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Complete, fold and seal
(see note 2 below)

FORENAME(S): Hefin

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.**

List the numbers of the questions you have attempted	Office Use
A	25
B 3	14
1	2
4	0
Total	41



a)

x	f	xf	$f(x-\bar{x})^2$
6	23	138	176.8592
7	56	392	176.0376
8	65	520	38.8394
9	53	477	2.731
10	47	470	70.7599
11	37	407	183.5026
12	14	228	197.8571
mean($\bar{x}$)	$\Sigma f = 300$	$\Sigma xf = 2632$	$\Sigma f(x-\bar{x})^2 = 846.5868$

$\bar{x} = \frac{\Sigma fx}{\Sigma f}$
 $\therefore \frac{2632}{300} = 8.773$
 $\bar{x} = 8.773$ ✓

$$23(6-8.773)^2 = 176.8592$$

$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}} \therefore \sqrt{\frac{846.5868}{300}} = 1.6799$$

$$\bar{x} = 8.773 = 8.77$$

$$\sigma = 1.6799 \approx 1.68$$

$$\bar{x} = 8.77$$

$$\sigma = 1.68$$

b) $p(x=r) = \frac{e^{-\lambda} \lambda^r}{r!}$

(i) $\lambda = 2.25$ $\therefore \frac{e^{-2.25} (2.25^3)}{3!} = 0.2001$ ✓
 $r = 3$

(ii) $\lambda = 2.25$ $\therefore \frac{e^{-2.25} (2.25^0)}{0!} = 0.1054$ ✓
 $r = 0$

$\lambda = 2.25$ $\therefore \frac{e^{-2.25} (2.25^1)}{1!} = 0.2372$ ✓
 $r = 1$

$$0.1054 + 0.2372 = 0.3426 \quad P \text{ more than } 1 = 1 - 0.3426 = 0.6574$$

$$= 0.6574$$

18

25
25

Section B

3. $y'' + 4y' + 3y = e^{-2t}$, given $y=0$ and $y'=3$ When $t=0$

$$(s^2 \bar{y} - sy_0 - y_1) + 4(s\bar{y} - y_0) + 3\bar{y} = \frac{1}{s+2}$$

Sub $y_0=0$ and $y_1=3$

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

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

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

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

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

$$= \bar{y}(s+1)(s+4) = \frac{4s+8}{s+2}$$

$$= \bar{y} = \frac{4(s+2) + 4s+8}{(s+1)(s+2)(s+4)}$$

$$\frac{4(s+2)}{(s+1)(s+2)(s+4)} = \frac{4s+8}{(s+1)(s+2)(s+4)} = \frac{A}{(s+1)} + \frac{B}{(s+2)} + \frac{C}{(s+4)}$$

$$4s+8 = A(s+2)(s+4) + B(s+1)(s+4) + C(s+1)(s+2)$$

$$s = -1$$

$$4(-1)+8 = A(1)(3) + B(0) + C(0)$$

$$4 = 3A$$

$$\frac{4}{3} = A \quad A = 1.33$$

$$s = -2$$

$$4(-2)+8 = A(0) + B(-1)(2) + C(0)$$

$$0 = -2B$$

$$\frac{0}{-2} = B \quad B = 0$$

$$s = -4$$

$$4(-4)+8 = A(0) + B(0) + C(-4)(-8)$$

$$-8 = 32C$$

$$\frac{-8}{32} = C \quad C = -0.25$$

7.

1

1

1

Part 2 Section B

$$3. = \frac{1.33}{(s+1)} + \frac{0}{(s+2)} + \frac{-0.25}{(s+4)}$$

$$\int^{-1} \left[\frac{1.33}{(s+1)} + \frac{0}{(s+2)} + \frac{-0.25}{(s+4)} \right]$$

$$= 1.33 e^{-1t} - 0.25 e^{-4t}$$

2

14
25

1. Integrating factor to find current in RC circuit.

$$R=30\Omega, \quad C=1/30 \text{ or } 0.03, \quad E=30e^{-3t} \text{ and } I(0)=0$$

R-C circuit

$$a=30 \quad k=-3 \quad x=t$$

$$\begin{aligned} \circ \circ \quad RI + \frac{1}{C} \int I dt &= E(t) \\ &= (30)(0) + \left(\frac{1}{1/30}\right) \int (0) dt = 30e^{-3t}(t) \\ &= \frac{RI}{dt} + \frac{1}{C} \frac{dI}{dt} = \frac{dE}{dt} \end{aligned}$$

$$\begin{aligned} / \quad RI + \frac{1}{C} \int I dt &= 30e^{-3t}(t) \\ &= RI + \frac{1}{C} \int I dt = -90e^{-3(t)} \\ (30 \div 1/30) I &= 900 \end{aligned}$$

2.

$$\circ \circ \quad \frac{(30)(0)}{dt} + \frac{(1)}{(1/30)} \frac{dI}{dt} = \frac{dE}{dt}$$

$$= 30 + \frac{dI}{dt} = \frac{dE}{dt}$$

$$\text{Integrating factor} = \frac{dy}{dx} + Py = Q$$

$$\frac{dy}{dx} + Py = Q \quad \circ \circ \quad \frac{dy}{dx} + (900)(1) = Q$$

$$= \frac{dy}{dx} + 900 = Q$$

X

2
25

Part 3 Section B

4. $i(t)$ $I(0) = 0$ and $I'(0) = 25$

$R = 65 \Omega$, $C = 1/50$ or 0.02 , $L = 3.5 H$, $E(t) = 70V$

RLC circuit:

$$E = RI + L \frac{dI}{dt} + \frac{1}{C} \int I dt$$

$$\therefore E = (65)I + (3.5) \frac{dI}{dt} + \frac{1}{(0.02)} \int I dt \quad \times \quad a=1 \quad n=1 \quad x=I$$

$$E = (65)I + (3.5) \frac{dI}{dt} + \frac{1}{(0.02)} + \frac{(1)I^{1+1}}{(1)+1} + (0.02)$$

$$\therefore E = (65)I + (3.5) \frac{dI}{dt} + \frac{1}{(0.02)} + \frac{I^2}{2} + (0.02)$$

$$E = 65I + 3.5 \frac{dI}{dt} + 50 + \frac{I^2}{2} + (0.02) \quad \times$$

$$\frac{0}{25}$$