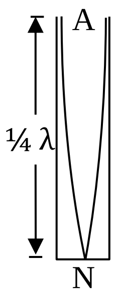
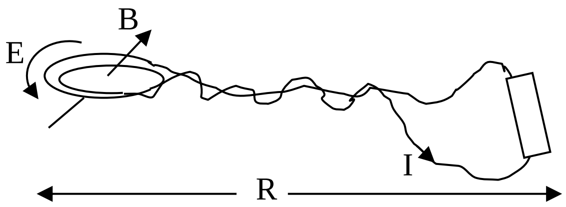
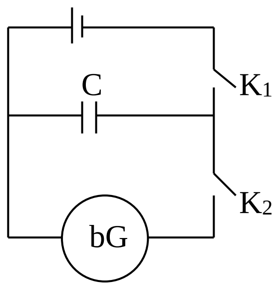
Qn	Answer	Marks
1. (a)	Transverse waves: - Propagate with vibrations perpendicular to the direction of travel - Can be polarized Longitudinal waves: - Propagate with vibrations parallel to the direction of travel - Cannot be polarised	1 1
(b)	(i) The given equation is of the form: $Y = a \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$ $\therefore \frac{1}{T} = 10 \Rightarrow T = \mathbf{0.1\ s}$	1 2
	(ii) $\frac{1}{\lambda} = 0.4 \Rightarrow \lambda = 2.5$ m $V = f\lambda = \frac{\lambda}{T} = 2.5 \times 10 = \mathbf{25\ m\ s^{-1}}$	1½ 1½
(c)	(i) This is the apparent change in the frequency of a wave motion when there is relative motion between the source and the observer.	1
	(ii) Let u_s = velocity of the car = 90 km h^{-1} = 25 m s^{-1} V = velocity of sound f = frequency of the siren The apparent wavelength, $\lambda' = \frac{V - u_s}{f}$ Since the observer is stationary, the velocity remains unaffected So apparent frequency, $f' = \frac{V}{\lambda'} = \frac{fV}{V - u_s} = \frac{945 \times 335}{335 - 25}$ $= \mathbf{1021\ Hz}$	1 1 1
	(iii) Applications of Doppler effect: - Speed detection, e.g. of vehicles - Determination of plasma temperature - In determining speed of a star or planet Any one	1
(d)	(i)  Air at end A vibrates with maximum amplitude	1 ½

	The amplitude of vibration decreases as the end N is approached. Air at N is stationary. A is the antinode while N is the node.	½ ½ ½
	(ii) Wavelength of the fundamental mode, $\lambda_o = 4l = 4 \times 29 = 116$ cm If there were no end correction, the wavelength of the 3rd harmonic $\lambda_1 = \frac{V}{f_1} = \frac{V}{3f_o} = \frac{1}{3}\lambda_o = \frac{1}{3} \times 116 = 38.7$ cm But the observed wavelength, $\lambda = \frac{V}{f} = \frac{340}{860} = 39.5$ cm $\Rightarrow$ The mode is the 3rd harmonic Now $29 + c = \frac{3}{4}\lambda_r = \frac{3}{4} \times 39.5 = 29.63$ $\therefore \quad c = $ **0.63 cm**	½ 1 ½ ½ ½ 1
	Total = 20	
2. (a)	(i) ….the sum of the fluxes through the individual turns of a circuit (coil)	1
	(ii) …the development of an emf in a coil due to fluctuation of current in a nearby coil.	1
(b)	 Let R = total resistance of the circuit. Φ = flux linkage at any instant At any instant, the emf induced in the circuit is $E = -\frac{d\Phi}{dt}$ $\therefore$ Current, $I = \frac{E}{R} = -\frac{1}{R}\frac{d\Phi}{dt}$ But the current, I = rate of flow of charge = $\frac{dQ}{dt}$ $\therefore \quad \frac{dQ}{dt} = -\frac{1}{R}\frac{d\Phi}{dt}$ If the flux changes from, say Φ_1 to Φ_2, the total charge that circulates in the circuit is $Q = \int_0^Q dQ = -\frac{1}{R}\int_{\Phi_1}^{\Phi_2} d\Phi$ $\therefore \quad Q = \frac{\Phi_1 - \Phi_2}{R}$	 1 1 ½ ½ 1

	Thus, the charge circulated is independent of the time taken.	
(c)	(i) A heavy coil - for a long period of oscillation so that all the charge flows through the coil before it moves appreciably. An insulating former - to minimise damping of the oscillations of the coil. No shunt - so that all charge flows through the coil. No shot-cuicuited turns - so that all charge flows through each turn of the coil.	½ ½ ½ ½ ½ ½ ½ ½
	(ii)  - A capacitor of known capacitance, C, is charged to a known p.d, V, by closing switch K_1. - K_1 is opened and then K_2 is closed while observing the pointer of the ballistic galvanometer and the throw, θ, is noted. Now, the charge circulated through the galvanometer is Q = CV. - By changing C or V, different values of charge, Q, are passed through the ballistic galvanometer, each time noting the corresponding throw, θ. - Then a graph of Q against θ is plotted. Its gradient, s , is found. $s = \frac{Q}{\theta}$ = charge per deflection.	1 ½ ½ ½ ½ ½ ½
(d)	(i) The pointer remains at zero deflection since a steady current would not induce an emf	1 1
	(ii) For the solenoid, n = 1000 $\therefore \quad \Phi = BAN = \mu nIAN$, where $A = 12 \times 10^{-4}\ m^2$ and N = 1000 Charge circulated in the coil is $Q = \frac{\Delta\Phi}{R} = \frac{\mu nIAN}{R} = k\theta$ .... (1) Charge from the capacitor $= CV = 100 \times 10^{-6} \times 12 = k\theta'$ where $\theta' = 25$ div. $\therefore \quad 25k = 100 \times 10^{-6} \times 12$ $k = \frac{100 \times 10^{-6} \times 12}{25} = 4.8 \times 10^{-5}\ C\ div^{-1}$	½ ½ ½ ½

	From (1) $I = \frac{k\theta R}{\mu nAN}$	1
	$= \frac{4.8 \times 10^{-5} \times 20 \times 20}{4\pi \times 10^{-7} \times 1000 \times 12 \times 10^{-4} \times 1000}$ = **12.7 A**	1
Total = 20		