

## SAMPLE PAPER 3: PAPER 2

### QUESTION 8 (50 MARKS)

#### Question 8 (a)

$$P = 100 + 20 \cos 6t$$

Maximum value :  $\cos 6t = 1$

$$\therefore P = 100 + 20(1) = 120 \text{ mm Hg (SP)}$$

$$P = 100 + 20 \cos 6t$$

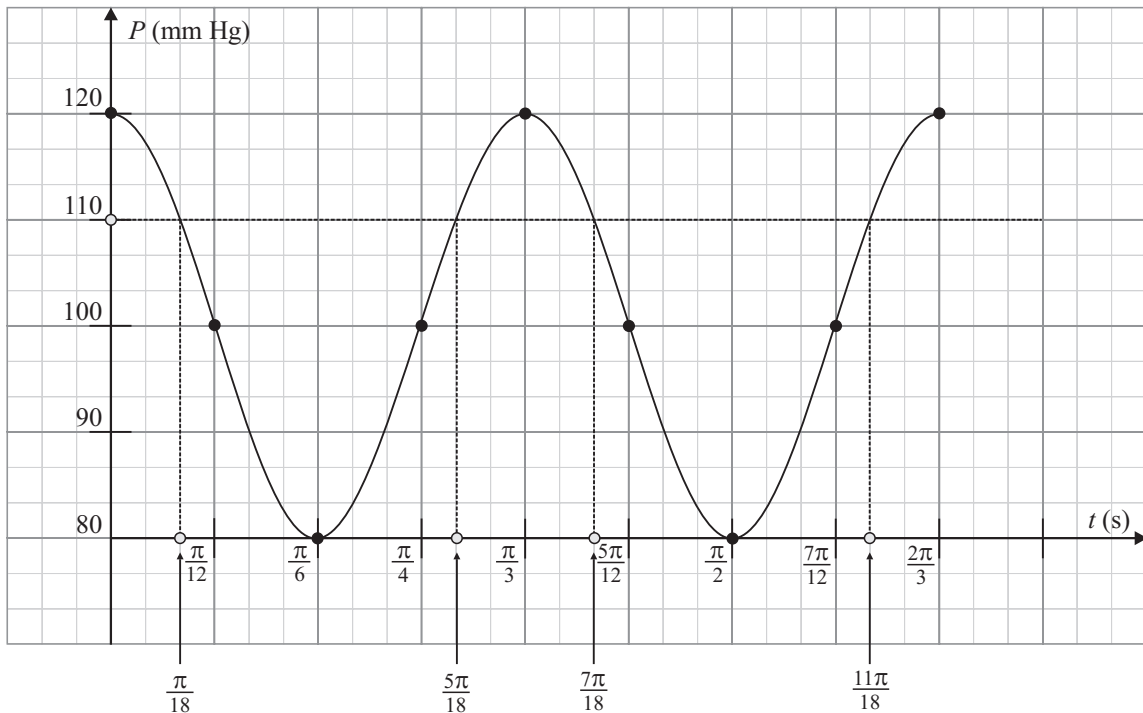
Minimum value :  $\cos 6t = -1$

$$\therefore P = 100 + 20(-1) = 80 \text{ mm Hg (DP)}$$

#### Question 8 (b) (i)

$t$ (s)	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$	$\frac{7\pi}{12}$	$\frac{2\pi}{3}$
$P$ (mm Hg)	120	100	80	100	120	100	80	100	120

#### Question 8 (b) (ii)



#### Question 8 (b) (iii)

$$\text{Range} = [80, 120]$$

$$\text{Period} = \frac{\pi}{3}$$

#### Question 8 (b) (iv)

$$\text{Duration} = \frac{\pi}{3} \text{ s}$$

$$\text{Number of beats per minute} = \frac{60}{\frac{1}{3}\pi} = \frac{180}{\pi} = 57$$

#### Question 8 (c) (i)

Draw a line through  $P = 100$  mm Hg and read off the times as shown above.

$$P = 100 \text{ mm Hg} \Rightarrow t = \frac{\pi}{18} \text{ s}, \frac{5\pi}{18} \text{ s}, \frac{7\pi}{18} \text{ s}, \frac{11\pi}{18} \text{ s}$$

**Question 8 (c) (ii)**

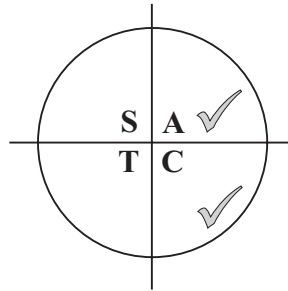
$$P = 100 + 20 \cos 6t = 110$$

$$20 \cos 6t = 10$$

$$\cos 6t = \frac{1}{2} \Rightarrow 6t = \cos^{-1}\left(\frac{1}{2}\right) = 60^\circ = \frac{\pi}{3}$$

$$6t = \frac{\pi}{3}, \frac{7\pi}{3} \text{ [First quadrant]}$$

$$= \frac{5\pi}{3}, \frac{11\pi}{3} \text{ [Fourth quadrant]}$$



$$t = \frac{\pi}{18}, \frac{7\pi}{18}$$

$$= \frac{5\pi}{18}, \frac{11\pi}{18}$$

**Question 8 (d)**

$$P = 100 + 20 \cos 6t$$

$$\frac{dP}{dt} = -20 \sin 6t \times 6 = -120 \sin 6t$$

$$\left(\frac{dP}{dt}\right)_{t=0} = -120 \sin 6(0) = 0$$

$$\left(\frac{dP}{dt}\right)_{t=\frac{\pi}{15}} = -120 \sin 6\left(\frac{\pi}{15}\right) = -120 \sin\left(\frac{2\pi}{5}\right) = -114 \text{ mm Hg}$$

$$\left(\frac{dP}{dt}\right)_{t=\frac{\pi}{5}} = -120 \sin 6\left(\frac{\pi}{5}\right) = -120 \sin\left(\frac{6\pi}{5}\right) = 70.5 \text{ mm Hg}$$

$$\left(\frac{dP}{dt}\right)_{t=\frac{\pi}{3}} = -120 \sin 6\left(\frac{\pi}{3}\right) = -120 \sin 2\pi = 0 \text{ mm Hg}$$


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