

1809806

by Richard Harrison

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369

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06 May 2020

Exam

Section A

①	x	f	xf	$f(x - \bar{x})^2$	$\bar{x} = \frac{\sum xf}{\sum f} = 8.59$
	6	7	42	46.9567	
	7	21	147	53.0901	$\sigma = \frac{\sum f(x - \bar{x})^2}{\sum f} = 2.5019$
	8	25	200	8.7025	~~4.5019~~
	9	19	171	3.1939	$\sigma = \underline{\underline{2.50}}$ ^x
	10	14	140	27.8334	
	11	9	99	52.2729	
	12	5	60	58.1405	5/7
	$\Sigma = 100 \quad \Sigma = 859 \quad \Sigma = 250.19$				

② $P = 0.6 \quad Q = 1 - 0.6 = 0.4 \quad n = 3 \quad k = 1$

i) 1 resistor in 3

$$\binom{n}{k} P^k Q^{n-k}$$

$$\text{So, } = \binom{3}{1} 0.6^1 0.4^{3-1}$$

$$= \binom{3}{1} 0.6 \times 0.4^2$$

$$= 3(0.6)(0.16)$$

$$= 0.288$$

7



16ii) ~~At least~~ At least 3 in 4

$$p = 0.6 \quad q = 0.4 \quad n = 4 \quad K = 3$$

$$\text{Prob of 3: } \binom{4}{3} 0.6^3 0.4^{4-3}$$

$$= \binom{4}{3} 0.6^3 0.4$$

$$= 4(0.216)(0.4)$$

~~$$= 0.864 \times 0.4$$~~

$$= 0.3456$$

4

$$\text{Prob of 4: } \binom{4}{4} 0.6^4 \times 0.4^{4-4}$$

$$= 1(0.6)^4$$

$$\binom{4}{4} - \text{no difference}$$

$$= 0.1296$$

4

$$\text{Probability of at least 3} = 0.3456 + 0.1296$$

$$= \underline{\underline{0.4752}}$$

3

section A total = 23/25



Section B

2) $y'' + 3y' + 2y = e^t$, given $y=0$ and $y'=1$ when $t=0$

$$(s^2 \bar{y} - sy_0 - y_1) + 3(s\bar{y} - y_0) + 2\bar{y} = e^t$$

$$s^2 \bar{y} - sy_0 - y_1 + 3s\bar{y} - 3y_0 + 2\bar{y} = e^t$$

$$s^2 \bar{y} - 1 + 3s\bar{y} + 2\bar{y} = e^t$$

$$s^2 \bar{y} + 3s\bar{y} + 2\bar{y} = e^t + 1$$

$$\bar{y}(s^2 + 3s + 2) = e^t + 1$$

~~Given~~ Given, $t=0$: $e^t = 1$

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

$$\begin{array}{l} 1 \times 2 = 2 \\ + + 2 = 3 \end{array}$$

$$\mathcal{L}^{-1} \left\{ \frac{2}{(s+1)(s+2)} \right\} = \underline{\underline{2e^{-t} - 2e^{-2t}}}$$

total = 5/25

3) $R=60$ $L=2$ $C=0.02$ $E=50$ $I(0)=0$ and $I'(0)=10$

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

$$50 = 60I + 2 \frac{dI}{dt} + \frac{1}{0.02} \int I dt$$

$$2 \frac{d^2 I}{dt^2} + 60 \frac{dI}{dt} + 50I = \frac{dE}{dt}$$

$\frac{dE}{dt} = 0$ ~~and simplify:~~

$$2 \frac{d^2 I}{dt^2} + 60 \frac{dI}{dt} + 50I = 0$$

(A)

(B)

(C)

$$m = \frac{-60 \pm \sqrt{60^2 - 4 \times 2 \times 50}}{2 \times 2}$$

$$= \frac{-60 \pm \sqrt{60^2 - 4 \times 2 \times 50}}{4}$$

$$\text{or } \frac{-60 \pm \sqrt{60^2 - 4 \times 2 \times 50}}{4}$$

$$= \frac{-60 \pm \sqrt{3200}}{4}$$

$$\text{or } \frac{-60 \pm \sqrt{3200}}{4}$$

$$= -0.858$$

$$\text{or } -29.142$$



$$-0.858 \text{ or } -29.142$$

Real + different

$$\text{So: } I = Ae^{m_1 x} + Be^{m_2 x}$$

$$I(0) = 0 \text{ so } t=0:$$

no GS-2

$$A + B = 0 \rightarrow \text{eqn (1)}$$

$$\frac{dI}{dt} = -0.858Ae^{-0.858t} - 29.142Be^{-29.142t}$$

Using the differentiated equation for "I" knowing that $I'(0) = 10$

$$10 = -0.858A - 29.142B$$

Add eqn (1)
x 0.858

$$+ 0 = 0.858A + 0.858B$$

$$10 = -28.284B$$

Therefore:

$$B = \frac{10}{-28.284}$$

$$~~B = -0.354 \text{ (3dp)}~~ B = -0.354 \text{ (3dp)}$$

$$\text{Therefore: } A = 0.354$$

$$\text{So, } I = 0.354e^{-0.858t} - 0.354e^{-29.142t}$$

23/25

$$(4) f(x) = -4x \quad (-\pi < x < 0)$$

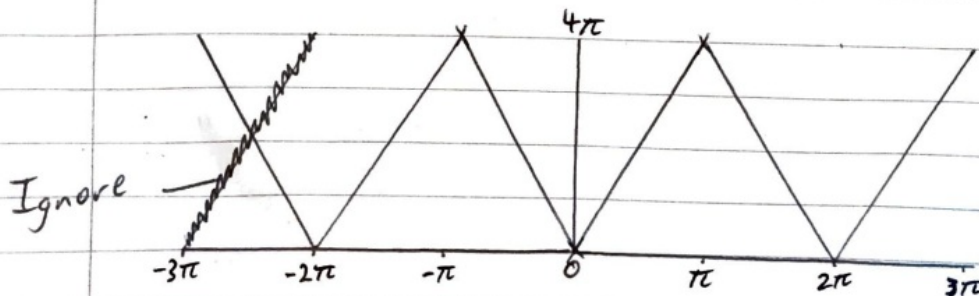
$$f(x) = 4x \quad (0 < x < \pi) \text{ and } f(x+2\pi) = f(x)$$

Sketch graph + First 4 non-zero terms

$$\text{if } x = -\pi, -4x = -4(-\pi) = 4\pi$$

$$\text{if } x = 0, -4x = 0$$

$$\text{if } x = \pi, 4x = 4(\pi) = 4\pi$$



Wave is above the y-axis and symmetrical so $b_n = 0$



Since $b_n = 0$; Function is even.

$$a_0 = \frac{2}{\pi} \int_0^{\pi} f(x) dx$$

$$a_0 = \frac{2}{\pi} \int_0^{\pi} 4x dx$$

To get rid of $\left(\frac{2}{\pi}\right)$

$$a_0 = \frac{2}{\pi} \left[\frac{4x^2}{2} \right]_0^{\pi}$$

$$a_0 = \cancel{\frac{2}{\pi}} \left[\frac{4\pi^2}{\cancel{2}} \right]$$

$$a_0 = 4\pi$$

Then:

$$a_n = \frac{2}{\pi} \int_0^{\pi} f(x) \cos nx dx$$

$$= \frac{2}{\pi} \int_0^{\pi} 4x \cos nx dx$$

$$\text{Let } u = 4x \quad \frac{dv}{dx} = \cos nx$$

$$\frac{du}{dx} = 4 \quad v = \frac{1}{n} \sin nx$$

$$\int 4x \cos nx = (4x) \left(\frac{1}{n} \sin nx \right) - \int \frac{1}{n} \sin nx (4) dx$$

$$= \frac{4x}{n} \sin nx + \frac{4}{n^2} \cos nx$$

$$\text{Therefore: } a_n = \frac{2}{\pi} \left[\frac{4x}{n} \sin nx + \frac{4}{n^2} \cos nx \right]_0^{\pi}$$

$$= \frac{2}{\pi} \left[\underbrace{\frac{4\pi}{n} \sin(n\pi)}_{=0} + \frac{4}{n^2} \cos(n\pi) \right] - \frac{2}{\pi} \left[\underbrace{\frac{4(0)}{n} \sin(0)}_{=0} + \frac{4}{n^2} \cos(0) \right]$$

$$= \frac{2}{\pi} \left[\frac{4}{n^2} \cos(n\pi) \right] - \frac{2}{\pi} \left[\frac{4}{n^2} \right] \quad \boxed{\cos(0) = 1}$$

~~16/25~~

$$a_n = \frac{8}{\pi n^2} [\cos(n\pi) - 1]$$

$$\text{if } n=1 \quad a_1 = \frac{8}{\pi^2} [\cos(\pi) - 1] = \frac{8}{\pi^2} \times -2 = \frac{16}{\pi^2}$$

should be -ve

$$\text{if } n=2 \quad a_2 = \frac{8}{\pi^2} [\cos(2\pi) - 1] = \frac{8}{\pi^2} \times 0 = 0$$

$$\text{if } n=3 \quad a_3 = \frac{8}{\pi^2} [\cos(3\pi) - 1] = \frac{8}{\pi^2} \times -2 = \frac{16}{\pi^2}$$

-1

$$\text{if } n=4 \quad a_4 = \frac{8}{\pi^2} [\cos(4\pi) - 1] = \frac{8}{\pi^2} \times 0 = 0$$

$$f(x) = \frac{1}{2} (4\pi) - \frac{16}{\pi^2} \cos x - \frac{16}{\pi^2} \cos 3x - \frac{16}{\pi^2} \cos 5x \dots \text{etc}$$

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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

74/100

Instructor

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