| Qns | Answer | Marks |
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| 1 (a) | … a wave whose profile remains static | 1 |
| (b) | (i) The equation is of the form $y = a \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$<br>$\therefore \frac{1}{\lambda} = 5$<br>$\therefore \lambda = \mathbf{0.2\ m}$ | <br>1<br>1 |
| | (ii) Now, $f = 12$ Hz<br>and $v = f\lambda = 12 \times 0.2 = \mathbf{2.4\ m\ s^{-1}}$ | 1<br>1 |
| (c) | $y_1 = 0.2 \sin 2\pi(12t - 5x)$<br>and $y_2 = 0.2 \sin 2\pi(12t + 5x)$ the reflected ray<br>So $y = y_1 + y_2$<br>$= 0.2 \sin 2\pi(12t - 5x) + 0.2 \sin 2\pi(12t + 5x)$<br>$= 0.4 \sin 24\pi t \cos 10\pi x$<br>$= A \sin 24\pi t$<br>where $A = 0.4 \cos 10\pi x = 0.4 \cos\left(\frac{2\pi x}{\lambda}\right)$<br>So, the amplitude of the resultant wave is not constant but depends on the distance, x, along the direction of the wave.<br>A is maximum when $x = 0, \frac{1}{2}\lambda, \lambda$, etc. These are the antinodes.<br>$A = 0$ when $x = \frac{1}{4}\lambda, \frac{3}{4}\lambda, \frac{5}{4}\lambda$, etc. These are nodes.<br>So the resultant is a stationary wave.<br>At an antinode the amplitude = 0.4 m | ½<br>½<br>½<br>½<br>½<br>½<br>½<br>½<br>1 |
| (d) | (i) Beats means the periodic rise and fall of loudness that occur when two notes of slightly different frequencies but same amplitude are sounded together.<br><br>Doppler effect is the apparent change in the frequency of a wave motion when there is relative motion between the source and the observer. | 1<br><br>1 |
| | (ii) Used:<br>- in measuring unknown frequencies<br>- to tune an instrument to a certain frequency<br>- as intermediate frequency in radios, TVs, etc<br>Any 2 @1 | 2 |
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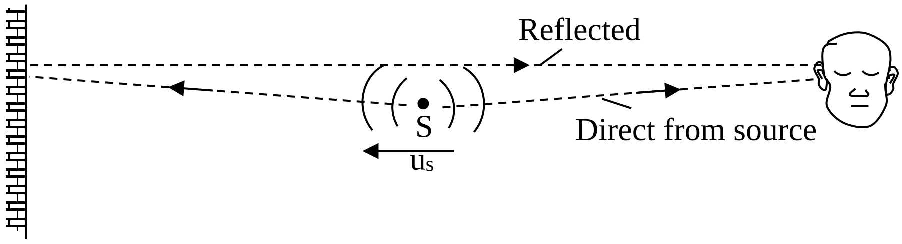
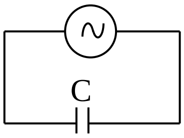
| (e) | <br><br><br>The observer receives two sounds of slightly different frequencies -<br>one is due to sound of slightly lower frequency arriving directly from the source which is receding,<br>and another reflected by the wall.<br>Since the source is approaching the wall, the frequency as received (and reflected) by the wall is of slightly higher frequency.<br>When the two sounds are received they form beats at the observer. | 1<br><br>½<br>½<br><br>½<br>½ |
| | (ii) Apparent frequency of the direct sound, $f' = \frac{Vf}{V + u_s}$<br><br>Apparent frequency of the direct sound, $f'' = \frac{Vf}{V - u_s}$<br><br>Beat frequency, $f_b = f'' - f' = Vf\left(\frac{1}{V - u_s} - \frac{1}{V + u_s}\right) = \frac{2u_s Vf}{V^2 - u_s^2}$<br><br>$\therefore \quad f = \frac{f_b(V^2 - u_s^2)}{2u_s V} = \frac{5(340^2 - 4^2)}{2 \times 4 \times 340}$ = **212.5 Hz** | <br><br><br>1½<br><br>1½ |
| | ***Total = 20*** | |
| 2 (a) | … that value of steady current which would dissipate heat at the same rate in a given resistor as the alternating current. | 1 |
| (b) | E = $V_o\sin\omega t$<br><br><br><br>Suppose that at a certain instant the p.d across the capacitor is E= $V_o\sin\omega t$.<br><br>Then, the charge Q = CE = $CV_o\sin\omega t$.<br>The current flowing at the instant is the rate at which charge is accumulating on or leaving the capacitor.<br>i.e. $I = \frac{dQ}{dt} = \frac{d(CV_o\sin\omega t)}{dt} = \omega CV_o\cos\omega t$ ….. (1)<br>Equation (1) can also be written as<br>$I = I_o\cos\omega t$ ……………………..(2)<br>where $I_o$ is the peak current.<br>i.e $I_o = \omega CV_o$<br>Thus $\frac{V_o}{I_o} = \frac{1}{\omega C}$<br><br>But $\frac{V_o}{I_o} = \frac{V_{r.m.s}}{I_{r.m.s}} = \frac{1}{\omega C} = \frac{1}{2\pi f}$ | <br><br>½<br><br><br>1<br><br><br><br>½<br>½<br><br>½ |

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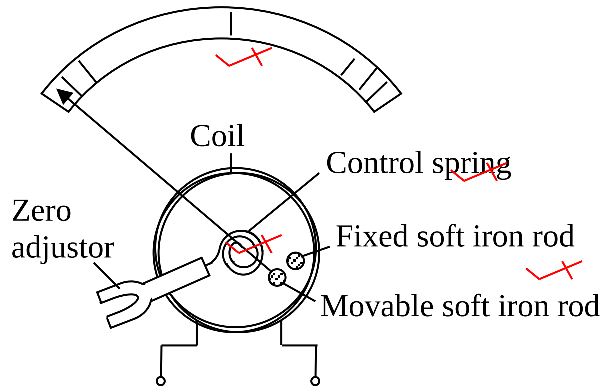
| | $\therefore I_{r.m.s} = $ **2πfCV** | 1 |
| (c) | (i) The direction of deflection of the coil of a moving-coil meter depends on the direction of current.<br>If an alternating current is passed through the coil, the point would simply oscillate at the frequency of the a.c.<br>So, no reading can be taken | 1<br>1<br>1 |
| | (ii) <br>It consists of two parallel soft iron rods, one fixed and the other free to move, located inside a coil. The rods are parallel to the axis of the coil and the bottom end of the pointer is fixed onto the movable rod.<br>The current to be measured flows round the coil and magnetises the two soft iron rods with like poles side by side.<br>Since like poles repel, the soft iron rods repel each other with the result that the movable one moves away thereby turning the pointer fixed to it.<br>The pointer turns until the counter torque developed in the control spring is enough to stop it.<br>The repulsion force, and therefore the angle turned through by the pointer, depends on the current flowing in the coil (but not linearly). | ½<br>½<br>½<br>½<br>1<br>1<br>½<br>½ |
| (d) | (i) Let θ be the phase angle<br>Then $\theta = \tan^{-1}\left(\frac{X_L}{R}\right) = \tan^{-1}\left(\frac{\omega L}{R}\right) = \tan^{-1}\left(\frac{160 \times 0.5}{60}\right)$<br>$= \tan^{-1}1.333 = \mathbf{53.1^o}$ | 1<br>1 |
| | (ii) $I = \frac{V_{r.m.s}}{Z} = \frac{V\sqrt{2}}{\sqrt{(\omega L)^2 + R^2}} = \frac{200\sqrt{2}}{\sqrt{80^2 + 60^2}} = 2\sqrt{2} = \mathbf{2.83\ A}$ | 3 |
| | (iii) Power is dissipated only in the pure resistance.<br>$\therefore$ Power $= I^2R = (2\sqrt{2})^2 \times 60 = \mathbf{480\ W}$ | 2 |
| | ***Total = 20*** | |