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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: Davies

FORENAME(S): Steffan Wyn

1	Student Number	
2	Title of Examination Paper	SGE5001 Further eng. maths
3	Module Code	SGE5001
4	Date and Time of Examination	5/4/22 9:30-12:00
5	Examination Venue	G43
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	25
B 1	13
3	23
4	25
Total	86

Section A

a)

x	f	xf	$f(x-\bar{x})^2$
6	23	138	176.4767
7	56	392	175.4424
8	65	520	38.5385
9	53	477	2.8037
10	47	470	71.1063
11	37	407	183.9973
12	19	228	198.2251
	300	2632	846.59

$$\bar{x} = \frac{\sum xf}{\sum f} \rightarrow \frac{2632}{300}$$

$$\bar{x} = 8.77$$

$$\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}} \rightarrow \sqrt{\frac{846.59}{300}}$$

$$\sigma = 1.68 \text{ (approx)}$$

b) (i) $p(x=3) = \frac{e^{-2.25} \cdot 2.25^3}{3!}$

$\therefore$ Probability of 3 goals = ~~0.20~~ 0.20

ii) $p(x=0) = \frac{e^{-2.25} \times 2.25^0}{0!}$

$$= 0.1054$$

$$p(x=1) = \frac{e^{-2.25} \times 2.25^1}{1!}$$

$$= 0.2371$$

$$\therefore \text{probability } (>1) = 1 - 0.1054 - 0.2371$$

$$= 0.6575 \text{ or } 65.75\%$$

18

25
 25

Section B

1. $E(t) = RI + \frac{1}{C} \int I dt$

$\frac{dE}{dt} = R \frac{dI}{dt} + \frac{1}{C} I$

$\therefore 30 \frac{dI}{dt} + 30I = 30e^{-3t}$

$\frac{dI}{dt} + I = e^{-3t}$

$\int p dx = \int 1 = 1$

$I \cdot f = e^{1x}$

Ie^{1x}

$Ie^t = \int e^t \times e^{-3t}$

$Ie^t = \int e^{-2t}$

$Ie^t = \frac{-1}{2} e^{-2t} + C$

$\frac{dI}{dt} = -0.5 + C$

$C = 0.5$

if $E = 30e^{-3t}$
 $\frac{dE}{dt} = -90e^{-3t}$

$30 \frac{dI}{dt} + 30I = -90e^{-3t}$

$\frac{dI}{dt} + I = -3e^{-3t}$

$\int p dx = \int 1 = 1$

$Ie^t = \int 1 \times -3e^{-3t}$

$= -3 \int e^{-3t}$

$= 0.11e^{-3t} + C$

$P=1 \quad Q=e^{-3t}$

1. $E(t) = RI + \frac{1}{C} \int I dt$

$\frac{dE}{dt} = R \frac{dI}{dt} + \frac{1}{C} \int I dt$

$\therefore 30 \frac{dI}{dt} + 30I = -90e^{-3t}$

$\frac{dI}{dt} + I = -3e^{-3t}$

$P=1 \quad Q=-3e^{-3t}$

$\int p dx = \int 1 = 1$

$I \cdot f = e^0$

$Ie^{-t} = \int e^{-t} \times -30e^{-3t}$

$Ie^{-t} = \int -30e^{-4t}$

$Ie^{-t} = 7.5e^{-4t} + C$

$I(0) + 0 = 7.5 + C$

$\therefore C = -7.5$

if $E = 30e^{-3t}$

$\frac{dE}{dt} = -90e^{-3t}$



8.

1

1.

1, 1.

!

13/25

3. $y'' + 4y' + 3y = e^{-2t}$ $x_0 = 0$ $x_1 = 3$

$$(s^2 \bar{x} - sx_0 - x_1) + 4(s\bar{x} - x_0) + 3\bar{x} = \frac{1}{s+2}$$

$$s^2 \bar{x} - sx_0 - x_1 + 4s\bar{x} - 4x_0 + 3\bar{x} = \frac{1}{s+2}$$

Sub x_0, x_1 into: $s^2 \bar{x} - 0 - 3 + 4s\bar{x} - 0 + 3\bar{x} = \frac{1}{s+2}$

$$s^2 \bar{x} + 4s\bar{x} + 3\bar{x} = \frac{1}{s+2} + 3$$

$$\bar{x}(s^2 + 4s + 3) = \frac{1 + 3(s+2)}{(s+2)}$$

$$\bar{x}(s^2 + 4s + 3) = \frac{3s+7}{(s+2)}$$

$$\bar{x}(s+3)(s+1) = \frac{3s+7}{(s+2)}$$

$$\therefore \bar{x} = \frac{3s+7}{(s+2)(s+3)(s+1)}$$

$$3s+7 = \frac{A}{s+2} + \frac{B}{s+3} + \frac{C}{s+1}$$

$$3s+7 = A(s+3)(s+1) + B(s+2)(s+1) + C(s+2)(s+3)$$

$$s = -2 \rightarrow 3(-2)+7 = A(1)(-1) + B(0) + C(0)$$

$$1 = -1A$$

$$A = -1$$

$$s = -3 \rightarrow 3(-3)+7 = A(0) + B(-1)(-2) + C(0)$$

$$-2 = 2B$$

$$B = -1$$

$$s = -1 \rightarrow 3(-1)+7 = A(0) + B(0) + C(1)(2)$$

$$4 = 2C$$

$$C = 2$$

$$\therefore 3s + 7 = \frac{-1}{s+2} + \frac{1}{s+3} + \frac{2}{s+1}$$

$$\therefore x = \mathcal{L}^{-1} \left\{ \frac{-1}{s+2} + \frac{1}{s+3} + \frac{2}{s+1} \right\}$$

$$\underline{\underline{x = -e^{-2t} + e^{-3t} + 2e^{-t}}}$$

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25

$$4. \quad E = Ri + L \frac{di}{dt} + \frac{1}{C} \int I dt$$

$$\frac{d^2i}{dt^2} = L \frac{d^2i}{dt^2} + R \frac{di}{dt} + \frac{1}{C} I$$

$$3.5 \frac{d^2i}{dt^2} + 65 \frac{di}{dt} + 50I = 70$$

$$3.5m^2 + 65m + 50 = 0$$

$$m = \frac{-65 \pm \sqrt{65^2 - 4 \times 3.5 \times 50}}{2 \times 3.5}$$

$$m = -0.80 \quad \text{or} \quad m = -17.77$$

Real and different therefore Case 1:

$$y = Ae^{m_1x} + Be^{m_2x}$$

$$y = Ae^{-0.80t} + Be^{-17.77t}$$

When $I(0) = 0 \rightarrow 0 = A + B$ equation 1

$$\frac{dy}{dt} = -0.80Ae^{-0.80t} - 17.77Be^{-17.77t}$$

$$I'(0) = 25 \rightarrow 25 = -0.80A - 17.77B$$

$$\therefore 0.80A + 17.77B = -25 \quad \text{equation 2}$$

$$\text{eq 1} \times 0.8 \rightarrow 0.8A + 0.8B = 0 \quad \text{equation 3}$$

$$0.8A + 17.77B = -25 \quad \text{equation 4}$$

$$\text{eq 3} - \text{eq 4} \rightarrow -16.97B = 25$$

$$B = -1.47$$

Sub B value into eq 1

$$A + (-1.47) = 0$$

$$A = 1.47$$

$$\therefore \underline{I = 1.47e^{-0.80t} - 1.47e^{-17.77t}}$$

25
25