25. A certain pressure 'P' is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to 0.01% whereas the liquid gets compressed to 0.03%. The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of x is _____.

Official Ans. by NTA (1)

Ans. (1)

Sol. $B_{water} = \frac{-\Delta P}{\left(\frac{\Delta V}{V}\right)} = \frac{-\Delta P}{\frac{0.01}{100}}$

$B_{liquid} = \frac{-\Delta P}{\frac{0.03}{100}}$

$\frac{B_{water}}{B_{liquid}} = 3$

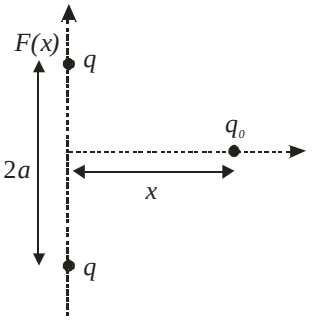
$x = 1$

26. Two equal positive point charges are separated by a distance $2a$. The distance of a point from the centre of the line joining two charges on the equatorial line (perpendicular bisector) at which force experienced by a test charge q_0 becomes maximum is $\frac{a}{\sqrt{x}}$. The value of x is _____.

Official Ans. by NTA (2)

Ans. (2)

Sol.



$F = \frac{2Kqq_0x}{(x^2 + a^2)^{3/2}}$

For F to be maximum

$\frac{dF}{dx} = 0$

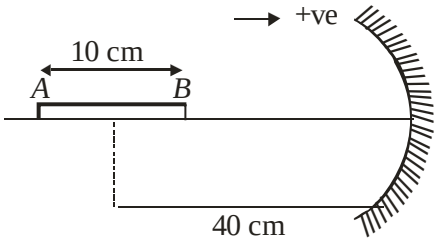
$x = \frac{a}{\sqrt{2}}$

27. A thin cylindrical rod of length 10 cm is placed horizontally on the principle axis of a concave mirror of focal length 20 cm. The rod is placed in a such a way that mid point of the rod is at 40 cm from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}$ cm. The value of x is _____.

Official Ans. by NTA (32)

Ans. (32)

Sol.



$U_A = -45$ cm, $f = -20$ cm

$V_A = \frac{-45 \times (-20)}{-45 - (-20)} = \frac{-900}{25} = -36$ cm

And $U_B = -35$cm

$\therefore V_B = \frac{-35 \times (-20)}{-35 - (-20)} = \frac{700}{-15}$

$\therefore V_A - V_B =$ length of image

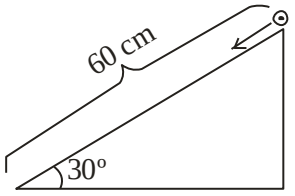
$= \left(-36 + \frac{140}{3}\right)$ cm

$= \frac{-108 + 140}{3}$ cm

$= \frac{32}{3}$ cm

$\therefore x = 32$

28. A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is _____ ms^{-1}. (Given g = 10 ms^{-2})



Official Ans. by NTA (2)

Ans. (2)

Sol. $v = \sqrt{\dfrac{2gh}{1+\dfrac{k^2}{R^2}}}$

Where $h = 60 \sin 30^\circ = 30$ cm

$$k^2 = \frac{R^2}{2}$$

$v = 2\ \text{ms}^{-1}$

29. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is: _____ cm.

Official Ans. by NTA (2)

Ans. (2)

Sol. $KE = PE + \dfrac{PE}{4}$

$KE = \dfrac{5}{4}PE$

$\dfrac{1}{2}m\omega^2(A^2 - x^2) = \dfrac{5}{4} \times \dfrac{1}{2}m\omega^2 x^2$

$[v = \omega\sqrt{A^2 - x^2}]$

$A^2 - x^2 = \dfrac{5}{4}x^2$

$\dfrac{9x^2}{4} = A^2$

$\boxed{x = \dfrac{2}{3}A}$

$\therefore x = \dfrac{2}{3} \times 3\text{cm}$

$x = 2$ cm

30. A series LCR circuit is connected to an ac source of 220V, 50Hz. The circuit contain a resistance $R = 100\Omega$ and an inductor of inductive reactance $X_L = 79.6\ \Omega$. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be _____ μF.

Official Ans. by NTA (40)

Ans. (40)

Sol. To maximize the average rate at which energy supplied i.e. power will be maximum.

So in LCR circuit power will be maximum at the condition of resonance and in resonance condition

$X_L = X_C$

$79.6 = \dfrac{1}{\omega C}$

$\therefore C = \dfrac{1}{2\pi \times 50 \times 79.6}$

$\therefore \boxed{C = 40\mu\text{F}}$