Shivam Classes

A Premier Institute JEE(Main & Adv.)
NEET/AIIMS.NTSE.OLYMPID KVPY

SHIVAM CLASSES - By IITians

TEST
CLASS : XI

Test Date : 24-02-2025 **JEE (Advanced) - 6** **MAX. MARKS : 198**

ANSWER KEY

PHYSICS	CHEMISTRY	MATHEMATICS
1. B	19. B	37. C
2. C	20. B	38. C
3. B	21. D	39. (*)
4. B	22. A	40. A
5. AC	23. ABD	41. ABCD
6. ABCD	24. BCD	42. AD
7. AC	25. ABCD	43. ABCD
8. AB	26. BD	44. BD
9. C	27. D	45. B
10. D	28. B	46. A
11. A	29. B	47. A
12. C	30. A	48. C
13. A	31. B	49. B
14. B	32. C	50. D
15. 0.09 to 0.10	33. 6	51. 9
16. 1	34. 3	52. 6
17. 5	35. 3.	53. 6
18. 8	36. 6	54. 3

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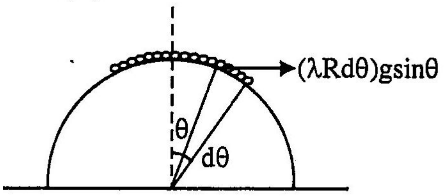
(SOLUTION) [PHYSICS]

1. Ans. (C)



Net tangential force

$= \lambda Rg\int_0^{\alpha_2}\sin\theta d\theta - \lambda Rg\int_0^{\alpha_1}\sin\theta d\theta$

$F = \lambda Rg[\cos\alpha_1 - \cos\alpha_2] = \lambda R(\alpha_1+\alpha_2)a$

$\frac{\lambda Rg(\cos\alpha_1 - \cos\alpha_2)}{\lambda R(\alpha_1+\alpha_2)} = a$

$\frac{g(\cos\alpha_1 - \cos\alpha_2)}{(\alpha_1+\alpha_2)} = a$

2. Ans. (C)

$f_{x_{net}} = mg\cos 30°$

$\therefore a_x = g\cos 30°$

3. Ans. (B)

For $0 \le t \le \frac{1}{2}$, body will perform SHM with time period 2 sec starting from –ve amplitude.

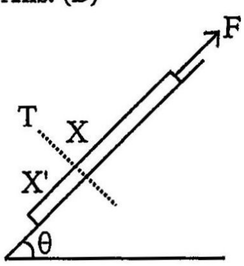
$\therefore$ At $t = \frac{1}{2}$ sec, body passes through x = 0 with speed 2π m/sec.

$\therefore$ At $x = \frac{\pi}{2}$, we have

$v^2 = 4\pi^2 + 2\times 5\pi \times \frac{\pi}{2}$ $(v^2 = u^2 + 2as)$

$\Rightarrow v = 3\pi$ m/sec

4. Ans. (B)



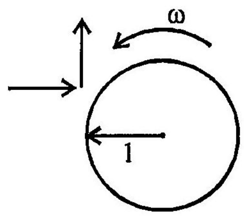
$F - Mg\sin\theta = ma$

$T - \frac{Mx'}{L}g\sin\theta = \frac{Mx'}{L}a$

$T - \frac{Mx'}{L}g\sin\theta = (F - Mg\sin\theta)\frac{x'}{L}$

$T = \frac{Fx'}{L} = \frac{F(L-x)}{L}$

5. Ans. (A,C)



$I_x = .1\times 20 = 2$ & $I_y = 1\uparrow$

$\therefore$ on ball $I_x = 2$ & $I_y = 1\downarrow$

$-2 = P_f - P_i = P_f - P_f = 0$

$-I_x \times .25 + I_x \times \frac{.5\sqrt{3}}{2}$

$= .5 + \frac{.5\sqrt{3}}{2} = \frac{.5(2-\sqrt{3})}{2}$

& $I\omega = mR^2 = 2\times .5\times 1 = 1$ & J $\therefore \omega \ne 0$

6. Ans. (A,B,C,D)

Volume of tetrahedron $= \frac{a}{6\sqrt{2}}$

(C) Net force by liquid = Buoyant force

$= \frac{a^3}{6\sqrt{2}}\rho g = B$

(B) Force on the bottom $= h\rho g\times\frac{\sqrt{3}}{4}a^2 = F_1$

(A) Net force on all the side faces

$= F_1 - B = \frac{\sqrt{3}\rho g h a^2}{4} - \frac{a^3\rho g\sqrt{2}}{12}$

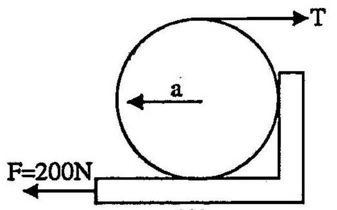
(D) Vertical force of each face is $\frac{1}{3}$ of F_{net} vertical force as in option A.

The net force on each face = $\frac{F_0}{3\cos\theta}$, where θ is angle the net force makes with vertical

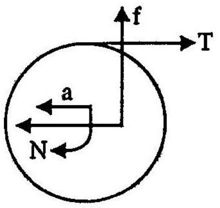
$\because \cos\theta = \frac{1}{3}$

$f = F_0$

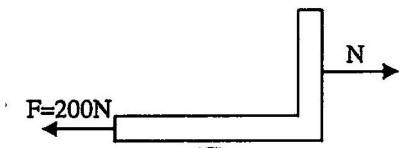
7. **Ans. (A,C)**



(A)



(B)



(C)

For L shaped massless body

$F - N = 0 \quad \Rightarrow N = 200N$ -------(A)

For the system

$200 - T = 4a$ --------(B)

For cylinder

$TR - fR = I\alpha$

$T - \mu N = Ia/R^2$

$T - 0.2 \times 200 = Ma/2 = 2a$

$T - 40 = 2a$ ---------(C)

From (B) & (C)

$160 = 6a$

$a = 80/3\ m/s^2$

$T = 40 + 160/3 = 280/3\ N$

8. **Ans. (A,C)**

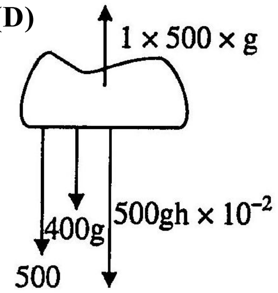
$$y = \frac{n\lambda D}{d}$$

$$v_f = \frac{dy}{dt} = \frac{n\lambda}{d}\frac{dD}{dt} = \frac{n\lambda D}{dD}\frac{dD}{dt} = \frac{y}{D}v_{mean}$$

$$= \frac{5}{50} \times (100 \times 1) = 10\ cm/s$$

9. **Ans. (C)**

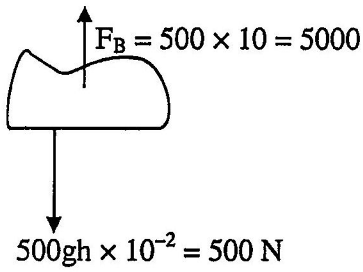
10.(D)



$500\,g = 500 + 500gh \times 10^{-2} + 4000$

$500 = 50\,h \Rightarrow h = 10\ m$

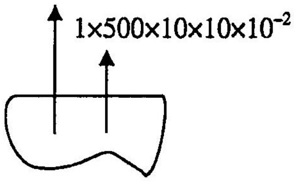
Force by liquid on upper object



$5000 - 500 = 4500\ N$

Force by liquid on lower object

$F_B = 1 \times 500 \times 10$



$5000 + 500 = 5500$

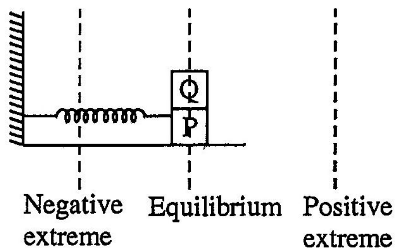
Total force by liquid on both object

$5500 + 4500 = 10^4\ N$

11. C

12. A

13. **Ans. (A)**



Friction on Q will always be towards equilibrium and friction on P will be opposite to that.

Friction is only force acting on block Q in horizontal direction which is responsible for its oscillation.

Friction force will be maximum at extreme position and zero at equilibrium.

14. *(b)* P → 4, Q → 3, R → 5, S → 2.

Velocity of particle, $\mathbf{v} = \dfrac{d\mathbf{r}}{dt} = 3t^2\hat{\mathbf{i}} + 2t\hat{\mathbf{j}} + \hat{\mathbf{k}}$

$$\mathbf{v}(t = 1\text{ s}) = 3\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + \hat{\mathbf{k}}$$

$$|\mathbf{v}|(\text{at } t = 1\text{ s}) = \sqrt{14}\text{ ms}^{-1}$$

Acceleration of particle at $t = 1\text{s}$;

$$\mathbf{a} = \frac{d\mathbf{v}}{dt} = 6t\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$$

$$\mathbf{a}\ (\text{at } t = 1\text{ s}) = 6\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$$

$\Rightarrow \quad |\mathbf{a}|$ at $t = 1\text{s} = 6.32\text{ ms}^{-2}$

Now, radius of curvature,

$$R = \frac{v^3}{|\mathbf{a} \times \mathbf{v}|} = \frac{v^3}{\sqrt{76}} = \frac{14\sqrt{14}}{\sqrt{76}} \approx 6\text{ m}$$

Centripetal acceleration, $|\mathbf{a}_c| = \dfrac{v^2}{R} = \dfrac{14}{6} = 2.33\text{ ms}^{-2}$

Tangential acceleration,

$$a_t = \sqrt{a^2 - a_c^2} = \sqrt{(6.32)^2 - (2.33)^2}$$

$$= 5.88\text{ ms}^{-2}$$

15. **Ans. (0.09 to 0.10)**

$$a = \frac{v_2 - v_1}{t} = \frac{0.85 - 0.21}{8.0} = 0.08\text{ m/s}^2$$

$$\frac{\Delta a}{a} = \frac{\Delta(v_2 - v_1)}{(v_2 - v_1)} + \frac{\Delta t}{t} = \frac{\Delta v_2 + \Delta v_1}{v_2 - v_1} + \frac{\Delta t}{t}$$

$$\frac{\Delta a}{a} = \frac{0.05 + 0.05}{0.85 - 0.21} + \frac{0.1}{8.0}$$

$$= \frac{0.1}{0.64} + \frac{0.1}{8.0}$$

$$\Delta a = 0.08\left(\frac{0.1}{0.64} + \frac{0.1}{8.0}\right) = 0.0125 + 0.001$$

$= 0.0135$

Since error is in the 2nd place of decimal so Δa must be rounded to 0.0. So acceleration will be quested as 0.08 ± 0.01

$|a| + |\Delta a| = 0.09$

16. **Ans. (1)**

Analog to gauss law

$$E dr = \text{mass} \times 4\pi G \quad G \to \frac{1}{4\pi\varepsilon_0}$$

$$\oint E ds = \int_0^r \rho(r) 2\pi r dr L \times 4\pi G$$

$$E \cdot 2\pi r L = \int_0^r \rho(r) 2\pi r dr L \times 4\pi G$$

Diff. both side

$$E 2\pi L \frac{dr}{dr} = \rho(r) 2\pi r L 4\pi G \frac{dr}{dr} - 0$$

$$E = \rho(r) r 4\pi G$$

$$F_{cetripetal} = dm\omega^2 r$$

$$dmE = dm\omega^2 r$$

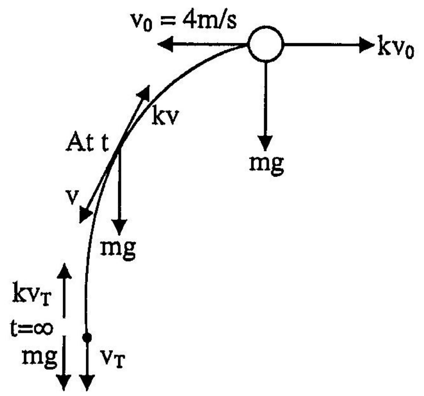
$$E = \omega^2 r$$

$$\rho(r) r 4\pi G = \omega^2 r$$

$$\rho(r) = \frac{\omega^2}{4\pi G} = \text{constant}$$

$$\text{So, } \frac{\rho\left(\frac{3R}{4}\right)}{\rho\left(\frac{R}{2}\right)} = 1$$

17. **Ans. (5)**



With respect to wind blowing towards right. Object will have velocity 4 m/s towards left at t = 0.

So at $t \to \infty$ $kv_T = mg$

$$v_T = \frac{mg}{k} = 3\text{ m/s}$$

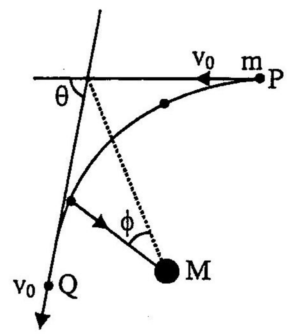
with respect to ground.

$$v = \sqrt{3^2 + 4^2} = 5\text{m/s}$$

18. **Ans. (8)**

$$|\Delta\vec{P}| = 2mv_0 \sin\frac{\theta}{2}$$

$$|\Delta\vec{P}| = \left|\int \vec{F} dt\right|$$



$$\int_P^Q \frac{GMm}{r^2} \cdot \cos\phi\, dt$$

But $mr^2\omega = mv_0b$ (in L)

$$r^2 = \frac{v_0 b}{d\phi}dt$$

$$\int_P^Q \frac{GMm}{r^2}\cos\phi dt = \int_{-\left(\frac{\pi}{2}+\frac{\theta}{2}\right)}^{\left(\frac{\pi}{2}+\frac{\theta}{2}\right)} \frac{GMm}{v_0 b}\cos\phi d\phi$$

$$= \frac{GMm}{v_0 b}2\cos\frac{\theta}{2}$$

So, $\frac{GMm}{v_0 b}2\cos\frac{\theta}{2} = 2mv_0 \sin\frac{\theta}{2}$

$$\tan\frac{\theta}{2} = \frac{GM}{v_0^2 b}$$

$$\Rightarrow \theta = 2\tan^{-1}\left(\frac{GM}{v_0^2 b}\right) = 2\tan^{-1}\left(\frac{GM}{4b}\right)$$

Ans. : $2 \times 4 = 8$