



Complete, fold and seal
(see note 2 below)

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FORENAME(S): Charlie

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	
2	Title of Examination Paper	TCA2
3	Module Code	PLCE4000
4	Date and Time of Examination	14/05/2025 11:15
5	Examination Venue	Rembrokeshire college
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1a	3
1b	3
1c	4
1d	6
2	6
3a	3
3b	8
4a	8
4b	4
7	12
8a	3
8b	8
6	6
5	2
Total	70

Second Marked
SD/22
28/05/2025

(1)

not actual
question!

a. $y = 3e^{4x} \sin 4x$ $U = 3e^{4x}$ $V = \sin 4x$
 $\frac{dU}{dx} = 4 \times 3e^{4x} = 12e^{4x}$ $\frac{dV}{dx} = 4 \times 1 \cos 4x = 4 \cos 4x$
 ~~$\frac{dy}{dx} = 4 \times 3e^{4x} \times 4 \cos 4x + 3e^{4x} \times 4 \sin 4x$~~ ✓

$$\frac{dy}{dx} = 3e^{4x} \times 4 \cos 4x + \sin 4x \times 12e^{4x}$$

$$= 12e^{4x} \cos 4x + 12e^{4x} \sin 4x$$
 ✓

$$\frac{dy}{dx} = 12e^{4x} (\cos 4x + \sin 4x)$$
 ✓

Correct
for question
written.

(3)

b. $y = \frac{x-1}{3e^{2x}}$ $U = x-1$ $V = 3e^{2x}$
 $\frac{dU}{dx} = 1 \times 1x^{-1} = 1$ $\frac{dV}{dx} = 2 \times 3e^{2x} = 6e^{2x}$ ✓

$$\frac{dy}{dx} = \frac{3e^{2x} \times 1 - (x-1) \times 6e^{2x}}{(3e^{2x})^2}$$

$$= \frac{3e^{2x} - 6e^{2x}x}{(3e^{2x})^2}$$
 ✓

$$= \frac{3e^{2x}(1-2x)}{9e^{4x}}$$

$$= \frac{3e^{2x}(1-2x)}{(3e^{2x})^2}$$

$$= \frac{e^x(1-2x)}{3e^{2x}}$$

(3)

$$1c) y = \sqrt{x} - \frac{1}{x^4} - \cos 3x$$

$$= 1x^{1/2} - 1x^{-4} - -3 \times 1 \sin 3x \quad \checkmark$$

$$= 1/2 \times 1x^{1/2-1} - -4 \times 1x^{-4-1} - -3 \times 1 \sin 3x$$

$$= \frac{1}{2} x^{-1/2} + 4x^{-5} + 3 \sin 3x \quad \checkmark$$

$$= \frac{1}{2\sqrt{x}} + \frac{4}{x^5} + 3 \sin 3x \quad \checkmark$$

(4)

$$d) y = 3 \sin(2x^4)$$

$$u = 2x^4$$

$$\frac{du}{dx} = 4 \times 2x^{4-1} \quad \checkmark$$

$$= 8x^3 \quad \checkmark$$

$$y = 3 \sin u$$

$$\frac{dy}{du} = 1 \times 3 \cos u$$

$$\frac{dy}{du} = 3 \cos u \quad \checkmark$$

$$3 \cos u \times 8x^3 = 24x^3 \cos u \quad \checkmark$$

$$= 24x^3 \cos(2x^4) \quad \checkmark$$

(6)

SDP

$$2) V = 12(1 - 2e^{-t})$$

$$V = 12 - 24e^{-t} \quad \checkmark$$

$$-24e^{-t} \times -1 = 24e^{-t} \quad \checkmark$$

$$t=0s \quad 24e^{-1 \times 0} = 24e^0 = 24 \text{ V/s.} \quad \checkmark$$

(6)

$$3) y = 4x^3 - 21x^2 + 18x + 6 = 0$$

a.

$$\frac{dy}{dx} = 3 \times 4x^{3-1} - 2 \times 21x^{2-1} + 1 \times 18x^{1-1} + 6 = 0 \quad \checkmark$$

$$\frac{dy}{dx} = 12x^2 - 42x + 18$$

$$x = \frac{-(-42) \pm \sqrt{(-42)^2 - 4 \times 12 \times 18}}{2 \times 12}$$

$$x = 3 \quad \checkmark = 4(3)^3 - 21(3)^2 + 18(3) + 6 = -21 \quad (3, -21) \quad \checkmark$$

$$x = \frac{1}{2} \quad \checkmark = 4\left(\frac{1}{2}\right)^3 - 21\left(\frac{1}{2}\right)^2 + 18\left(\frac{1}{2}\right) + 6 = \left(\frac{1}{2}, \frac{41}{4}\right) \quad \checkmark$$

$$b) \frac{dy}{dx} = 12x^2 - 42x + 18$$

$$= 2 \times 12x^{2-1} - 1 \times 42^{1-1} = 24x - 42 \quad \checkmark$$

$$\frac{d^2y}{dx^2} = 24 \times 3 - 42 = 30 \quad \checkmark \text{ minimum} \quad \checkmark$$

$$\frac{d^2y}{dx^2} = 24 \times \frac{1}{2} - 42 = -30 \quad \checkmark \text{ maximum} \quad \checkmark$$

(8)

$$4) \int_2^3 (2x^3 - 3x^2 + 2) dx = (2x^3 - 3x^2 + 2x^0) \Big|_2^3$$

$$\textcircled{a} \int_2^3 \left[\frac{2x^{3+1}}{3+1} - \frac{3x^{2+1}}{2+1} + \frac{2x^{0+1}}{0+1} \right] = \left[\frac{2x^4}{4} - \frac{3x^3}{3} + \frac{2x^1}{1} \right]_2^3$$

$$= \left[\frac{1}{2}x^4 - x^3 + 2x \right]_2^3$$

$$x=3 \quad \frac{1}{2} \times 3^4 - 3^3 + 2 \times 3 = \frac{39}{2} \quad \checkmark$$

$$x=2 \quad \frac{1}{2} \times 2^4 - 2^3 + 2 \times 2 = 4 \quad \checkmark$$

$$\frac{39}{2} - 4 = \frac{31}{2} \quad \checkmark$$

8

$$\textcircled{b} \int_0^{\pi/4} (3\cos 2x - 4\sin \frac{1}{3}x) dx = \left[\frac{3}{2} \sin 2x - \frac{4}{\frac{1}{3}} \cos \frac{x}{3} \right]_0^{\pi/4}$$

$$= \left[\frac{3}{2} \sin 2x + 12 \cos \frac{x}{3} \right]_0^{\pi/4} \quad \checkmark$$

$$x = \frac{\pi}{4} = \frac{3}{2} \sin 2\left(\frac{\pi}{4}\right) + 12 \cos \left(\frac{\pi}{\frac{4}{3}}\right) = -6.985 \quad \times$$

$$x=0 = \frac{3}{2} \sin 2(0) + 12 \cos(0) = 12 \quad \checkmark$$

4

$$-6.99 - 12 = -18.99 \quad \times$$

SDP

7) Time(s)	$0 \leq t < 1.5$	$1.5 \leq t < 3$	$3 \leq t < 4.5$	$4.5 \leq t < 6$	$6 \leq t < 7.5$	
Frequency (F)	3	13	20	3	1	40
midpoint (x)	0.75	2.25	3.75	5.25	6.75	✓
fx	2.25	29.25	75	15.75	6.75	129 ✓
$f(x - \bar{x})^2$	18.375	12.375	5.513	12.302	12.426	60.976 ✓

$$\bar{x} = \frac{129}{40} = 3.225 \quad \checkmark \quad \sigma = \sqrt{\frac{60.976}{(40-1)}} = 1.56 \quad \checkmark$$

(12)

8) ~~P(A)~~ $P(A) = 0.89$ $P(B) = 0.95$

a) Series = $P(A) \times B = 0.89 \times 0.95$
 $P(A) = 0.85 \quad \checkmark$

b) Parallel = $1 - 0.89 = 0.11 \quad \checkmark$
 $1 - 0.95 = 0.05 \quad \checkmark$

$0.11 \times 0.05 = \frac{11}{2000} \quad \checkmark$

$(\bar{P}) =$

$1 - \frac{11}{2000} = 0.99 \quad \checkmark$

(8)

6) $\int_2^5 \frac{2x+6}{x(2x-1)}$ $\frac{5-2}{4} = 0.75$ ✓

x	2	2.75	3.50	4.25	5
2x+6	5	92	<u>23</u>	116	16
x(2x-1)	3	99	<u>42</u>	255	45
	y ₀	y ₁	y ₂	y ₃	y _n

$\frac{1}{3} \times 0.75 \left(\left(\frac{5}{3} + \frac{16}{45} \right) + 4 \left(\frac{92}{99} + \frac{116}{225} \right) + 2 \left(\frac{23}{42} \right) \right)$
 $= 2.2242$ ✓

⑤ $\frac{2x+6}{x(2x-1)} = \frac{A}{x} + \frac{B}{2x-1}$
 $= A(2x-1) + B(x)$

6

②

SDP