Class 12 Physics Model Question Solution 2077 | Group A (Very Short Questions) and Group C (Numerical Problems) Solutions | NEB Physics | Grade 12 | Physics in Depth

- November 04, 2020

Model Question 2077

Solution

Physics, Grade XII

NEB

Group A Solution

- **Why is the conductivity of an electrolyte very low as compared to a metal at room temperature?**
  Solution:
  Conductivity depends on both the concentration (i.e. number density) and drift velocity of charge carriers. The concentration of ions (charge carriers in electrolytes) is very low compared to the concentration of free electrons (charge carriers in metals) and even the ions drift slowly due to their heavier mass. Hence, conductivity of an electrolyte is very low compared to metal at room temperature.

- **What are the advantages of A.C. over D.C.?**
  Solution:
  A.C. refers to the alternating current and D.C. refers to the direct current. Both are advantageous in their own

way and have limitations too. However, in the modern era, use of A.C. has increased drastically due to many reasons. Some of the main advantages of A.C. over D.C. are as follows:

- A.C. is more economic in use than D.C. due to its lesser generation, transmission and distribution cost.
- A.C. can reach much distant places than D.C. without much loss of electric power.
- The alternating high voltage can be stepped down or stepped up easily by using transformer which is not the case for direct voltage.
- A.C can be better controlled without any loss of electric power.

- **Production of X - ray is the inverse phenomenon of photoelectric effect. Justify it.**
  Solution:
  In Photoelectric effect, the electrons are ejected from the matter when the radiation of sufficient frequency falls upon the matter. However, in X - ray production, the fast moving electrons are bombarded in a target of heavy nuclei to form X - ray. To be precise, the fast moving electrons produce X - ray and radiations (like X - ray) produce electrons (i.e., photoelectrons). Hence, the production of this two are inverse phenomenon.

- **What is the threshold of hearing? Define one bel.**
  Solution:
  Threshold of hearing is the lowest intensity of sound that can be heard by human ear. For an average normal human ear, the threshold of hearing is taken as 10^{-12} Watt / m^2. Threshold of hearing is frequency - dependent.
  One bel is defined as the measure of the sound intensity level when the measured intensity of sound is 10 times the reference intensity.
  The sound intensity level β is measured as,

$$\beta = log_{10}\frac{I}{I_0}$$

  where I is the measured intensity of sound and I_0 is the reference intensity.
  If $I = I_0$, then,

$$\beta = log_{10}\frac{10I_0}{I_0} = 1$$

$$\therefore \beta = 1 \quad \text{bel}$$

- **Is polarization possible in longitudinal waves? Justify.**
  Solution:
  Polarization of waves confines the vibrations of wave in a particular orientation from the sets of orientations as it is in the case of transverse wave. However, in longitudinal wave the direction of wave is oriented in a particular direction unlike the electromagnetic wave which are oriented in all directions when travelling

particular direction unlike the electromagnetic wave which are oriented in all directions when travelling through the space. Hence, longitudinal waves cannot be polarized.

Group C Solution

1. **The total length of the wire of a potentiometer is 10 m. A potential gradient of 0.0015 v/cm is obtained when a steady current is passed through this wire. Calculate,**
    - **the distance of null point on connecting standard cell of 1.018 V.**
    - **the unknown p.d. if the null point is obtained at a distance of 940 cm,**

      and,
    - **the maximum p.d. which can be measured by this instrument.**

   Solution:
   From the principle of potentiometry,
   $$V \propto l$$
   where, V is the potential difference with *l* as null point.
   For (i),
   distance of null point , l_1 = ?
   p.d. , V_1 = 1.018 V
   potential gradient, k = 0.0015 v/cm = 0.15 v/m
   $$\begin{aligned} V_1 &= kl_1 \\ 1.018 &= 0.15 \times l_1 \\ l_1 &= 6.8m \end{aligned}$$
   For (ii),
   p.d. V_2 = ?
   distance of null point, l_2 = 940 cm = 9.40 m
   $$\begin{aligned} V_2 &= kl_2 \\ &= 0.15 \times 9.40 \\ \therefore V_2 &= 1.41\,V \end{aligned}$$
   For (iii),
   the maximum p.d. that can be measured by this instrument can be achieved when the distance of null point equals the total length of the potentiometer, i.e., L = 10 m.
   So,
   $$\begin{aligned} V &= kL \\ &= 0.15 \times 10 \\ \therefore V &= 1.5\,V \end{aligned}$$

Conclusion : The required solutions are 6.8 m , 1.41 V and 1.5 V respectively.

2. **$_{28}Ni^{62}$ may be described as the most strongly bound nucleus because it has the highest B.E. per nucleon. Its neutral atomic mass is 61.928349 a.m.u. . Find its mass defect, its total binding energy and binding energy per nucleon.**

   Given, mass of neutron = 1.008665 amu mass of proton = 1.007825 amu
   1 amu = 931.5 MeV.

   Solution:

   Here, number of neutrons in $_{28}Ni^{62}$ = Atomic mass number - Atomic number = 62 - 28 = 34
   number of protons = 28 (i.e., = atomic number)
   We have,
   mass of neutron = 1.008665 amu
   mass of proton = 1.007825 amu
   So,
   mass of 34 neutrons = 34 * 1.008665 amu = 34.29461 amu
   mass of 28 protons = 28 * 1.007825 amu = 28.2191 amu
   Thus,

   Total mass of nucleons = 34.29461 + 28.2191 = 62.51371 amu

   But, the experimental mass or neutral atomic mass is 61.928349 amu
   Difference in mass i.e., mass defect Δm = 62.51371 - 61.928349 = 0.585361 amu
   Binding energy , B.E. = ? We know,
   1 amu = 931.5 MeV
   Thus,

$$\begin{aligned} \text{B.E.} &= \Delta m \times 931.5 \\ &= 0.585361 \times 931.5 \\ &\approx 545.26 \text{ MeV} \end{aligned}$$

   Remember! Binding energy per nucleon is the ratio of binding energy and the total no. of nucleons in an atom (i.e. atomic mass number)

   Now,
   B.E. per nucleon is,

$$\begin{aligned} &= \frac{545.26}{62} \\ &\approx 8.79 \text{ MeV} \end{aligned}$$

   Conclusion : The required solutions are 0.585351 amu, 545.26 MeV and 8.79 MeV respectively.

3. **A source of sound produces a note of 512 Hz in air at 17° C with wavelength 66.5 cm. Find the ratio of molar heat capacities at constant pressure to constant volume at NTP. Densities of air and mercury at NTP are**

1.293 kg/m^3 and 13600 kg/m^3 respectively.

Solution:

frequency of sound, f = 512 Hz

temperature, T_1 = 17° C = 273 + 17 = 290 K

wavelength, λ = 66.5 cm = 0.665 m

density of air at NTP, ρ = 1.293 kg/m^3

density of mercury at NTP, ρ' = 13600 kg/m^3 *# don't worry about notation of density, you can use any other notations like σ.*

temperature at NTP, T_2 = 293 K

Normally, the students are confused with STP and NTP. At NTP, temperature of air is at 20 ° C and at STP, the temperature of air is at 0 ° C.

ratio of molar heat capacities at constant pressure to constant volume at NTP, γ = ?

Now,

Pressure at NTP,

$$\begin{aligned} P &= \rho' h g \\ &= 13600 \times 0.76 \times 9.8 \\ &= 101292.8 \therefore P \quad &\approx 1.01 \times 10^5 \,\mathrm{Pa} \end{aligned}$$

! Don't be confused guys. Here, I have used the standard height of mercury i.e. 760 mm = 0.76 m at sea level for NTP.

Now,

Velocity of sound in air at 17 ° C i.e., 290 K is,

$$\begin{aligned} v_1 &= \lambda f \\ &= 0.665 \times 512 \\ \therefore v &= 340.48 \end{aligned}$$

And,

Velocity of sound in air at NTP is,

$$\begin{aligned} v_2 &= \sqrt{\frac{\gamma P}{\rho}} \\ &= \sqrt{\frac{\gamma \times 101292.8}{1.293}} \end{aligned}$$

We know that, $v \propto T$

So,

$$\begin{aligned} \frac{v_1}{v_2} &= \sqrt{\frac{T_1}{T_2}} \\ \frac{340.48}{v_2} &= \sqrt{\frac{290}{293}} \end{aligned}$$

$$\therefore v_2 = 342.23 \text{ m/s}$$

Now, we use the relation,

$$v_2 = \sqrt{\frac{\gamma \times 101292.8}{1.293}}$$

Thus,

$$342.23 = \sqrt{\frac{\gamma \times 101292.8}{1.293}}$$
$$\frac{(342.23)^2 \times 1.293}{101292.8} = \gamma$$
$$\therefore \gamma \approx 1.4$$

Conclusion : Thus, the required solution is 1.4.

4. **Two coherent sources A and B of radio waves are 5 m apart. Each source emites waves with wavelength 6 m. Consider points along the line between two sources, at what distances, if any, from A is the interference constructive.**

Solution:

We have,

wavelength, λ = 6 m

distance between two coherent sources, *d* = 5 m

For constructive interference, the interfering waves must have path difference equal to the integral multiple of the wavelength. i.e.,

$$\Delta = n\lambda$$

Here, n=0, positive integers and negative integers.

The path difference between the interfering waves will be zero only at the midway between A and B and thus the constructive interfernce occurs here.

So, the interference is constructive at a distance of 2.5 m from A.

Conclusion : Thus the required solution is 2.5 m.

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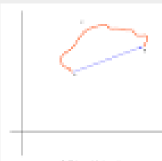

Kinematics Rest and Motion When do you declare that some body is in rest or in motion ? Place the book on a table and watch it! Is it in rest? Imagine you being on moon and by some means you could watch your book on your table. Would you again see it in rest? In first case, you would see …

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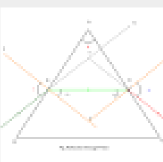
Refraction through prism

- *March 29, 2020*



A prism is a transparent refracting medium bounded by two plane surfaces meeting each other along a straight edge. In the figure below, AB and AC are the refracting surfaces and ∠BAC is the angle of prism. Consider a prism placed in air and a ray PQ be inicident on a refracting surface A …

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