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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).
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Complete, fold and seal

(see note 2 below)

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FORENAME(S): Matthew

1	Student Number	2015848 150589
2	Title of Examination Paper	TCAR
3	Module Code	PC EE 4000 PC PO 4000
4	Date and Time of Examination	19-5-21 14-00
5	Examination Venue	Pembrokeshire College
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	23
2	7
3	16
4	18
5	14
6	14
7	8
Office Use	100 ✓

Second Marker
SD/UC
25/05/21

1.

$$a. y = \frac{1}{3x^4} - 2x^5 - \sqrt{x}$$

$$y = \frac{1}{3}x^{-4} - 2x^5 - x^{1/2}$$

$$\frac{dy}{dx} = \frac{1}{3}x^{-4-1} - 2 \times 5x^{5-1} - 1 \times \frac{1}{2}x^{1/2-1}$$

$$= -\frac{4}{3}x^{-5} - 10x^4 - \frac{1}{2}x^{-1/2}$$

$$\frac{dy}{dx} = -\frac{4}{3x^5} - 10x^4 - \frac{1}{2\sqrt{x}}$$

(4) ✓

$$b. y = \frac{5 \cos 2x}{x^4}$$

$$u = 5 \cos 2x$$

$$v = x^4$$

$$\frac{du}{dx} = -5 \times 2 \sin 2x$$

$$\frac{dv}{dx} = 1 \times 4x^{4-1}$$

$$\frac{du}{dx} = -10 \sin 2x$$

$$\frac{dv}{dx} = 4x^3$$

$$\frac{d(uv)}{dx} = \frac{x^4 \times -10 \sin 2x - 5 \cos 2x \times 4x^3}{(x^4)^2}$$

$$= \frac{-10x^4 \sin 2x - 20x^3 \cos 2x}{(x^4)^2}$$

$$= \frac{-10x^3(x \sin 2x + 2 \cos 2x)}{(x^4)^2}$$

$$\frac{d(uv)}{dx} = \frac{-10(x \sin 2x + 2 \cos 2x)}{x^5}$$

(7) ✓

$$c. y = 2 \cos(4x^2)$$

$$u = 4x^2$$

$$= 2 \cos u$$

$$\frac{dy}{du} = -2 \sin u$$

$$\frac{dy}{du} = -2 \sin u$$

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

$$\frac{du}{dx} = 8x$$

$$\frac{dy}{dx} = -2 \sin u \times 8x = -16x \sin u$$

$$= -16x \sin(4x^2)$$

(6) ✓

d. $y = 5x^2 e^{4x}$

$$u = 5x^2$$

$$v = e^{4x}$$

$$\frac{du}{dx} = 5 \times 2x^{2-1}$$

$$\frac{dv}{dx} = 4 \times 1 e^{4x}$$

$$\frac{du}{dx} = 10x \quad \checkmark$$

$$\frac{dv}{dx} = 4e^{4x} \quad \checkmark$$

$$\frac{dy}{dx} = 5x^2 \times 4e^{4x} + e^{4x} \times 10x$$

$$= 20x^2 e^{4x} + 10x e^{4x} \quad \checkmark$$

$$= 10x e^{4x} (2x + 1) \quad \checkmark$$

6 ✓

2. $v = 10(2 - 3e^{-4t})$

$t = 0$, initial rate.

$$= 20 - 30e^{-4t} \quad \checkmark$$

$$\frac{dv}{dt} = -30 \times -4e^{-4t} \quad \checkmark$$

$$\frac{dv}{dt} = 120e^{-4t} \quad \checkmark$$

$$-4 \times 0 = 0$$

$$= 120 \text{ v/s} \quad \checkmark$$

7 ✓

3.

a. $\int_3^4 (20 + 5x^2 - 2x^3) dx$

$$= \int_3^4 (20x^0 + 5x^2 - 2x^3) dx \quad \checkmark$$

$$\left[\frac{20x^{0+1}}{0+1} + \frac{5x^{2+1}}{2+1} - \frac{2x^{3+1}}{3+1} \right]_3^4 = \left[\frac{20x^1}{1} + \frac{5x^3}{3} - \frac{2x^4}{4} \right]_3^4 \quad \checkmark$$

$$\left[(20x) + \left(\frac{5x^3}{3} \right) - \left(\frac{2x^4}{4} \right) \right]_3^4 \quad \checkmark$$

upper limit = 4

$$(20 \times 4) + \left(\frac{5 \times 4^3}{3} \right) - \left(\frac{2 \times 4^4}{4} \right) = 58.667 \quad \checkmark$$

lower limit = 3

$$(20 \times 3) + \left(\frac{5 \times 3^3}{3} \right) - \left(\frac{2 \times 3^4}{4} \right) = 64.5 \quad \checkmark$$

$$\text{area} = 58.667 - 64.5 = -5.833 \text{ units}^2 \quad \checkmark$$

8 ✓

$$b) \int_0^{\pi} \left(3 \sin \frac{x}{2} - \cos \frac{x}{4} \right) dx$$

$$\left[-\frac{3}{\frac{1}{2}} \cos \frac{x}{2} - \frac{1}{\frac{1}{4}} \sin \frac{x}{4} \right]_0^{\pi} = \left[-6 \cos \frac{x}{2} - 4 \sin \frac{x}{4} \right]_0^{\pi} \quad \checkmark$$

Upper limit = π

$$= \left[-6 \cos \left(\frac{\pi}{2} \right) - 4 \sin \left(\frac{\pi}{4} \right) \right] = -2.828 \text{ units}^2 \quad \checkmark$$

Lower limit = 0

$$= \left[-6 \cos \left(\frac{0}{2} \right) - 4 \sin \left(\frac{0}{4} \right) \right] = -6 \text{ units}^2 \quad \checkmark$$

$$\text{area} = -2.828 - (-6) = 3.172 \text{ units}^2 \quad \checkmark$$

8 ✓

$$4. \quad \frac{2x+1}{4x(x+2)} \Rightarrow \frac{A}{4x} + \frac{B}{x+2} = \frac{A(x+2) + B(4x)}{4x(x+2)}$$

$$\therefore 2x+1 = A(x+2) + B(4x) \quad \checkmark$$

if $x = -2$

$$2(-2)+1 = A(-2+2) + B(4(-2))$$

$$-3 = 0A - 8B$$

$$-3 = -8B \quad \Rightarrow \frac{3}{8} = B$$

$$B = \frac{3}{8} \quad \checkmark$$

if $x = 0$

$$2(0)+1 = A(0+2) + B(4(0))$$

$$1 = 2A + 0B$$

$$1 = 2A$$

$$A = \frac{1}{2} \quad \checkmark$$

$$\int_1^3 \left(\frac{2x+1}{4x(x+2)} \right) dx = \int_1^3 \left(\frac{A}{4x} + \frac{B}{x+2} \right) dx = \int_1^3 \left(\frac{1/2}{4x} + \frac{3/8}{x+2} \right) dx \quad \checkmark$$

$$\int \left(\frac{1}{ax+b} \right) dx = \frac{1}{a} \ln(ax+b)$$

$$= \frac{1}{2} \times \frac{1}{4} \times \ln(4x) + \frac{3}{8} \times \frac{1}{1} \times \ln(x+2) \quad \checkmark$$

$$= \frac{1}{8} \times \ln(4x) + \frac{3}{8} \times \ln(x+2) \quad \checkmark$$

0.9142 units²

$$\text{Upper limit} = 3 = \frac{1}{8} \times \ln(4 \times 3) + \frac{3}{8} \times \ln(3+2) = 0.8305 \text{ units}^2$$

4 Question 4 continued.

$$\text{Lower limit} = 1 = \frac{1}{8} \times \ln(4 \times 1) + \frac{3}{8} \times \ln(1+2) = 0.5853 \checkmark$$

$$\text{area} = 0.9142 - 0.5853 = 0.3289 \text{ units}^2$$

$$\text{area} = 0.8305 - 0.4332 = 0.3973 \text{ units}^2$$

$$\text{area} = 0.9142 - 0.5853 = 0.3289 \text{ units}^2$$

$$5. \text{ 4 strips } \frac{(3-1)}{4} = 0.5 = h \quad = 0.3289 \text{ units}^2$$

$2x+1$	1	1.5	2	2.5	3	x
$4x(x+2)$	$\frac{1}{4}$	$\frac{4}{21}$	$\frac{5}{32}$	$\frac{2}{15}$	$\frac{7}{60}$	
	y_0	y_1	y_2	y_3	y_n	

$$\text{Simpson's Rule} = \frac{1}{3} \times h \left\{ (y_0 + y_n) + 4(y_1 + y_3) + 2(y_2) \right\}$$

in this table

$$= \frac{1}{3} \times 0.5 \left\{ \left(\frac{1}{4} + \frac{7}{60} \right) + 4 \left(\frac{4}{21} + \frac{2}{15} \right) + 2 \left(\frac{5}{32} \right) \right\} \checkmark$$

$$= 0.3291 \checkmark$$

$$\% \text{ error} = \frac{0.3339 - 0.3291}{0.3291} \times 100 = 1.46\% \text{ error}$$

$$\% \text{ error} = \frac{0.3291 - 0.3289}{0.3289} \times 100 \checkmark$$

$$= 0.06\% \text{ error} \checkmark$$

(18) ✓

(14) ✓

60 components

6.	$0 \leq t < 2$	$2 \leq t < 4$	$4 \leq t < 6$	$6 \leq t < 8$	$8 \leq t < 10$
f	3	19	24	10	4
x	1	3	5	7	9 ✓
fx	3	57	120	70	36 ✓

$$\text{Mean } (\bar{x}) = \frac{\sum fx}{\sum f} = \frac{286}{60} = 4.767 \quad \checkmark$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

$f(x-\bar{x})^2$	$3(1-4.767)^2$	$19(3-4.767)^2$	$24(5-4.767)^2$	$10(7-4.767)^2$	$4(9-4.767)^2$
	42.571	59.323	~~193.754~~ 1.303	49.863	71.673

$$\sum f(x-\bar{x})^2 = \del{407.181} 224.733 \quad \checkmark$$

$$\text{Standard Deviation} = \sqrt{\frac{\del{407.181}}{60}} = \del{2.605} \sqrt{\frac{224.733}{60}} = 1.935 \quad \checkmark$$

(14) ✓

7.

a) Series $P(\text{connection}) = P(A) \times P(B) = 0.77 \times 0.81 = 0.6237 \quad \checkmark$

b) Parallel $P(\text{connection}) = P(\bar{A}) \times P(\bar{B}) = \del{0.23} \times (1-0.77) \times (1-0.81)$
 $= 0.23 \times 0.19 = 0.0437 \quad \checkmark$

$$1 - 0.0437 = \underline{0.9563} \quad \checkmark$$

(8) ✓