

**FINAL JEE-MAIN EXAMINATION – FEBRUARY, 2021**

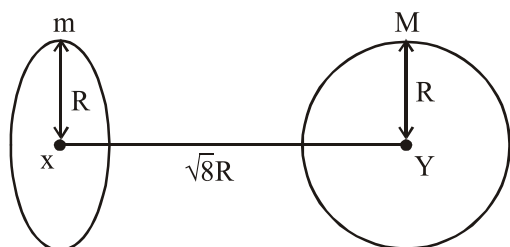
(Held On Friday 26<sup>th</sup> February, 2021) TIME : 9 : 00 AM to 12 : 00 NOON

**PHYSICS**

**TEST PAPER WITH ANSWER & SOLUTIONS**

**SECTION-A**

1. Find the gravitational force of attraction between the ring and sphere as shown in the diagram, where the plane of the ring is perpendicular to the line joining the centres. If  $\sqrt{8}R$  is the distance between the centres of a ring (of mass 'm') and a sphere (mass 'M') where both have equal radius 'R'.



- (1)  $\frac{\sqrt{8}}{9} \cdot \frac{GmM}{R}$       (2)  $\frac{2\sqrt{2}}{3} \cdot \frac{GmM}{R^2}$   
 (3)  $\frac{1}{3\sqrt{8}} \cdot \frac{GmM}{R^2}$       (4)  $\frac{\sqrt{8}}{27} \cdot \frac{GmM}{R^2}$

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

**Sol.** Gravitational field of ring

$$= -\frac{Gmx}{(R^2 + x^2)^{3/2}}$$

Force between sphere & ring

$$= \frac{GmM(\sqrt{8}R)}{(R^2 + 8R^2)^{3/2}}$$

$$= \frac{GmM}{R^2} \times \frac{\sqrt{8}}{27}$$

**Ans. (4)**

2. Consider the combination of 2 capacitors  $C_1$  and  $C_2$ , with  $C_2 > C_1$ , when connected in parallel, the equivalent capacitance is  $\frac{15}{4}$  time the equivalent capacitance of the same connected in series. Calculate the ratio of capacitors,  $\frac{C_2}{C_1}$ .

- (1)  $\frac{15}{11}$       (2)  $\frac{111}{80}$       (3)  $\frac{29}{15}$       (4)  $\frac{15}{4}$

**Official Ans. by NTA (2)**

**Allen Ans. (Bonus)**

**Sol.** When connected in parallel

$$C_{eq} = C_1 + C_2$$

When in series

$$C'_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

$$C_1 + C_2 = \frac{15}{4} \left( \frac{C_1 C_2}{C_1 + C_2} \right)$$

$$4(C_1 + C_2)^2 = 15 C_1 C_2$$

$$4C_1^2 + 4C_2^2 - 7C_1 C_2 = 0$$

dividing by  $C_1^2$

$$4 \left( \frac{C_2}{C_1} \right)^2 - \frac{7C_2}{C_1} + 4 = 0$$

$$\text{Let } \frac{C_2}{C_1} = x$$

$$4x^2 - 7x + 4 = 0$$

$$b^2 - 4ac = 49 - 64 < 0$$

No solution exists

**Ans. (Bonus)**

















