

## FINAL JEE-MAIN EXAMINATION – FEBRUARY, 2021

**(Held On Thursday 25<sup>th</sup> February, 2021) TIME : 9 : 00 AM to 12 : 00 NOON**

### PHYSICS

### TEST PAPER WITH ANSWER & SOLUTIONS

#### SECTION-A

1. Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : When a rod lying freely is heated, no thermal stress is developed in it.

Reason R : On heating the length of the rod increases.

In the light of the above statements, choose the correct answer from the options given below:

- (1) Both A and R are true but R is NOT the correct explanation of A  
 (2) A is false but R is true  
 (3) A is true but R is false  
 (4) Both A and R are true and R is the correct explanation of A

**Official Ans. by NTA (1)**

**Sol.** A and R are true but R is not the correct explanation of A.

2. A student is performing the experiment of resonance column. The diameter of the column tube is 6 cm. The frequency of the tuning fork is 504 Hz. Speed of the sound at the given temperature is 336 m/s. The zero of the meter scale coincides with the top end of the resonance column tube. The reading of the water level in the column when the first resonance occurs is:

- (1) 13 cm                                      (2) 16.6 cm  
 (3) 18.4 cm                                    (4) 14.8 cm

**Official Ans. by NTA (4)**

**Sol.**  $d = 6\text{cm}$ ,  $f = 504$ ,  $v = 336\text{ m/s}$   
 $e = 0.3d$

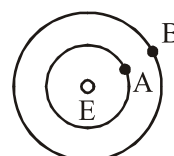
$$l + e = \frac{\lambda}{4} = \frac{v}{4f}$$

$$l = 16.66 - 0.3 \times 6$$

$$l = 14.866\text{ cm}$$

$$l = 14.8\text{ cm}$$

3. Two satellites A and B of masses 200kg and 400kg are revolving round the earth at height of 600 km and 1600 km respectively. If  $T_A$  and  $T_B$  are the time periods of A and B respectively then the value of  $T_B - T_A$ :



[Given : radius of earth = 6400km, mass of earth =  $6 \times 10^{24}\text{ kg}$ ]

- (1)  $1.33 \times 10^3\text{ s}$                               (2)  $3.33 \times 10^2\text{ s}$   
 (3)  $4.24 \times 10^3\text{ s}$                               (4)  $4.24 \times 10^2\text{ s}$

**Official Ans. by NTA (1)**

**Sol.**  $T = 2\pi \sqrt{\frac{r^3}{GM}}$

$$T_A = 2\pi \sqrt{\frac{(6400+600) \times 10^3}{GM}}$$

$$T_A = 2\pi \times 10^9 \sqrt{\frac{7^3}{GM}}$$

$$T_B = 2\pi \times 10^9 \sqrt{\frac{8^3}{GM}}$$

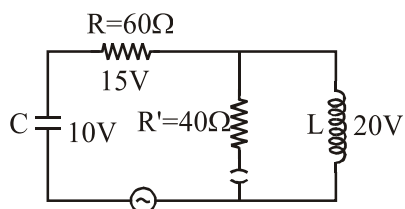
$$T_B - T_A = \frac{2\pi 10^9}{\sqrt{GM}} [8\sqrt{8} - 7\sqrt{7}]$$

$$= 314 \times 4.107$$

$$= 1289.64$$

$$= 1.289 \times 10^3\text{ s}$$

4. The angular frequency of alternating current in a L-C-R circuit is 100 rad/s. The components connected are shown in the figure. Find the value of inductance of the coil and capacity of condenser.



- (1) 0.8 H and 150  $\mu$ F  
 (2) 0.8 H and 250  $\mu$ F  
 (3) 1.33 H and 250  $\mu$ F  
 (4) 1.33 H and 150  $\mu$ F

Official Ans. by NTA (2)

Sol. Current through 60 $\Omega$  resistance =  $\frac{15}{60} = \frac{1}{4}$  A

thus capacitor current =  $\frac{1}{4}$  A

$\therefore V_C = I X_C$

$10 = \frac{1}{4} \times \frac{1}{\omega C}$

$\therefore C = \frac{1}{40\omega} = \frac{1}{4000} = 250 \mu\text{F}$

Now,

current through 40 $\Omega$  resistance =  $\frac{20}{40} = \frac{1}{2}$  A

thus current through inductor =  $\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$  A

$V_L = I X_L = \frac{1}{4} \times \omega L$

$20 = \frac{1}{4} \times 100 \times L$

$\Rightarrow L = 0.8$  H

5. A proton, a deuteron and an  $\alpha$  particle are moving with same momentum in a uniform magnetic field. The ratio of magnetic forces acting on them is \_\_\_\_ and their speed is \_\_\_\_ in the ratio.

- (1) 1 : 2 : 4 and 2 : 1 : 1  
 (2) 2 : 1 : 1 and 4 : 2 : 1  
 (3) 4 : 2 : 1 and 2 : 1 : 1  
 (4) 1 : 2 : 4 and 1 : 1 : 2

Official Ans. by NTA (2)

Sol.  $F = q(\vec{v} \times \vec{B}) = \frac{q}{m}(\vec{P} \times \vec{B})$

$\Rightarrow F \propto \frac{q}{m}$

thus  $F_1 : F_2 : F_3 = \frac{q_1}{m_1} : \frac{q_2}{m_2} : \frac{q_3}{m_3}$

$= \frac{e}{m_p} : \frac{e}{2m_p} : \frac{2e}{4m_p}$

$= \frac{1}{1} : \frac{1}{2} : \frac{2}{4}$

$= 2 : 1 : 1$

Now for speed calculation

$P = \text{constant} \Rightarrow v \propto \frac{1}{m}$

thus  $v_1 : v_2 : v_3 = \frac{1}{m_p} : \frac{1}{2m_p} : \frac{1}{4m_p}$

$= \frac{1}{1} : \frac{1}{2} : \frac{1}{4}$

$= 4 : 2 : 1$















