\ (x+6)(x-4) &= 0 \\ \therefore x &= 4, -6 \end{aligned}$$

As $x > 0$ (length), $\therefore x = 4$ only.

(c) i. (1 mark)

$$\frac{d}{dx} (\log_e (\sin x)) = \frac{\cos x}{\sin x}$$

ii. (2 marks)

$$\begin{aligned} \int \cot x \, dx &= \int \frac{\cos x}{\sin x} \, dx \\ &= \log_e (\sin x) + C \end{aligned}$$

(d) (4 marks)

$$\begin{aligned} y &= \frac{1}{x^2} - 2 \\ y + 2 &= \frac{1}{x^2} \\ x^2 &= \frac{1}{y+2} \end{aligned}$$

$$\begin{aligned} V &= \pi \int_{-1}^2 x^2 \, dy = \pi \int_{-1}^2 \frac{dy}{y+2} \\ &= \pi \left[\log_e (y+2) \right]_{-1}^2 \\ &= \pi (\log_e 4 - \log_e 1) \\ &= \pi \log_e 4 \end{aligned}$$

Question 16 (Lam)

(a) i. (1 mark)

$$\sin(x + 15^\circ) = \cos 24^\circ = \sin(90^\circ - 24^\circ)$$

$$x + 15^\circ = 66^\circ$$

$$\therefore x = 51^\circ$$

ii. (3 marks)

$$A_{\triangle CAB} = \frac{1}{2} \times 100^2 \sin \alpha = 5\,000 \sin \alpha$$

$$A_{\triangle CAD} = \frac{1}{2} \times 100^2 \sin\left(\frac{\pi}{2} - \alpha\right) = 5\,000 \cos \alpha$$

$$\therefore A_{ABCD} = 5\,000 (\sin \alpha + \cos \alpha)$$

iii. (4 marks)

$$A_{ABCD} = 5\,000 (\sin \alpha + \cos \alpha)$$

$$\therefore \frac{dA}{d\alpha} = 5\,000(\cos \alpha - \sin \alpha)$$

Stationary pts occur when $\frac{dA}{d\alpha} = 0$,
i.e.

$$5\,000(\cos \alpha - \sin \alpha) = 0$$

$$\frac{\cos \alpha}{\div \cos \alpha} = \frac{\sin \alpha}{\div \cos \alpha}$$

$$\tan \alpha = 1$$

$$\therefore \alpha = \frac{\pi}{4}$$

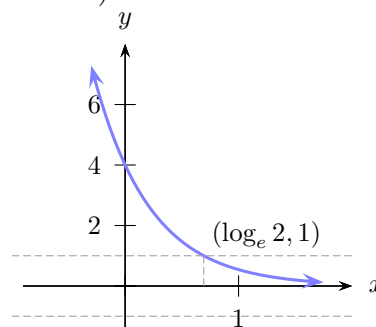
α	$\frac{\pi}{4}$
$\frac{dA}{d\alpha}$	+ 0 -
A	

- $\alpha < \frac{\pi}{4}$, $\frac{dA}{d\alpha} < 0$.
- $\alpha > \frac{\pi}{4}$, $\frac{dA}{d\alpha} > 0$.

Maximum area occurs when

$$\begin{aligned} A &= 5\,000 (\sin \alpha + \cos \alpha) \Big|_{\alpha=\frac{\pi}{4}} \\ &= 5\,000 \left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} \right) = 5\,000 \left(\frac{2}{\sqrt{2}} \right) \\ &= 5\,000\sqrt{2} \text{ m}^2 \end{aligned}$$

(b) i. (2 marks)

ii. (α) (1 mark)

$$2e^x + 8e^{-x} + 32e^{-3x} \dots$$

$$\frac{T_2}{T_1} = \frac{8e^{-x}}{2e^x} = 4e^{-2x}$$

$$\frac{T_3}{T_2} = \frac{32e^{-3x}}{8e^{-x}} = 4e^{-2x}$$

$$\frac{T_2}{T_1} = \frac{T_3}{T_2}$$

$\therefore 2e^x + 8e^{-x} + 32e^{-3x} \dots$ is a
geometric series with $a = 2e^x$
and $r = 4e^{-2x}$.

(β) (2 marks)

$$\checkmark [1] \text{ for } |4e^{-2x}| < 1.$$

$$\checkmark [1] \text{ for justification.}$$

A geometric series has a limiting
sum when $-1 < r < 1$; i.e.

$$-1 < 4e^{-2x} < 1$$

By inspecting the graph in the
previous part, $-1 < 4e^{-2x} < 1$
when $x > \log_e 2$.

\therefore limiting sum exists when

$$x > \log_e 2$$

(γ) (2 marks)

$$\checkmark [1] \text{ for recalling formula}$$

$$\checkmark [1] \text{ for final answer}$$

$$S = \frac{a}{1-r} = \frac{2e^x}{1-4e^{-2x}}$$