

LC 2014: PAPER 2

QUESTION 4 (25 MARKS)

Question 4 (a)

$$V = 311\sin(100\pi t)$$

(i) $R = [-311, 311]$

(ii) $P = \frac{2\pi}{100\pi} = 0.02 \text{ s}$

$$f = \frac{1}{P} = \frac{1}{0.02} = 50 \text{ Hz}$$

NOTE: $P = 0.02 \text{ s}$ can also be read off the graph.

PERIOD P AND RANGE R

$$y = a \sin bx$$

$$\text{Range } R = [-a, a]$$

$$\text{Period } P = \frac{2\pi}{b}$$

$$\text{Frequency } f = \frac{1}{P}$$

MARKING SCHEME NOTES

Question 4 (a) (i) (ii) [Scale 10C (0, 3, 7, 10)]

- 3: • Some reference to 311 or -311
 • Some indication that term 'range' understood
 • Ranges (other than correct one) between $\pm 300, \pm 320$ (consistent)
 • Some reference to how long it takes to complete a cycle
 • Time for one period found
- 7: • Correct range
 • Correct number of periods

Question 4 (b) (i)

t	t_1	t_2	t_3	t_4	t_5	$t_6 = 0.01$	t_7	t_8	t_9	t_{10}	t_{11}	$t_{12} = 0.02$
V	156	269	311	269	156	0	-156	-269	-311	-269	-156	0

Question 4 (b) (ii)

$$\mu = 0$$

$$\sigma = \sqrt{\frac{2 \times 0^2 + 4 \times 156^2 + 4 \times 269^2 + 2 \times 311^2}{12}} = 220 \text{ V}$$

FORMULAE AND TABLES BOOK Statistics and probability:

Standard deviation from a list of n numbers [page 33]

$$\sigma = \sqrt{\frac{\sum (x - \mu)^2}{n}}$$

MARKING SCHEME NOTES

Question 4 (b) (i) (ii) [Scale 10C (0, 3, 7, 10)]

- 3: • At least three further entries in table correct
 • Formula for standard deviation
- 7: • Table correct
 • Errors in table (with at least three additional entries) but standard deviation correct from candidates work

Question 4 (c) (i)

$$V_{\max} = 311 \text{ V}$$

$$\sigma = 220 \text{ V}$$

$$k\sigma = V_{\max}$$

$$\therefore k = \frac{V_{\max}}{\sigma} = \frac{311}{220} = 1.414$$

Question 4 (c) (ii)

$$f = 60 \text{ Hz}$$

$$\therefore P = \frac{1}{60} = \frac{2\pi}{b} \Rightarrow b = 120\pi$$

$$\sigma = 110 \text{ V}, k = 1.414$$

$$a = V_{\max} = k\sigma$$

$$\therefore a = 1.414 \times 110 = 155.54 \text{ V}$$

PERIOD P AND RANGE R

$$y = a \sin bx$$

$$\text{Range } R = [-a, a]$$

$$\text{Period } P = \frac{2\pi}{b}$$

$$\text{Frequency } f = \frac{1}{P}$$

MARKING SCHEME NOTES**Question 4 (c) (i) (ii) [Scale 5C (0, 2, 3, 5)]**

- 2:**
- k isolated in formula
 - Value(s) entered in formula
 - $\frac{b}{2\pi}$ written
- 3:**
- k or b or a found