

SAMPLE PAPER 7: PAPER 1

QUESTION 9 (50 MARKS)

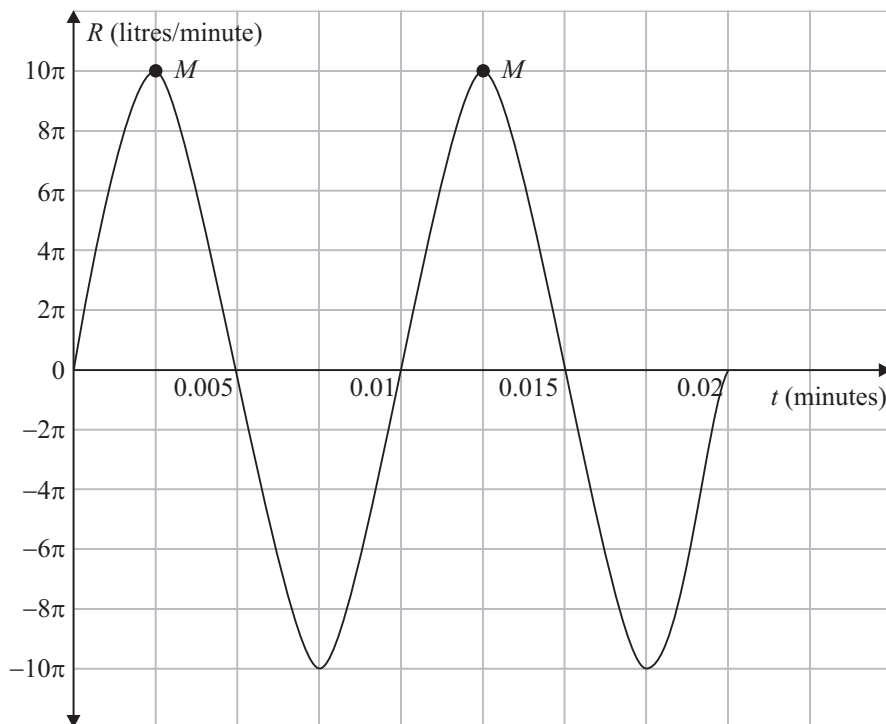
Question 9 (a)

$$\text{Period} = \frac{2\pi}{200\pi} = \frac{1}{100} \text{ min} = 0.01 \text{ min}$$

$$\text{Range} = [-10\pi, 10\pi]$$

Question 9 (b)

| | | | | | | | | | |
|------------------------|---|-----------------|-------|------------------|--------|------------------|--------|------------------|--------|
| t (minutes) | 0 | 0.0025 | 0.005 | 0.0075 | 0.01 | 0.0125 | 0.015 | 0.0175 | 0.02 |
| $200\pi t$ | 0 | $\frac{\pi}{2}$ | π | $\frac{3\pi}{2}$ | 2π | $\frac{5\pi}{2}$ | 3π | $\frac{7\pi}{2}$ | 4π |
| $\sin(200\pi t)$ | 0 | 1 | 0 | -1 | 0 | 1 | 0 | -1 | 0 |
| $10\pi \sin(200\pi t)$ | 0 | 10π | 0 | -10π | 0 | 10π | 0 | -10π | 0 |



Question 9 (c)

- (i) Breathing in: $0 \text{ s} - 0.0025 \text{ s}$, $0.0075 \text{ s} - 0.0125 \text{ s}$, $0.0175 \text{ s} - 0.02 \text{ s}$
- (ii) Breathing out: $0.0025 \text{ s} - 0.0075 \text{ s}$, $0.0125 \text{ s} - 0.0175 \text{ s}$
- (iii) Maximum values: 0.0025 s , 0.0125 s

Question 9 (d)

$$\frac{dV}{dt} = 10\pi \sin(200\pi t)$$

$$\int dV = 10\pi \int \sin(200\pi t) dt$$

$$V = -\frac{10\pi}{200\pi} \cos(200\pi t) + c$$

$$V = -0.05 \cos(200\pi t) + c$$

$$t = 0, V = 2.95:$$

$$2.95 = -0.05 \cos(200\pi(0)) + c$$

$$2.95 = -0.05 + c$$

$$\therefore c = 3$$

$$V = -0.05 \cos(200\pi t) + 3$$

Question 9 (e)

$$V = -0.05 \cos(200\pi t) + 3$$

$$V_{\text{Ave.}} = \frac{1}{0.01 - 0} \int_0^{0.01} (-0.05 \cos(200\pi t) + 3) dt$$

$$= 100 \left[3t - \frac{0.05}{200\pi} \sin(200\pi t) \right]_0^{0.01}$$

$$= 100 \left\{ 3(0.01) - \frac{0.05}{200\pi} \sin(200\pi(0.01)) - 0 \right\}$$

$$= 3 - \frac{0.05}{200\pi} \sin(2\pi)$$

$$= 3 \text{ litres}$$