The average velocity of the particle between...

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MODEL QUESTIONS

1. A particle is projected from the ground with an initial speed V at an angle of projection θ. The average velocity of the particle between its time of projection and time it reaches highest point of trajectory is

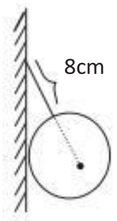
1) v cos θ

2) $\frac{V}{2}\sqrt{1+3\cos^2\theta}$

3) $\frac{V}{2}\sqrt{1+2\sin^2\theta}$

4) $\frac{V}{2}\sqrt{1+2\cos^2\theta}$

2. A uniform sphere of weight w and radius 5cm is being held by a string as shown in the figure. The tension in the string will be



1) $\frac{15}{5}$w 2) $\frac{5}{12}$w

3) $\frac{12}{5}$w 4) $\frac{13}{12}$w

3. A thin uniform rod of length *l* and mass m is swinging freely about a horizontal axis passing through its end. As maximum angular speed is ω. Its centre of mass rises to a maximum height of

1) $\frac{1}{6}\frac{l\omega}{g}$ 2) $\frac{1}{3}\frac{l^2\omega^2}{g}$

3) $\frac{1}{2}\frac{l^2\omega^2}{g}$ 4) $\frac{1}{6}\frac{l^2\omega^2}{g}$

4. A constant power is supplied to a rotating disc. The relationship of the angular velocity (ω) of the disc and the number of rotations (n) made by the disc is governed by

1) $\omega\alpha n^2$

2) $\omega\alpha n^{\frac{3}{2}}$ 3) $\omega\alpha n^{\frac{2}{3}}$

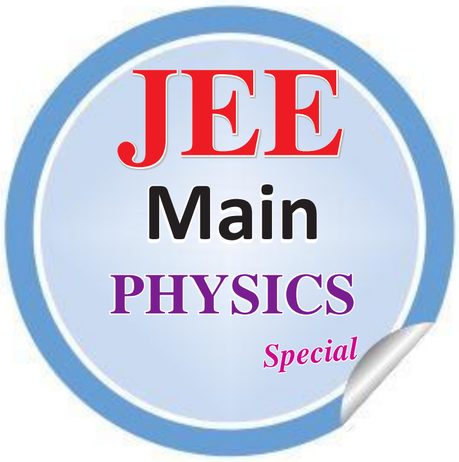
4) $\omega\alpha n^{\frac{1}{3}}$

5. From a solid sphere of mass M and radius R, a spherical portion of radius R/2 is removed, as shown in the figure taking gravitational potential v = 0 at r = ∞ the potential at the centre of the cavity thus formed is

1) $\frac{-2GM}{R}$ 2) $\frac{-2GM}{3R}$

3) $\frac{-GM}{R}$ 4) $\frac{-GM}{2R}$

6. Drops of liquid of density d are floating half immersed in a liquid of density ρ . If the surface tension of the liquid is T. Then the radius of the drop is



1) $\sqrt{\frac{3T}{g(4d-3\rho)}}$ 2) $\sqrt{\frac{3T}{g(2d-\rho)}}$

3) $\sqrt{\frac{6T}{g(2d-\rho)}}$ 4) $\sqrt{\frac{3T}{g(3d-\rho)}}$

7. A cube of side 20 cm is floating on a liquid with 5cm of the cube out side the liquid. If the density of liquid is 0.8 gm/cc. then the mass of the cube is

1) 4.2 kg 2) 4.8 kg

3) 5 kg 4) 5.2 kg

8. An ideal mono atomic gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_i . If the same gas is expanded adiabatically to a volume 2V, the final pressure is P_a the ratio $\left(\frac{p_a}{p_i}\right)$ is

1) $2^{\frac{2}{3}}$ 2) $2^{\frac{1}{3}}$ 3) $2^{\frac{-1}{3}}$ 4) $2^{\frac{-2}{3}}$

9. In a progressive sinusoidal wave the maximum particle velocity is twice the wave velocity. If the amplitude is A, the wave length is

1) Aπ 2) 2/3 Aπ

3) Aπ/2 4) Aπ/3

10. The magnetic field in a travelling electromagnetic wave has a peak value of 20nT. The peak value of electric field strength is

1) $3\frac{v}{m}$ 2) $12\frac{v}{m}$

3) $9\frac{v}{m}$ 4) $6\frac{v}{m}$

11. The electric field for an electro magnetic wave in free space is where magnitude of E is in V/m. The magnitude of wave vector K is (Velocity of kM wave in free space = 3 108 m/s).

1) 3 rad/m 2) 1.66 rad/m

3) 0.83 rad/m 4) 0.46 rad/m

12. If the radius of a nucleus with mass number 125 is 1.5 Fermi, then radius of a nucleus with mass number 64 is

1) 0.96 Fermi 2) 1.92 Fermi

3) 1.2 Fermi 4) 0.48 Fermi

13. In the Bohr model an electron moves in a circular orbit around the proton. Considering the orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in nth excited state is

1) $\left(\frac{e}{m}\right)\left(\frac{n^2h}{2\pi}\right)$ 2) $\left(\frac{e}{2m}\right)\left(\frac{n^2h}{2\pi}\right)$

3) $\left(\frac{e}{m}\right)\left(\frac{nh}{2\pi}\right)$ 4) $\left(\frac{e}{2m}\right)\left(\frac{nh}{2\pi}\right)$

14. A crystal of intrinsic silicon at room temperature has a carrier concentration of If the donor concentration level is , then the concentration of holes in the semiconductor is

1) $\frac{4\ \ 10^{11}}{m^3}$ 2) $\frac{4\ \ 10^{12}}{m^3}$

3) $\frac{5.3\ \ 10^{11}}{m^3}$ 4) $\frac{5.3\ \ 10^{12}}{m^3}$

15. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the first car at a relative speed of 15m/s. The speed of the image of the second car as seen in the mirror of the first one is

1) $\frac{1}{15}m/s$ 2) 15 m/s

3) 10 m/s 4) $\frac{1}{10}m/s$

16. The objective lens of an optical instrument in an achromatic combination with focal length of 90cm. The two lenses possess dispersive powers 0.024 and 0.036 respectively and are in contact with each other then their focal lengths are

1) 45cm, 45cm 2) 30cm, -45 cm

3) -30cm, 45cm 4) 30cm,-30cm

17. At two points P and Q on screen in young's double slit experiment, waves from slits have a path difference of 0 and /4 respectively. The ratio of intensities of P and Q will be

1) 4:1 2) √2:1

3) 2:1 4) 3:2

Solutions

1. 2; $\bar{V}_{avg}\ \frac{\bar{V}_1+\bar{V}_2}{2}$

$=\frac{\left(V\cos\theta\hat{i}+V\sin\theta\hat{j}\right)+V\cos\theta\hat{i}}{2}$

$=v\cos\theta\hat{i}+\frac{v}{2}\sin\theta\,\hat{j}$

$V_{avg}=\sqrt{V^2\cos^2\theta\frac{V^2}{4}+\sin^2\theta}$

$=\sqrt{V^2\cos^2\theta+\frac{V^2}{4}-\frac{V^2}{4}\cos^2\theta}$

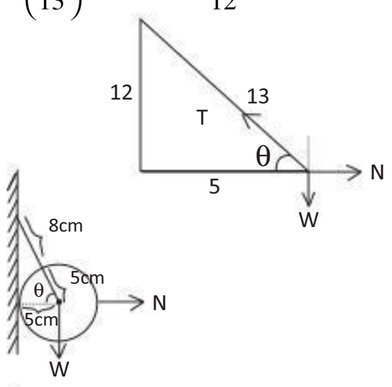
$V_{avg}=\sqrt{\frac{V^2}{4}+\frac{3}{4}V^2\cos^2\theta}$

$V_{avg}=\frac{V}{2}\sqrt{1+3\cos^2\theta}$

2. 4; To apply lamis theorem

T sinθ =w

$T\left(\frac{12}{13}\right)=w\Rightarrow T=\frac{13}{12}w$



3. 4; $\frac{1}{2}I\omega^2=mgh$

$\frac{1}{2}\left(\frac{1}{3}ml^2\right)\omega^2=mgh\Rightarrow h=\frac{1}{6}\frac{l^2\omega^2}{g}$

4. 4; Rotational power $=\frac{dw}{dt}=\frac{d}{dt}$

(Rotational K.E)

Constant $=\frac{d}{dt}\left[\frac{1}{2}Iw^2\right]$

$\frac{1}{2}Iw^2=kT\ \ \omega^2\alpha t$

But $\omega=\frac{2\pi n}{t}\rightarrow\omega\alpha\frac{n}{t}$

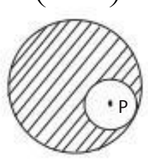
$\Rightarrow\omega^2\alpha\frac{n}{\omega}$

$\Rightarrow\omega^3\alpha n\Rightarrow\omega\alpha n^{\frac{1}{3}}$

5. 3; Potential at point P due to complete solid sphere

$V_0=\frac{-GM}{2R^3}\left[3R^2-\left(\frac{R}{2}\right)^2\right]$

$=\frac{-GM}{2R^3}\left(\frac{11R^2}{4R}\right)=\frac{-11GM}{8R}$



Potential at point P due to cavity part

$V_c=-\frac{3}{2}\frac{G\left(M/8\right)}{\left(R/2\right)}=\frac{-3GM}{8R}$ —— (2)

So potential due to remaining part at point P is

$V^1=V_0-V_c=\frac{-11GM}{8R}-\left(\frac{-3GM}{8R}\right)$

$=-GM/R$

6. 2; $\frac{V}{2}\rho g+(2\pi r)T=Vdg$

$\frac{Vg}{2}\left[-\rho+2d\right]=(2\pi r)T$

$r=\sqrt{\frac{3T}{g(2d-\rho)}}$

7. 2; $mg=Vdg$

8. 4; for 1st case $P_1V_1=P_2V_2$

$PV=P_1(2V)$

$P_1 1=P/2$____(1)

For 2nd case

$PV^\gamma=P_a(2V)^\gamma$

$P_a=P/2^\gamma$ _____ (2)

$\frac{(2)}{(1)}\rightarrow\frac{P_a}{P_i}=\frac{2}{2^\gamma}=2^{1-\gamma}=2^{1-\frac{5}{3}}=2^{-\frac{2}{3}}$

9. 1; $V_{max}=2V$

$A\omega=2(n\lambda)$

$A2(\pi\lambda)=2n\lambda$

$\lambda=A\pi$

10. 4; $C=\frac{E_0}{B_0}$

$E=CB_0=(3\ \ 10^8)(20\ \ 10^{-9})$

$=6\frac{Volt}{m}$

11. 2; $\vec{E}=\hat{i}(30)\cos(kz-5\ \ 10^8t)$

$\omega=5\ \ 10^8$ $c=3\ \ 10^8$

$c=n\lambda=\frac{\omega}{2\pi}\lambda=3\ \ 10^8$

$\lambda=\frac{2\pi\ \ 3\ \ 10^8}{\omega}=\frac{2\pi\ \ 3\ \ 10^8}{5\ \ 10^8}=\frac{6\pi}{5}m$

$k=\frac{2\pi}{\lambda}=\frac{5}{3}\Rightarrow k=1.66$

12. 3; $R\alpha A^{1/3}\Rightarrow\frac{R_2}{R_1}=\left(\frac{A_2}{A_1}\right)^{1/3}$

$R_2=\left(\frac{64}{125}\right)^{1/3}(1.5)$

$R_2=\left(\frac{4}{5}\right)(1.5)=1.2$ fermi

13. 4; $M=iA=\left(\frac{ev}{2\pi r}\right)(\pi r^2)=\frac{evr}{2}$

$M=\left(\frac{e}{2m}\right)(mvr)=\left(\frac{e}{2m}\right)\left(\frac{nh}{2\pi}\right)$

14. 3; $n^2=n_e.n_h$

$n_h=\frac{n^2}{h_e}=\frac{(1.6\ \ 10^{16})^2}{4.8\ \ 10^{20}}=\frac{2.56\ \ 10^{32}}{4.8\ \ 10^{20}}$

15. 1; $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$

Deferential on both sides

$-\frac{1}{u^2}\frac{du}{dt}-\frac{1}{v^2}\frac{dv}{dt}=0\frac{dv}{dt}=\frac{v^2}{u^2}\left(\frac{du}{dt}\right)$

$\frac{v}{u}=\frac{f}{u-f}\ \ \frac{dv}{dt}=-\left(\frac{f}{u-f}\right)^2\left(\frac{dy}{dt}\right)$

$=\left(\frac{0.2}{-2.8-0.2}\right)^2(15)=\left(\frac{0.2}{-3}\right)^2$

$=-\frac{1}{15}m/s$

16. 2; $\frac{1}{f_1}+\frac{1}{f_2}=\frac{1}{90}$ _____(1)

$\omega_1f_1+\omega_2f_2=0$

$\frac{\omega_1}{f_1}+\frac{\omega_2}{f_2}=0$

$\frac{f_1}{f_2}=-\frac{\omega_1}{\omega_2}=-\frac{0.024}{0.036}=\frac{-2}{3}$

$f_1=-\frac{2f_2}{3}$ _____(2)

(2) in (1)

$\frac{-3}{2f_2}+\frac{1}{f_2}=\frac{1}{90}$

$f_2=-45$ cm

$f_1=+30$ cm

17. 3; $I=4I_0\cos^2\phi/2$

$I_1=4I_0\cos^2 0/2=4I_0$ —— (1)

$(\Delta x=0)$

$I_2=4I_0\cos^2\frac{\pi}{4}=2I_0$ ____(2) $\left(\Delta x=\lambda/4\right)$

$\frac{I_1}{I_2}=\frac{2}{1}$