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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.

Complete, fold and seal
(see note 2 below)

SURNAME: CLAPHAM

FORENAME(S): RHIANNON

1	Student Number	
2	Title of Examination Paper	TCA2
3	Module Code	PCEE4000
4	Date and Time of Examination	14/05/2025 11:15
5	Examination Venue	PEMBROKESHIRE COLLAGE
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	20
2	6
3	6
4	15
5	5
6	10
7	14
8	8
Total	84

Second Marked
SDP
28/05/2025

$$1c) y = \sqrt{x} - \frac{1}{x^4} - \cos 3x \rightarrow x^{\frac{1}{2}} - x^{-4} - \cos 3x \quad \checkmark$$

$$\rightarrow \frac{1}{2}x^{-\frac{1}{2}} - 54x^{-5} - -3\sin 3x \rightarrow \frac{1}{2}x^{-\frac{1}{2}} + 4x^{-5} + 3\sin 3x \quad \checkmark$$

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

(4)

$$1a) y = 3e^{4x} \sin x$$

$$u = 3e^{4x} \quad v = \sin x$$

$$12e^{4x} \quad \checkmark \quad \cos x \quad \checkmark$$

$$3e^{4x} \times \cos x + \sin x \times 12e^{4x} \quad \checkmark$$

$$3e^{4x} \cos x + 12e^{4x} \sin x \quad \checkmark$$

$$3e^{4x} (\cos x + 4 \sin x) \quad \checkmark$$

(6)

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

$$u = x-1$$

$$\frac{du}{dx} = 1 \quad \checkmark$$

$$v = 3e^{2x}$$

$$\frac{dv}{dx} = 6e^{2x} \quad \checkmark$$

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

$$\frac{3e^{2x} - 6e^{2x}(x-1)}{9(e^{2x})^2}$$

$$\frac{3e^{2x}(1-2x+1)}{9(e^{2x})^2} \quad \times$$

(4)

$$1d) y = 3 \sin(2x^4)$$

$$3 \sin(u) \quad \checkmark$$

$$u \times 3 \cos(u)$$

$$\frac{dy}{dx} = 8x^3 \times 3 \cos(2x^4)$$

$$\cancel{24x^3 \cos(2x^4)}$$

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

$$u = 2x^4$$

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

(6)

2 $v = 12(1 - 2e^{-t})$ $t = 0$

$\frac{dv}{dt} = 12 - 24e^{-t}$
 $\rightarrow 1 \times 24e^{-t} \rightarrow t=0 \rightarrow 24e^0 \rightarrow 24 \text{ m/s}$

(6)

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

$12x^2 - 42x + 18$

a b c

$$\frac{- -42 \pm \sqrt{(-42)^2 - 4 \times 12 \times 18}}{2 \times 12} \rightarrow \frac{42 \pm \sqrt{900}}{24}$$

$x = 3$ ✓

$x = \frac{1}{2}$ ✓

At $x = 3$ $y = 4 \times 3^3 - 21 \times 3^2 + 18 \times 3 + 6 = 0$ $(3, 0)$ ✓

At $x = \frac{1}{2}$ $y = 12 \times \frac{1}{2}^2 - 42 \times \frac{1}{2} + 18 = 0$ $(\frac{1}{2}, 0)$ ✓

3b $12x^2 - 42x + 18$

$24x - 42$ ✓

At $x = 3$ $24 \times 3 - 42 = 30 > 0$ minima ✓

At $x = \frac{1}{2}$ $24 \times \frac{1}{2} - 42 = -30 < 0$ maxima ✓

(6)

4a $\int_2^3 2x^3 - 3x^2 + 2 \, dx$

$\left[\frac{2x^{3+1}}{3+1} - \frac{3x^{2+1}}{2+1} + \frac{2x^{0+1}}{0+1} \right]_2^3$ ✓

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

At $x = 3$ $\frac{2 \times 3^4}{4} - 3^3 + 2 \times 3 = 19.5$ ✓

At $x = 2$ $\frac{2 \times 2^4}{4} - 2^3 + 2 \times 2 = 4$ ✓

(7)

$19.5 - 4 = 14.5$

X

$$4b \int_0^{\frac{\pi}{4}} 3\cos 2x - 4\sin \frac{x}{3} dx \rightarrow \int_0^{\frac{\pi}{4}} 3\cos 2x - 4\sin \frac{1}{3}x$$

$$\left[\frac{3}{2} \sin 2x - -\frac{4}{\frac{1}{3}} \cos \frac{1}{3}x \right]_0^{\frac{\pi}{4}} /$$

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

$$\text{At } x = \frac{\pi}{4} \quad \frac{3}{2} \sin 2\frac{\pi}{4} + 12 \cos \frac{1}{3} \times \frac{\pi}{4} = 13.091 \checkmark$$

$$\text{At } x = 0 \quad \frac{3}{2} \sin 2 \times 0 + 12 \cos \frac{1}{3} \times 0 = 12 \checkmark$$

$$13.091 - 12 = 1.09 \checkmark$$

(8)

$$5 \int \frac{2x+6}{x(2x-1)} \rightarrow \frac{A}{x} + \frac{B}{2x-1} \rightarrow \frac{A(2x-1) + Bx}{x(2x-1)} \checkmark$$

$$2x+6 = A(2x-1) + xB \checkmark$$

$$\text{At } x=0 \quad 2 \times 0 + 6 = A(2 \times 0 - 1) + 0B$$

$$6 = A - 1$$

$$6 = -1A \quad / \quad \cancel{6 = -1A} \quad A = \cancel{-6}^{-\frac{1}{6}} \times$$

$$\text{At } x = \cancel{1}^{-6} \quad 2 \times \cancel{1}^{-6} + 6 = A(2 \times \cancel{1}^{-6} - 1) + \cancel{1}^{-6} B$$

$$-6 = -13A + -6B \quad -13 \times -6 = 78$$

$$-6 = 78 + -6B$$

$$72 = -6B$$

$$12 = -1B$$

$$B = \cancel{12}^{-\frac{1}{12}} \times$$

(5)

$$\frac{-6}{1x+0} + \frac{-12}{2x-1} \rightarrow \frac{\frac{-1}{6}}{1} \ln |x+0| + \frac{\frac{-1}{12}}{2} \ln |2x-1|$$

$$\text{At } x=5 \quad \frac{\frac{-1}{6}}{1} \ln |5+0| + \frac{\frac{-1}{12}}{2} \ln |5-1| = \cancel{0.32600}^{-0.32600}$$

x

$$\begin{aligned} & -0.32600 \\ & - \underline{-0.11552} \end{aligned}$$

At $x=2$ $\frac{-1}{6} \ln|2| + \frac{-1}{2} \ln|2-1| = -0.11552$

$-0.32600 - -0.11552 = -0.21048$

~~$2.19999 - 2.415888 = -0.21589$~~

6 $\int_2^5 \frac{2x+6}{x(2x-1)} dx$ 4 strips
Simpsons

$\frac{5-2}{4} = \frac{3}{4} = 0.75$

x	2	2.75	3.5	4.25	5
$\frac{2x+6}{x(2x-1)}$	$\frac{2 \times 2 + 6}{2(2 \times 2 - 1)}$	$\frac{2 \times 2.75 + 6}{2.75(2 \times 2.75 - 1)}$	$\frac{2 \times 3.5 + 6}{3.5(2 \times 3.5 - 1)}$	$\frac{2 \times 4.25 + 6}{4.25(2 \times 4.25 - 1)}$	$\frac{2 \times 5 + 6}{5(2 \times 5 - 1)}$
	$\frac{5}{3}$	$\frac{92}{99}$	$\frac{13}{21}$	$\frac{116}{255}$	$\frac{16}{45}$
	y_0	y_1	y_2	y_3	y_n

$\frac{1}{3} \times 0.75 \left\{ \left(\frac{5}{3} + \frac{16}{45} \right) + 4 \left(\frac{92}{99} + \frac{116}{255} \right) + 2 \left(\frac{13}{21} \right) \right\}$

$= 2.19993$

$\% \text{ error} = \frac{-0.21048}{-0.21048} \times 100 = 11.452\%$

10

7	freq	3	13	20	3	1	40
	mp(x)	0.75	2.25	3.75	5.25	6.75	
	f × mp(x)	2.25	29.25	75	15.75	6.75	129 ✓

$$\bar{x} = \frac{129}{40} = 3.225 \quad \checkmark$$

$$f(x - \bar{x})^2 \quad \left| \begin{array}{l} 3(0.75 - 3.225)^2 \\ 21854875 \\ 18.376875 \end{array} \right| \quad \left| \begin{array}{l} 13(2.25 - 3.225)^2 \\ 8804908125 \\ 12.358125 \end{array} \right| \quad \left| \begin{array}{l} 20(3.75 - 3.225)^2 \\ 1030350125 \\ 5.5125 \end{array} \right| \quad \left| \begin{array}{l} 3(5.25 - 3.225)^2 \\ 15275 - 3.225^2 \\ 12.301875 \end{array} \right|$$

$$1(6.75 - 3.225)^2 \quad \left| \begin{array}{l} 12.428625 \\ \Sigma = 60.975 \end{array} \right| \quad \checkmark$$

$$\sigma = \sqrt{\frac{60.975}{40-1}} = 1.25 \quad \checkmark$$

(14)

8a $A = 0.89$
 $B = 0.95$

$$0.89 \times 0.95 = 0.8455$$

$$P(\text{work in series}) = 0.85 \quad \checkmark$$

8b $1 - 0.89 = 0.11$

$$1 - 0.95 = 0.05$$

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

$$1 - \frac{11}{2000} = 0.9945 \quad \checkmark$$

$$P(\text{works in parallel}) = 0.99 \quad \checkmark$$

(15)