Hint/Solution of selected questions SDV

Question: What is Zeeman Effect?

Ans: The Zeeman Effect is the splitting of the spectral lines of an atom in the presence of a strong magnetic field. The effect is due to the distortion of the electron orbitals because of the magnetic field.

Question: What is Stark Effect in Atomic Spectra?

Ans: The splitting of atomic spectral lines as a result of an externally applied electric field is called the Stark effect

Question: why was gas at low pressure is taken during discharge tube experiment for discovery of electron?

Ans: Gas at low pressure is taken during discharge tube experiment so that the electrons in the beam cannot be deflected if they hit molecules of gas.

Question: if Rutherford mode is correct than why atom should collapse?

Ans: if we apply magnetic theory to Rutherford model of atom then electron will lose energy continuously due to radiation when revolve around nucleus. Nucleus attract electron strongly and at last electron will fall in nucleus. So, at last atom collapse.

Q. A man whose mass is 75kg walks up 10 steps, each 20cm high, in 5 second. Find the power he develops.

Solution: $P = \frac{w}{t} = \frac{mgh}{t} = \frac{75kg \times 10 \times 10 \times 0.20m}{5sec} = 30w$

Q. A radio station transmits wave of wavelength 280m.If the speed of the wave is 3x10^8 m/s. Find the frequency of the wave emitted by the radio station.

Solution: $v = f\,\lambda \Rightarrow f = \frac{v}{\lambda} \Rightarrow f = \frac{3\times10^8}{280} = 1.07 \times 10^6 \text{Hz}$

Q. A body of mass 10kg is dropped from a height of 20m. Find (i) its potential energy before it is dropped.
(ii) its kinetic energy it is8m above the ground and (iii) its kinetic energy when it hits the ground.

Solution: (i) Potential energy = mgh = 10 x 10 X 20 = 2000 J

(ii) KE when it is 8m above the ground = PE at 12m = 10 x10x 12 = 1200J

(iii) According to law of conservation of energy, Potential energy of the ball just before dropping = KE of the ball just on touching the ground = 2000 J

Q.A tube-well pumps out 2400 kg out of water per minute if water is coming out with a velocity of 3m/s. What is the power of the pump? How much work is done if the pump runs for 10 hours?

Solution: Speed of water = 3 m/s

Mass of water flow in 1 sec = 2400/60 kg = 40 kg/s

Work done by pump = The kinetic energy of water flowing = $\frac{1}{2}\, m\, v^2 = \frac{1}{2} \times 40 \times (3)^2 = 180J$

Power of the pump $= \frac{w}{t} = \frac{180j}{1sec} = 180w$

Work done if the pump runs for 10 hours = Pt= 180 w × 10 × 3600 = 6.48 x 10^6 j

Q. Calculates the change that should be affected in the velocity of a body to maintain the same kinetic energy. If the mass of the body is increased four times.

Solution: Let original mass = m the, Changed mass m' = 4m . Let initial velocity be v and new velocity will be v'

$$\frac{KE}{KE'} = \frac{\frac{1}{2}mv^2}{\frac{1}{2}m'V'^2} \Rightarrow 1 = \frac{m\,v^2}{4m\,V'^2} \Rightarrow v'^2 = \left(\frac{v}{2}\right)^2 \Rightarrow v' = \frac{v}{2}$$

Hence, New velocity will be half of initial velocity.

Q. Two pistons of hydraulic press have diameters 24cm and 2cm. Calculate the force exerted by the longer piston when 40 kg wt. is placed on the smaller piston.

Solution: Pascal Law : Pascal's law states that ***"pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and the walls of the containing vessel".***

A piston with small cross section area A_1, exerts a force F_1 on the surface of a liquid such as oil. The applied pressure $P = F_1 / A_1$ is transmitted through connecting pipe to a larger piston of area A_2.

The applied pressure is the same in both cylinders, so, $P = \frac{F2}{F1} = \frac{A2}{A1}$

$$\frac{F1}{A1} = \frac{F2}{A2} \Rightarrow \frac{F1}{\pi(12)^2} = \frac{40}{\pi(1)^2} \Rightarrow F1 = 40 \times 144 = 5760N$$

Q.A ball is dropped from rest from a height of 12m. If the ball loses 25% of its KE on striking the ground what is the height to which it bounces? How do you account for the loss in K.E.?

Solution: KE on striking ground = 75% $KE = 0.75\,x\,m\,g\,H = m\,g\,h' \Rightarrow h' = 0.75\,x\,12 = 9m$