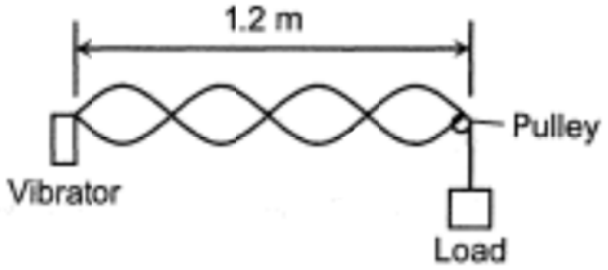
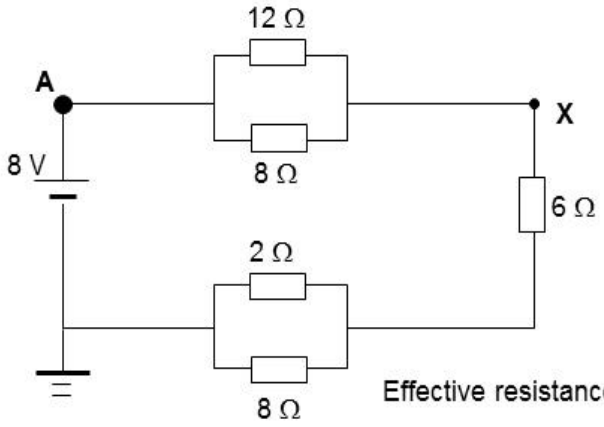
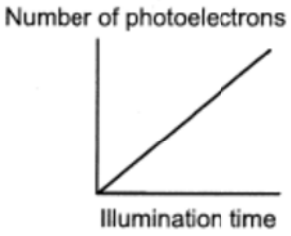
Solution for P1

Q	Working	Ans
1	For ping pong ball Diameter = 4.0 cm; Radius = 2.0 cm Vol of ping pong ball = $(4/3)(\pi)(0.02)^3 = 3.351 \times 10^{-5}$ m^3 Vol of classroom = 20 x 10 x 3.5 = 700 m^3 No. of ping pong balls = $(700) / (3.351 \times 10^{-5}) = 2.089 \times 10^7$	C
2	The pascal is a unit for pressure. $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$ In SI base units, $\text{Pa} = \frac{\text{kg m s}^{-2}}{\text{m}^2} = \text{kg m}^{-1}\text{s}^{-2}$	C
3	The acceleration-time graph is obtained from the velocity-time graph. Point Q is the turning point of the velocity-time graph and so is the maximum value.	B
4	vertically, $v_y^2 = u_y^2 + 2 a_y s_y$ $v_y^2 = (-50.0 \sin 30.0°)^2 + 2 (9.81) (30)$ $v_y = 34.8$ m s^{-1} horizontally, $v_x = (50.0 \cos 30.0°) = 43.3$ m s^{-1} tan Θ = 43.3/ 34.8 Θ = 51.2°	C
5	Let the initial velocity be v, then final velocity is (-v) Δ momentum = final momentum – initial momentum = m(-v) – mv = -2mv in direction O to X = 2mv in direction X to O	D
6	Area under F vs t graph = 6 x 10 – 0.5 x 2 x 10 = 50 Ns	C
7	According to Newton's 3rd law, action reaction pair must always be equal in magnitude and opposite in direction	D
8	F = 3ma a = F/3 F acting on 2m = 2m(a) =2m(F/3m) = 2F/3	C
9	Work done = area under graph $0.5 \times 60 \times 5 \times 10^{-3} + 0.5 (60 + 80) \times 4 \times 10^{-3} = 0.43$ J	C
10	tan θ = opposite/adjacent = F/W	C
11	Both wall and ground has normal and friction	C
12	Let E_T = total energy = constant Then $E_T = E_K + E_P$ $E_K = E_T – E_P$	B

	$= E_T - mgy$	
13	Lost in G.P.E = Gain in K.E + Work against friction 1(1)(9.81) = K.E + 0.5(10) K.E = 4.81 J	A
14	Average power = work done / time = gain in k.e. / time $= \frac{\frac{1}{2}\times 1500\times\left(\frac{100\times 10^3}{3600}\right)^2}{12.1}$ ≈ 47.8 kW	B
15	It represents displacement. It is not acceleration because its graph should be negative sine curve.	A
16	We need to first assume that the wave is progressing from the right to the left. By drawing the wave profile at the next instant, it can then be verified that the particles are moving in the same directions as the corresponding particles shown in the question. Hence the assumption is correct and it can then be deduced that energy is being transferred from the right to the left.	B
17	$\text{intensity} = \frac{power}{area}$, $I \propto \frac{1}{r^2}$ $I_1 = \frac{P_1}{A_1}$ $P_1 = I_1 A_1$ $P_2 = I_2 A_2$ $\frac{P_2}{P_1} = \frac{I_2 A_2}{I_1 A_1}$ $3 = \frac{I_2(4\pi)(4.5)^2}{0.18(4\pi)(3.0)^2}$ $I_2 = 0.24\ Wm^{-2}$	B
18	$x = \frac{\lambda D}{a}$ Increasing frequency will decrease the wavelength, hence decreasing the value of *x.*	C

19	 λ – 0.6 m (Dist between 3 Nodes) v = λf = 0.6 x 290 = 174 ms^{-1}	D
20	Only transverse wave can be polarized.	D
21	$R = \frac{\rho l}{A}$, $R_x = \frac{\rho(3L)}{L(2L)} = \frac{3\rho}{2L}$ ----(1), $R_y = \frac{\rho(L)}{2L(3L)} = \frac{\rho}{6L}$ ------(2) $\therefore \frac{(1)}{(2)} \Rightarrow \frac{R_x}{R_y} = 9$	D
22	V = I R I = V/R = 15/ 6 = 2.5 A V across 4 ohm = 2.5 x 4 = 10 V	C
23	Total current = current due to electrons I_e + current due to ions I_i. $I_i = 8.16x10^{-3} - (2.58x10^{16}\ x1.6x10^{-19}) = 4.032x10^{-3}\ A$ Number of ions per unit time = $4.03x10^{-3} / 3.2x10^{-19} = 1.26x10^{16}\ s^{-1}$.	A
24	When Temp increases, Resistance decreases	D

25	Effective resistance = = 4.8 Ω Potential difference across this pair of resistors = 3.097 V  The potential at point A is 8 V (since the other end of the battery is earthed). Therefore to create a potential difference of 3.09 V across the first pair of resistors, the potential at X must be 8.00 – 3.09 = 4.90 V	C
26	The magnetic field is directed along the axis of the solenoid (by Right Hand Grip Rule). The electron does not have a component of the velocity that is perpendicular to the magnetic field. Hence no magnetic force acts.	D
27	Towards X Two conductors carrying current in the same direction generate an attractive force and two carrying current in opposite directions generate a repulsive force. Y is attracted towards X and repelled from Z. The overall force acting on Y is towards X. (ans)	B

28	 The number of photoelectrons emitted per second is directly proportional to the intensity of incident radiation. Since the latter is constant, the number of photoelectrons emitted per second is second $\frac{N}{t}$. Hence, the number of electrons emitted will vary proportionally with the time of illumination ($N = \text{constant} \times t$). (ans)	B
29	$1.0\ \text{Wms}^{-2}$; 3.0eV; $6.0\times10^{-7}\ \text{m}$ $E_{300nm} = \frac{hc}{\lambda} = \frac{(6.63\times10^{-34})(3\times10^{8})}{(3\times10^{-7})(1.6\times10^{-19})} = 4.14eV$ $E_{600nm} = \frac{hc}{\lambda} = \frac{(6.63\times10^{-34})(3\times10^{8})}{(6\times10^{-7})(1.6\times10^{-19})} = 2.07eV$ $E_{600nm} < 3eV$ so there is no emission. Energy of photoelectrons is independent of intensity. (ans)	D
30	Since the frequency of the light didn't changed, the stopping potential, V' is unchanged. When the intensity doubles, more photons falls on the metal surface, emitting more photoelectrons and the photocurrent, I doubles.	C