

The height of roof above top of window is...



Dr. Ch. Rama Krishna

Subject expert
Dr. RK's Classes

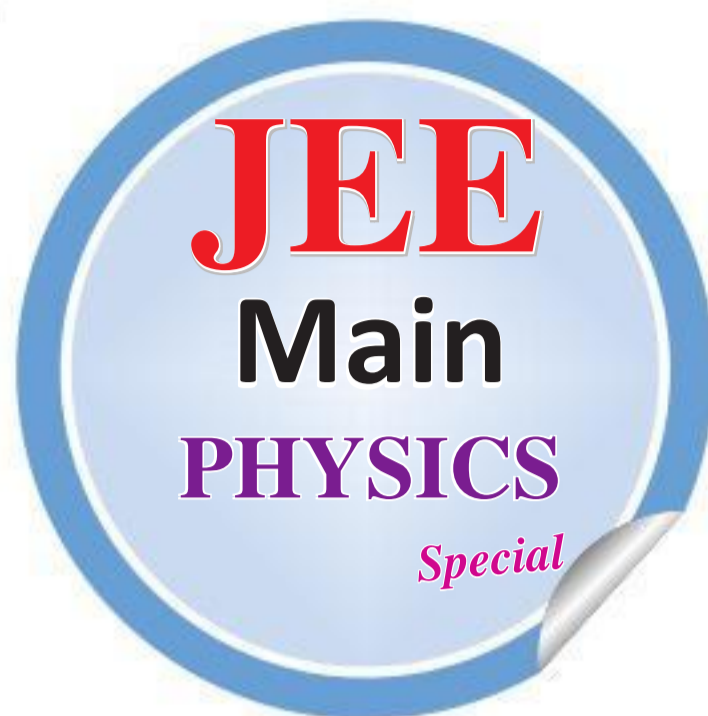
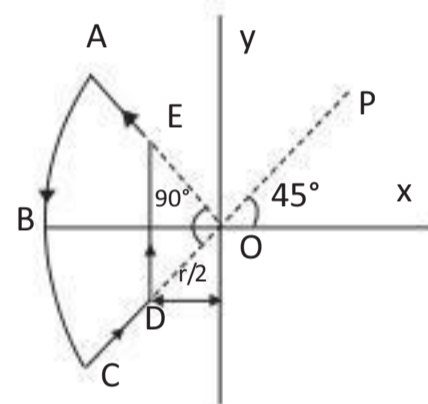
MODEL QUESTIONS

- The bob of a 0.2m pendulum describes an arc of circle in a vertical plane. If the tension in the cord is $\sqrt{3}$ times the weight of the bob when the cord makes an angle 30° with the vertical, the acceleration of the bob in that position is
1) g 2) $g/2$
3) $\frac{\sqrt{3}g}{2}$ 4) $g/4$
- A gas bubble of diameter 2 cm rises steadily through a solution of density $2 \times 10^3 \text{ kg/m}^3$ at the rate of $4 \times 10^{-3} \text{ m/s}$. The coefficient of viscosity of the solution is [Take $g = 10 \text{ m/s}^2$]
1) $4 \times 10^3 \frac{Ns}{m^2}$ 2) $\frac{1}{9} \times 10^3 \frac{Ns}{m^2}$
3) $36 \times 10^3 \frac{Ns}{m^2}$

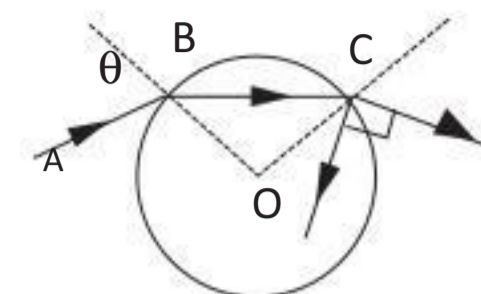
- 4) $\frac{4}{9} \times 10^3 \frac{Ns}{m^2}$
- A thermally insulated vessel containing a gas whose molar mass is M and ratio of specific heats $\frac{C_p}{C_v} = \gamma$ moves with a velocity v . Find the temperature increase in gas resulting from the stoppage of vessel

- 1) $\frac{Mv^2}{R}(\gamma-1)$ 2) $\frac{Mv^2(\gamma-1)}{2R}$
- 3) $\frac{Mv^2\gamma}{2R}$ 4) $\frac{Mv^2\gamma}{R}$

- A wire loop ABCDE carrying a current I is placed in xy -plane as shown in figure. A particle of mass m and charge q is projected from origin with velocity $\vec{v} = \frac{v_0}{\sqrt{2}}(\hat{i} + \hat{j}) \text{ m/s}$. The instantaneous acceleration acts along ($r = \text{radius of circular arc ABC}$)



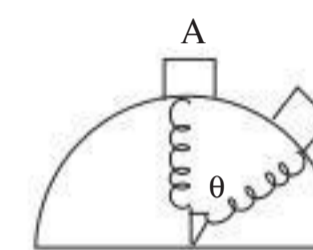
- 1) AO
- 2) OA
- 3) x -axis
- 4) OP
- A ray incident at a point B at an angle of incidence θ enters into a glass sphere and is reflected and refracted at the further surface of the sphere, as shown in figure. The angle between the reflected and refracted rays at this surface is 90° . If refractive index of material of sphere is $\sqrt{3}$, the value of θ is



- 1) $\pi/3$ 2) $\pi/4$
- 3) $\pi/6$ 4) $\pi/12$
- A roof tile falls from rest from top of a building. As observer inside the building notices that it takes 0.2 sec for the tile to pass window, whose height is 2.2 m. The height of roof above top of window is ($g = 10 \text{ m/s}^2$)
1) 3 m 2) 4 m
3) 5 m 4) 6 m
- A resistance R and capacitance C are connected in series across a voltage $V = 100\sqrt{2} \sin 314t$. The current is found to be $I = 5 \sin(314t + \frac{\pi}{4})$. The resistance R in the circuit is
1) 5Ω 2) 10Ω
3) 15Ω 4) 20Ω
- The number of possible overtones of air column in a pipe closed at one end of length 76.5 cm whose frequencies lie below

1000 Hz will be (velocity of sound = 340 m/s)
1) 5 2) 4
3) 6 4) 2

- A 10N block is released from rest at A and slides down along the smooth cylindrical surface. The attached spring has a stiffness, $k = 30 \text{ N/m}$. If it does not allow the block to leave the surface until $\theta = 60^\circ$, the compression/ elongation in the spring is
1) 0.166 m
2) 0.5 m 3) 0.333 m
4) 0.666 m



- The ionization energy of a hydrogen like atom is 4 Rydbergs. The radius of the first Bohr orbit of this atom is... (Take Rydberg constant = $2.2 \times 10^{-18} \text{ J}$. Bohr radius of hydrogen atom = $5 \times 10^{-11} \text{ m}$).
1) $5 \times 10^{-11} \text{ m}$ 2) $2.5 \times 10^{-11} \text{ m}$
3) $2.5 \times 10^{-10} \text{ m}$
4) $5 \times 10^{-10} \text{ m}$

Solutions

- 1; $a = \sqrt{a_n^2 + a_t^2}$
$$= \sqrt{\left(\frac{T - mg \cos 30^\circ}{m}\right)^2 + (g \sin 30^\circ)^2}$$

$$= g \sqrt{\left(\frac{\sqrt{3} - \frac{\sqrt{3}}{2}}{2}\right)^2 + \left(\frac{1}{4}\right)^2} = g$$
- 2; Upthrust = Viscous force
 $\frac{4}{3}\pi r^3 \rho g = 6\pi \eta r v$
$$\therefore \eta = \frac{2r^2 \rho g}{9v} = \frac{2(10^{-4})(2 \times 10^3)(10)}{9 \times 4 \times 10^{-3}}$$

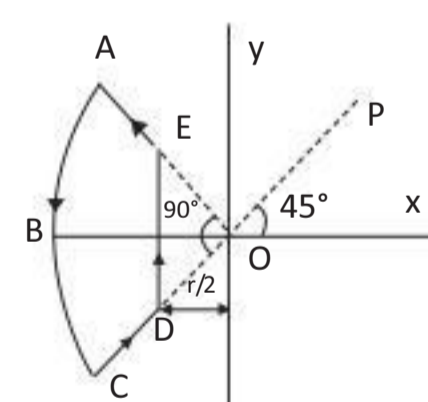
$$= \frac{1}{9} \times 10^3 \frac{N-s}{m^2}$$
- 3; $\frac{1}{2}mv^2 = \Delta u = \eta C_v \Delta T$
$$= \frac{m}{M} \left(\frac{R}{\gamma-1}\right) \Delta T$$

$$\therefore \Delta T = \frac{Mv^2(\gamma-1)}{2R}$$

- 4.2; Net field at O

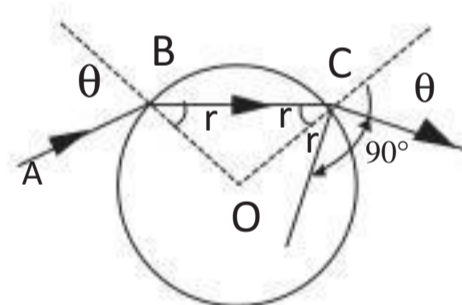
$$= \frac{1}{4} \left(\frac{\mu_0 I}{2r}\right) (\hat{k}) + \frac{0}{4\pi r^2} (\sin 45^\circ + \sin 45^\circ) (-\hat{k})$$

ie, net field at o is along negative z-axis



$$\text{Now } \vec{a} = \frac{\vec{F}}{m} = \frac{q(\vec{v} \times \vec{B})}{m}$$

- 5; $\theta = 90^\circ - \theta$



$$\text{Now } \frac{\sin \theta}{\sin r} = \frac{\sin \theta}{\sin(90^\circ - \theta)}$$

$$\text{or } \sqrt{3} = \tan \theta \quad \therefore \theta = \pi/3$$

- 6; $3; \sqrt{\frac{2(h+2.2)}{g}} - \sqrt{\frac{2h}{g}} = 0.2s$

Solving this equation we get $h = 5m$

- 7; 4; Phase difference between V and I is $\pi/4$. Therefore, $X_C = R$
 $\therefore Z = \sqrt{2} R$
Further, $V = IZ$

$$\text{or } 100\sqrt{2} = 5(\sqrt{2})R$$

$$\therefore R = 20\Omega$$

- 8; 2; $f_0 = \frac{v}{4l} = \frac{340}{4 \times 0.765} = 111.11 \text{ Hz}$
 $f_1 = 3f_0 = 333.33 \text{ Hz}$
 $f_2 = 5f_0 = 555.55 \text{ Hz}$
 $f_3 = 7f_0 = 777.77 \text{ Hz}$
 $f_4 = 9f_0 = 999.99 \text{ Hz}$
Therefore, total four overtones below 1000 Hz are possible.

- 9; 1; At $\theta = 60^\circ$
 $\theta = 60^\circ, h = r(1 - \cos 60^\circ) = R/2,$
 $v^2 = 2gh = gR$
Suppose, F is the spring force (towards centre), then at the point of leaving the contact with the surface,
$$F + mg \cos 60^\circ = \frac{mv^2}{R}$$

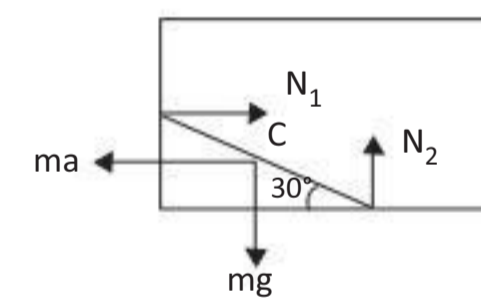
or $F = \frac{mg}{2} = 5N$

$$\text{or } kx = 5$$

$$\text{or } 30x = 5$$

$$\text{or } x = 0.166 \text{ m}$$

- 10; 1; $ma = N_1$ (i)
 $mg = N_2$ (ii)
 $\Sigma \tau_c = 0$



$$\therefore N_2 \left(\frac{1}{2} \cos 30^\circ\right) = N_1 \left(\frac{1}{2} \sin 30^\circ\right)$$

$$\text{or } \frac{N_1}{N_2} = \cot 30^\circ = \sqrt{3}$$

$$\text{But } \frac{N_1}{N_2} = \frac{a}{g}, \text{ from Eqs. (i) and (ii)}$$

$$\therefore \frac{a}{g} = \sqrt{3} \text{ or } a = \sqrt{3}g$$

GS - INDIAN HISTORY

- When did Queen Victoria declare the taking over of Indian Administration under British Crown?
1) 1 November, 1858
2) 31 December, 1857
3) 6 January, 1958
4) 17 November, 1859
- 'In this instance we could not play off the Mohammedans against the Hindus'. To which one of the following events did this remark of Aitchison relate?
1) Revolt of 1857
2) August Movement of 1942
3) Champaran Satyagraha (1917)
4) Non-Cooperation Movement

- Who was the Governor General of India during Sepoy Mutiny?
1) Lord Hardings
2) Lord Canning
3) Lord Lytton 4) Lord Dalhousie
- According to Dadabhai Naoroji 'Swaraj' means:
1) Complete independence
2) Political independence
3) Economic independence
4) Self government
- The partition of Bengal (1905) was annulled by:
1) Indian Councils Act of 1909
2) Proclamation of Delhi Durbar in 1911
3) Government of India Act, 1935
4) None of the above

- With reference to Indian freedom struggle, who among the following was labelled as 'Moderate' leader in the Congress?
1) Gopal Krishna Gokhle
2) Bipin Chandra Pal
3) Aurobindo Ghosh
4) Lala Lajpat Rai
- The theme of Bankim Chandra Chatterjee's famous novel 'Anand Math' is based on:
1) Chunar revolt
2) Rangpur and Dinajpur revolt
3) Sannyasi's revolt
4) Vishnupur revolt
- All India Muslim League was formed at:
1) Lahore 2) Dhaka

- 3) Lucknow 4) Aligarh
- The revolutionary association 'Abhinav Bharat' was setup in 1905 in:
1) Odisha 2) West Bengal
3) Uttar Pradesh 4) Maharashtra
- Who was the architect of North and South Blocks of the Central Secretariat in Delhi?
1) Herbert Backers
2) Antonin Raymond
3) Robert Tussel
4) Edward Lutyens
- "These are no polity devoid of religion" is stated by:
1) Mahatma Gandhi
2) Jay Prakash Narayan
3) Vinoba Bhawe 4) J.L. Nehru
- Which one of the following

- aroused a wave of popular indignation that led to the massacre by the British at Jallianwala Bagh?
1) The Arms Act
2) The Public Safety Act
3) The Rowlatt Act
4) The Vernacular Press Act

KEY

- 1) 1 2) 1 3) 2 4) 4 5) 2
6) 1 7) 3 8) 2 9) 4 10) 1
11) 1 12) 3

Prepared by:
N.D. Nagesh, Subject Expert.