



Prifysgol Cymru  
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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)

SURNAME: STEVEN

FORENAME(S): JAMES

DAVID

|   |                                  |                          |
|---|----------------------------------|--------------------------|
| 1 | Student Number                   | 2015847<br>172352        |
| 2 | Title of Examination Paper       | TCA2                     |
| 3 | Module Code                      | PCEE4000/<br>PCPO4000    |
| 4 | Date and Time of Examination     | 19th May 2021            |
| 5 | Examination Venue                | Pembroke Dock<br>College |
| 6 | Seat Number                      |                          |
| 7 | Number of Answer Books handed in |                          |

| List the numbers of the questions you have attempted | Office Use |
|------------------------------------------------------|------------|
| 1                                                    | 21         |
| 2                                                    | 4          |
| 3                                                    | 8          |
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| Office Use                                           | 72 ✓       |

Second Marker  
SDP  
25/05/21

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

$$\begin{aligned} \frac{dy}{dx} &= \cancel{1000} \frac{1}{3}x^{-4-1} - 2 \times 5x^{5-1} - 1 \times 1x^{\frac{1}{2}-1} \quad \checkmark \\ &= -\frac{1}{3}x^{-5} - 10x^4 - 1x^{-\frac{1}{2}} \quad \checkmark \\ &= -\frac{1}{3x^5} - 10x^4 - \frac{1}{2\sqrt{x}} \quad \checkmark \end{aligned}$$

(4) ✓

$$1b) \quad y = \frac{5 \cos 2x}{x^4}$$

$$\begin{aligned} u &= 5 \cos 2x \quad \checkmark \\ \frac{du}{dx} &= -2 \times 5 \sin 2x \quad \checkmark \\ &= -10 \sin 2x \quad \checkmark \end{aligned}$$

$$\begin{aligned} v &= 1x^4 \quad \checkmark \\ \frac{dv}{dx} &= 4x \times 1x^{4-1} \quad \checkmark \\ &= 4x^3 \quad \checkmark \end{aligned}$$

$$\begin{aligned} \frac{dy}{dx} &= \frac{\frac{du}{dx}v - u\frac{dv}{dx}}{(v)^2} \quad \checkmark \\ &= \frac{-10x^4 \sin 2x - 5 \cos 2x \times 4x^3}{(x^4)^2} \quad \checkmark \\ &= \frac{-10x^4 \sin 2x - 20x^3 \cos 2x}{(x^4)^2} \quad \checkmark \\ &= \frac{-10x^3 (x \sin 2x - 2 \cos 2x)}{(x^4)^2} \quad \checkmark \end{aligned}$$

(6) ✓

$$1c) \quad y = 2 \cos(4x^2)$$

$$\begin{aligned} y &= 2 \cos(u) \quad \checkmark \\ \frac{dy}{du} &= -1 \times 2 \sin u \quad \checkmark \\ &= -2 \sin u \quad \checkmark \end{aligned}$$

$$\begin{aligned} \text{where } u &= 4x^2 \quad \checkmark \\ \frac{du}{dx} &= 4 \times 2x^{2-1} \quad \checkmark \\ &= 8x \quad \checkmark \end{aligned}$$

$$\begin{aligned} \frac{dy}{dx} &= -2 \sin u \times 8x \quad \checkmark = -16 \sin u \quad \checkmark \\ &= -16 \sin(4x^2) \quad \checkmark \end{aligned}$$

(6) ✓

1.d)

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

$$u = 5x^2 \quad \checkmark$$

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

$$= 10x \quad \checkmark$$

$$v = 1e^{4x} \quad \checkmark$$

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

$$= 4e^{4x} \quad \checkmark$$

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

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

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

$$= 10x(2xe^{8x}) \quad \times$$

(5) ✓

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

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

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

$$-30 \times -4e^{-4t}$$

$$= 120e^{-4t}$$

and where  $t = 0$ 

$$= 120e^{(0)} - (4 \times 0) = 120 \text{ v/unit of time} \quad \checkmark$$

(4) ✓

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

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

$$= \left[ 10x + \frac{5x^3}{3} - \frac{x^4}{2} \right]_3^4$$

~~Upper Limit  $x=4$   $10 \times 4 + \frac{5 \times 4^3}{3} - \frac{4^4}{2}$~~   
~~Lower Limit  $x=3$~~

Upper Limit  $x=4$   $10 \times 4 + \frac{5 \times 4^3}{3} - \frac{4^4}{2} = 18.667$

Lower Limit  $x=3$   $10 \times 3 + \frac{5 \times 3^3}{3} - \frac{3^4}{2} = 34.5$

Area =  $18.667 - 34.5 = -15.833 \text{ units}^2$

4 ✓

3b. 
$$\int_0^{\pi} \left( 3 \sin \frac{x}{2} - \cos \frac{x}{4} \right) dx = \int_0^{\pi} \left( 3 \sin \frac{1}{2}x - \cos \frac{1}{4}x \right)$$

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

so UPPER LIMIT  $x = \pi = -\frac{3}{\frac{1}{2}} \cos \frac{1}{2}\pi - \frac{1}{\frac{1}{4}} \sin \frac{1}{4}\pi = -2.82843$

LOWER LIMIT  $x = 0 = -\frac{3}{\frac{1}{2}} \cos \frac{1}{2}0 - \frac{1}{\frac{1}{4}} \sin \frac{1}{4}0 = -1.5$

$$\text{Area} = -2.82843 - (-1.5) = -1.32843 \text{ unit}^2$$

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

$$\text{so } 2x+1 = A(x+2) + B(4x) \quad \checkmark$$

$$\text{where } x=2, \quad (2 \times 2)+1 = A(2+2) + B(4 \times 2)$$

$$-3 = -8B$$

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

$$\text{and where } x=0, \quad (2 \times 0)+1 = A(0+2) + B(4 \times 0)$$

$$1 = 2A$$

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

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

$$\left[ \frac{\frac{1}{2}}{4} \ln 4x + \frac{3}{8} \ln x+2 \right]_1^3 \quad \checkmark$$

$$\text{Upper limit } x=3, \quad \frac{1}{4} \ln 4 \times 3 + \frac{3}{8} \ln 3+2 = 5.57335$$

$$\text{Lower limit } x=1, \quad \frac{1}{4} \ln 4 \times 1 + \frac{3}{8} \ln 1+2 = 3.18456$$

$$\text{Area} = 5.57335 - 3.18456 = 2.38879$$

$$5.57335 - 3.18456 = 2.38879$$

$$5.57335 - 3.18456 = 2.38879 \text{ unit}^2 \quad \times$$

5.

|                        |               |                |                |                |                |
|------------------------|---------------|----------------|----------------|----------------|----------------|
|                        | 1.0           | 1.5            | 2.0            | 2.5            | 3.0            |
| $\frac{2x+1}{4x(x+2)}$ | $\frac{1}{4}$ | $\frac{4}{21}$ | $\frac{5}{32}$ | $\frac{2}{15}$ | $\frac{7}{60}$ |
|                        | $y_0$         | $y_1$          | $y_2$          | $y_3$          | $y_4$          |

$$\frac{1}{3} \times 0.5 \times \left( \left( \frac{1}{4} + \frac{7}{60} \right) + 4 \left( \frac{4}{21} + \frac{2}{15} \right) + 2 \left( \frac{5}{32} \right) \right) = 0.32907$$

|                        |               |                |                |                 |                |
|------------------------|---------------|----------------|----------------|-----------------|----------------|
|                        | 1.0           | 1.5            | 2.0            | 2.5             | 3.0            |
| $\frac{2x+1}{4x(x+2)}$ | $\frac{3}{7}$ | $\frac{8}{19}$ | $\frac{5}{12}$ | $\frac{12}{29}$ | $\frac{7}{17}$ |
|                        | $y_0$         | $y_1$          | $y_2$          | $y_3$           | $y_4$          |

$$\frac{1}{3} \times 0.5 \times \left( \left( \frac{3}{7} + \frac{7}{17} \right) + 4 \left( \frac{8}{19} + \frac{12}{29} \right) + 2 \left( \frac{5}{12} \right) \right) = 0.8355$$

|                        |               |                |                |                |                |
|------------------------|---------------|----------------|----------------|----------------|----------------|
| $x$                    | 1.0           | 1.5            | 2.0            | 2.5            | 3.0            |
| $\frac{2x+1}{4x(x+2)}$ | $\frac{1}{3}$ | $\frac{4}{21}$ | $\frac{5}{32}$ | $\frac{2}{15}$ | $\frac{7}{60}$ |

$$\frac{1}{3} \times 0.5 \times \left( \left( \frac{1}{3} + \frac{7}{60} \right) + 4 \left( \frac{4}{21} + \frac{2}{15} \right) + 2 \left( \frac{5}{32} \right) \right) = 0.34296 \text{ units}^2$$

$$\% \text{ error} = \frac{(\text{calculated area} - \text{estimated area})}{\text{calculated area}} \times 100\%$$

$$= \frac{(2.38879 - 0.34296)}{2.38879} \times 100 = 85.643\%$$

|    |                  |                             |        |       |        |        |                                                  |
|----|------------------|-----------------------------|--------|-------|--------|--------|--------------------------------------------------|
| 6. | Midpoint $x$     | 1                           | 3      | 5     | 7      | 9      | $\sum f = 60$                                    |
|    | $fx$             | 3                           | 57     | 120   | 70     | 36     | $\sum fx = 286$ ✓                                |
|    | $f(x-\bar{x})^2$ | <del>42.775</del><br>42.775 | 56.862 | 1.204 | 54.429 | 71.369 | $\bar{x} = \frac{286}{60} = 4.776$<br>rounding ✓ |

$$\sum f(x-\bar{x})^2 = 226.639$$

bried method

$$s.d. = \sqrt{\frac{226.639}{60}} = 1.944$$

(10) ✓

$$\begin{aligned} 7a. P(\text{connection}) &= P_A(\text{connection}) \times P_B(\text{connection}) \\ &= 0.77 \times 0.81 = 0.624 \quad \checkmark \end{aligned}$$

$$\begin{aligned} 7b. P(\overline{\text{connection}}) &= P_A(\overline{\text{connection}}) \times P_B(\overline{\text{connection}}) \\ &= (1 - 0.77) \times (1 - 0.81) = 0.0437 \quad \checkmark \end{aligned}$$

$$P(\text{connection}) = 1 - 0.0437 = 0.9563 \quad \checkmark$$

(8) ✓