Sri Chaitanya IIT Academy, India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR-HYD

Sec: Sr. IPLCO **Date: 14-08-15**

Time: 9:00 AM to 12:00 Noon **RPTM-3** **Max.Marks: 360**

KEY SHEET

PHYSICS			CHEMISTRY			MATHS	
Q.NO	ANSWER		Q.NO	ANSWER		Q.NO	ANSWER
1	1		31	2		61	3
2	1		32	3		62	1
3	4		33	1		63	2
4	3		34	1		64	1
5	1		35	2		65	2
6	2		36	4		66	3
7	1		37	3		67	2
8	3		38	1		68	4
9	2		39	2		69	4
10	2		40	4		70	2
11	4		41	1		71	2
12	1		42	3		72	4
13	1		43	2		73	3
14	3		44	2		74	3
15	3		45	3		75	2
16	1		46	4		76	3
17	3		47	1		77	3
18	4		48	2		78	1
19	3		49	4		79	3
20	4		50	3		80	3
21	4		51	4		81	2
22	4		52	2		82	2
23	1		53	3		83	2
24	1		54	4		84	2
25	3		55	4		85	1
26	4		56	3		86	1
27	2		57	2		87	3
28	2		58	1		88	3
29	3		59	4		89	1
30	3		60	3		90	2

PHYSICS

1. Area under P–x graph $= \int \rho\, dx = \int mv \dfrac{dv}{dt}$ dx $= \int_1^v mv^2\, dV = \left[\dfrac{mv^3}{3}\right]_1^v = \dfrac{10}{7\times 3}$ ($v^3 - 1$)

from graph ; area = $\dfrac{1}{2}$ (2 + 4) × 10 = 30

$\therefore \quad \dfrac{10}{7\times 3}$ ($v^3 - 1$) = 30

$\therefore \quad$ v = 4 m/s

3. x = x_1 and x = x_3 are not equilibrium positions because $\dfrac{du}{dx} \neq 0$ at these points.

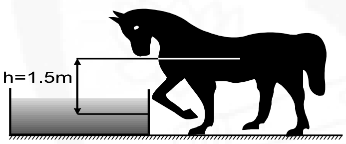
x = x_2 is unstable, as u is max. at this point.

5. Applying work energy theorem to body

ΔKE = work done by forces delivering power P

$= \int_{t=2}^{4} P dt = \int_2^4 3t^2\, dt$ = 56 J

6. The mass of water is



m = 1 × 10^3 kg

$\therefore$ The increase in potential energy of water is

= mgh = (1 × 10^3) (10) 1.5 = 15 kJ

7. From work energy theorem

for upward motion

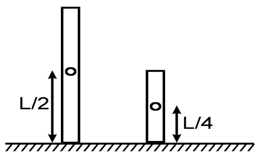
$\dfrac{1}{2}$ m $(16)^2$ = mgh + W (work by air resistance)

for downward motion

$\dfrac{1}{2}$ m $(8)^2$ = mgh – W

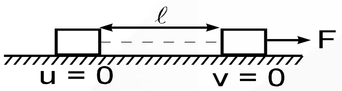
$\dfrac{1}{2}$ [$(16)^2 + (8)^2$] = 2 gh $\qquad$ or $\quad$ h = 8 m

8. The work done by man is negative of magnitude of decrease in potential energy of chain



$\Delta U = mg\frac{L}{2} - \frac{m}{2}g\frac{L}{4} = 3\ mg\ \frac{L}{8} \quad \therefore\ -\frac{3mg\ell}{8}$

9. Applying work energy theorem on block



$F\ell - \frac{1}{2}k\ell^2 = 0 \quad \therefore \quad \ell = \frac{2F}{k}$ or work done $= F\ell = \frac{2F^2}{k}$

10. $F_x = -\frac{\partial U}{\partial x} = \sin(x+y)$

$F_y = -\frac{\partial v}{\partial y} = \sin(x+y)$

$F_x = \sin(x+y)\Big]_{(0,\pi/4)} = \frac{1}{\sqrt{2}} \qquad F_y = \sin(x+y)\Big]_{(0,\pi/4)} = \frac{1}{\sqrt{2}}$

$\therefore\ F = \frac{1}{\sqrt{2}}\left[\hat{i} + \hat{j}\right]$

11. **Statement I :** Work done by gravity is same for motion from A to Z and B to M for equal mass. So K.E. will be equal.

Statement II : Acceleration = g sin θ

$\tan\theta_A > \tan\theta_B$

$\frac{h}{\ell} > \frac{h}{2\ell}$

Statement III :

$W_g + W_{ext} = 0$ (Because moved slowly)

$W_{ext} = -W_g$

W_g is positive so $W_{ext} < 0$

12. $V_B = \sqrt{2\times10\times10}$; $\frac{m v_B^2}{R} \le mg$; $R \ge \frac{v_B^2}{g} \Rightarrow R \ge 20$ m

13. The speed of the water leaving the hose must be $\sqrt{2gh}$ if it is to reach a height h when directed vertically. If the diameter is d, the volume of water ejected at this speed is

$\frac{1}{4}\pi d^2 \times \sqrt{2gh}\,\frac{m^3}{s}$.

Mass ejected is $\frac{1}{4}\pi d^2 \times \sqrt{2gh} \times \rho\,\frac{kg}{s}$.

The kinetic energy of this water leaving the hose $= \frac{1}{2}mv^2 = \frac{1}{8}\pi d^2 \times (2gh)^{3/2} \times \rho$

= 21.5 kW

14. F = 0 when $\frac{dU(x)}{dx} = 0$

18. If the particle is released at the origin, it will try to go in the direction of force. Here $\frac{du}{dx}$ is positive and hence force is negative, as a result it will move towards – ve x-axis.

When the particle is released at $x = 2 + \Delta$; it will reach the point of least possible potential energy (–15 J) where it will have maximum kinetic energy.

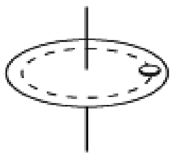
$\therefore \quad \frac{1}{2}m v_{max}^2 = 25 \quad \Rightarrow \quad v_{max} = 5$ m/s

The particle will now perform oscillatory motion between $-15 \le U \le 15$, because reaching U = + 15 J, the kinetic energy and hence speed becomes zero.

In (C); $E_i = U_i + k_i = 15 + 6 = 21$ J

At x = 10; $U_f = 20 \Rightarrow k_f = 1 \neq 0 \Rightarrow$ The particle cross x = 10.

20.



The friction force on coin just before coin is to slip will be : $f = \mu_s mg$

Normal reaction on the coin ; N = mg

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Normal reaction on the coin ; N = mg

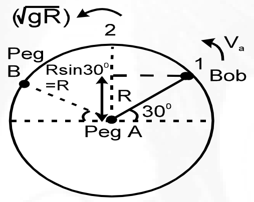
The resultant reaction by disk to the coin is

$= \sqrt{N^2 + f^2} = \sqrt{(mg)^2 + \mu_s (mg)^2}$

$= mg\sqrt{1+\mu^2}$

$= 40 \times 10^{-3} \times 10 \times \sqrt{1 + \frac{9}{16}}$ **= 0.5 N**

25. For anti-clockwise motion, speed at the highest point should be $\sqrt{gR}$. Conserving energy at (1) & (2) :

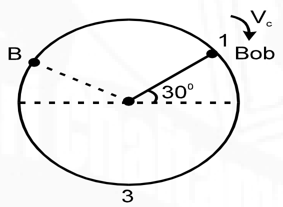


$\frac{1}{2}mv_a^2 = mg\frac{R}{2} + \frac{1}{2}m(gR)$

$\Rightarrow v_a^2 = gR + gR = 2gR \qquad \Rightarrow v_a = \sqrt{2gR}$

For clock-wise motion, the bob must have at least that much speed initially, so that the string must not become loose any where until it reaches the peg B.

At the initial position :



$T + mg\cos 60^0 = \frac{mv_c^2}{R}$;

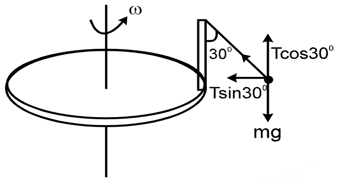
V_C being the initial speed in clockwise direction.

For $V_{C\ min}$: Put T = 0 ;

$\Rightarrow V_C = \sqrt{\frac{gR}{2}} \qquad \Rightarrow V_C/V_a = \frac{\sqrt{\frac{gR}{2}}}{\sqrt{2gR}} = \frac{1}{2}$

$\Rightarrow \quad V_C : V_a = 1 : 2$

26. The bob of the pendulum moves in a circle of radius $(R + R\sin 30^0) = \frac{3R}{2}$

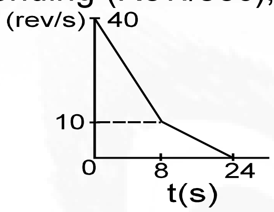


Force equations : $T\sin 30^0 = m\left(\frac{3R}{2}\right)\omega^2$

$T\cos 30^0 = mg$

$\Rightarrow \quad \tan 30^0 = \frac{3}{2}\frac{\omega^2 R}{g} = \frac{1}{\sqrt{3}} \Rightarrow \omega = \sqrt{\frac{2g}{3\sqrt{3}R}}$

27. The corresponding (Rev./sec), graph is :



Area under this curve gives the total number revolutions.

$\Delta = \frac{1}{2}(8)(30) + (10 \times 8) + \frac{1}{2}(16)(10)$

$= 280$ revolutions.

28. since $T = 2\pi\sqrt{\frac{L\cos\theta}{g}}$

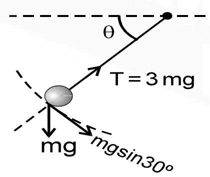
$\therefore \quad T_1 = T_2 \quad \Rightarrow L_1\cos\theta_1 = L_2\cos\theta_2$

$\therefore \quad \frac{L_1}{L_2} = \frac{\cos\theta_2}{\cos\theta_1} = \frac{\cos 45°}{\cos 30°}$

29. $V_{min} = \sqrt{5gR} = \sqrt{5 \times 10 \times 2} = 10$ m/s

30. $T - mg\sin\theta = \frac{mv^2}{R}$

$\Rightarrow 3mg - mg\sin 30° = \frac{m.(u_0^2 + 2g\ell\sin 30°)}{\ell}$



$\therefore \quad u_0 = \sqrt{3g/2}$