JEE EXPERT

ANSWER KEY

JEE Mains

MODULE TEST (MT - 01)

Batch : 12TH Pass (Desire - A01 & A02)

Date 15.09.2019

PHYSICS

1	(B)	2	(D)	3	(A)	4	(D)	5	(D)
6	(B)	7	(D)	8	(C)	9	(D)	10	(A)
11	(B)	12	(D)	13	(D)	14	(A)	15	(C)
16	(A)	17	(C)	18	(B)	19	(C)	20	(C)
21	(0001)	22	(0002)	23	(0006)	24	(0008)	25	(0002)

CHEMISTRY

26	(D)	27	(A)	28	(B)	29	(A)	30	(C)
31	(C)	32	(C)	33	(A)	34	(B)	35	(B)
36	(C)	37	(A)	38	(D)	39	(B)	40	(C)
41	(A)	42	(D)	43	(B)	44	(D)	45	(B)
46	(0030)	47	(0006)	48	(0007)	49	(0004)	50	(0002)

MATHEMATICS

51	(C)	52	(A)	53	(A)	54	(B)	55	(B)
56	(B)	57	(C)	58	(B)	59	(A)	60	(D)
61	(B)	62	(B)	63	(A)	64	(C)	65	(B)
66	(C)	67	(B)	68	(C)	69	(A)	70	(B)
71	(0001)	72	(0)	73	(0146)	74	(0002)	75	(0028)

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SOLUTIONS

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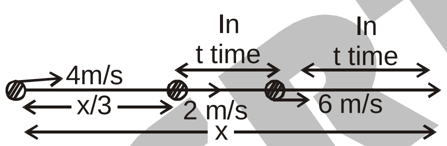
PART - 1 [PHYSICS]

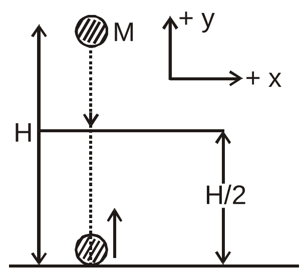
1. **Sol. (B)**



Here $2t + 6t = \frac{2x}{3} \Rightarrow t = \frac{x}{12}$

$$\text{average velocity} = \frac{x}{\frac{x}{3\times 4}+t+t} = \frac{x}{\frac{x}{12}+\frac{2x}{12}} = 4\,m/s$$

2. **Sol. (D)**



When mass M reaches at bottom its velocity is downward and it is $\sqrt{2gH}$.

Collision lasted for time T.

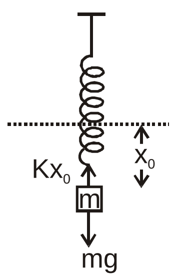
Since it goes only upto height $\frac{H}{2}$ after collision its velocity is upward and is equal to $\sqrt{gH}$

we know

Rate of change of momentum = Force applied

$$\Rightarrow \text{average net force acting on the mass} = M\frac{M(\vec{v}_f-\vec{v}_i)}{T} = M\frac{M(\sqrt{gH}\,\hat{j}-(-)\sqrt{2gH}\,\hat{j}}{T} = \frac{M\sqrt{gH}}{T}(1+\sqrt{2})\,\hat{j}$$

3. **Sol. (A)** $mg = Kx_0$ ...... (i)



All force are conservative force & mass m is pulled down slowly.

Here applying principle of conservation of work, we have

$W_{man} + W_{mg} + W_{spring\ force}$ = change in K.E. = 0

$\Rightarrow \quad W_{man} = W_{mg} - W_{spring\ force}$

$$= -mg\,y + \left\{\frac{1}{2}K(x_0+y)^2 - \frac{1}{2}Kx_0^2\right\} \qquad ..... \text{(ii)}$$

from (i) & (ii)

$$W_{max} = \frac{1}{2}\frac{mg}{x_0}y$$

4. Sol. (D) Since speed of airplane is constant, so only contripetal force is acting on airplane. there is no tangential force. Obviously when $\theta = 90°$, net force on airplane will be towards centre & it will be horizontal.

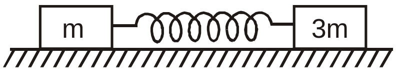
5. Sol. (D) Apply Newton's third law of motion.

6. Sol. (B) Figure (a) shows that $m_A < m_S$ & figure (b) shows that $m_S < m_B \Rightarrow m_A < m_S < m_B$

7. Sol. (D) Centripetal acceleration = $50 \cos 37° = \frac{v^2}{R} \Rightarrow 50 \times \frac{4}{5} = \frac{v^2}{10} \Rightarrow v = 20$ m/s

8. Sol. (C)

Initially system is at rest net momentum = 0 when it is released, m & 3m gains speed.
spring force is internal force



we have $\vec{F}_{ext} = \frac{d}{dt}(\vec{P}_f - \vec{P}_i)_{system}$

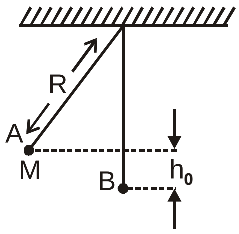
$\because \quad \vec{F}_{ext} = 0 \quad \Rightarrow \quad \vec{P}_{f_{system}} = \vec{P}_{i_{system}} = 0$

So momentum of m & 3 m are opposite but equal in magnitude.

9. Sol. (D)

Particle will reach upto D due to conservation of energy.
(there is no dissipative forces, only conservative forces are there.)

10. Sol. (A)



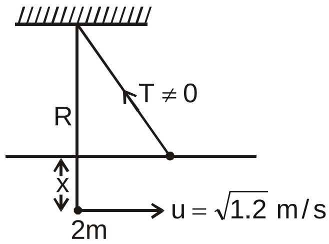
Speed of A just before colliding to B = $\sqrt{2gh_0}$ and it is horizontal.

When A & B stick together, their combined horizontal

speed = $\frac{\sqrt{2gh_0}}{2} = \sqrt{\frac{gh_0}{2}} = \sqrt{\frac{10}{2} \times \frac{24}{100}} = \sqrt{1.2}$ m/s

Horizontal speed $\sqrt{1.2} < \sqrt{2gR} = \sqrt{10}$

So in this case mass will oscillate
maximum height reached = x



Applying conservation of energy, $\frac{1}{2}(2m)u^2 = (2m)gx$

$\Rightarrow x = \frac{u^2}{2g} = \frac{1.2}{2 \times 10} = \frac{6}{100}$ meter = 6 cm

11. Sol. (B) F is sinusoidal function of time, so it is periodical

μ mg > F. So, a = 0

12. Sol. (D) Force of engine = F = (20 M)K   1M = 1000 kg

K = constant,

Retardation of last box = $\frac{(4M)K}{4M} = K$

Acceleration of train for 3200 meter = $\frac{20MK}{16M} = \frac{20K}{16}$

Speed of rest train for this distance = 3200 meter

$$v_1^2 = v^2 + \left(\frac{5}{4}K\right)3200$$

Retardation there after = $\dfrac{(16M)K}{16M} = K$

$v^2 = u^2 + 2as$

$$0 = v^2 + \left(\frac{5K}{4}\right)3200 - 2K(s);\ S = \frac{v^2}{2K} + \frac{5}{8}(3200)$$

Distance travelled by last box till it stops

$$S_1 = \frac{v^2}{2K}$$

Total distance = $3200 - \dfrac{v^2}{2K} + 5$

13. **Sol. (D)** N – mg cos 60º = m(3)

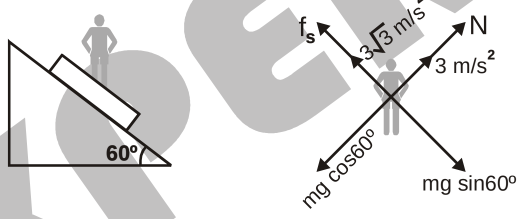
N = 8M

N = 400 Newton

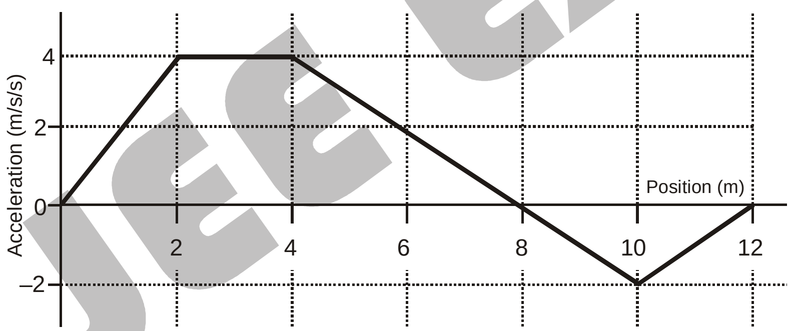
in kg 40 kg

40 = 10x

x = 4



14. **Sol. (A)**



W = $\int_i^f \vec{F}.d\vec{r} = \int_i^f m\vec{a}.d\vec{r} = m\int_i^f \vec{a}.d\vec{r}$ = m × (Area under curve)

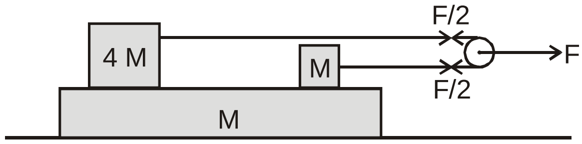
Here in taking area we take area above axis as + ve & below x - axis as – ve.

So W = 2.25 {(Area of curve from 0 to 8m) + (Area of curve form 8 to 12 m as – ve)}

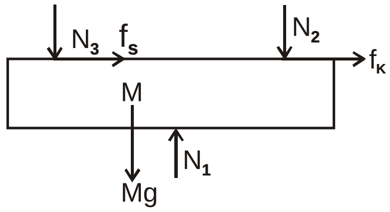
= 2.25 $\left\{\frac{1}{2} \times 4(8+2) + (-) \times \frac{1}{2} \times 4 \times 2\right\}$ = 36 J.

15. **Sol. (C)**

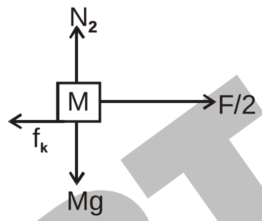
F.B.D. of platform



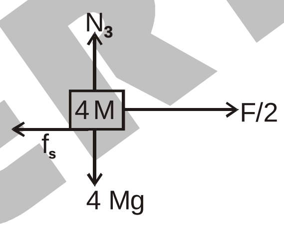
F.B.D. of platform



F.B.D. of mass M



Equation of motion for platform $f_k + f_s = M \times 0.2\ g$ F.B.D. of mass M



or $\mu_k Mg + f_s = 0.2\ Mg$

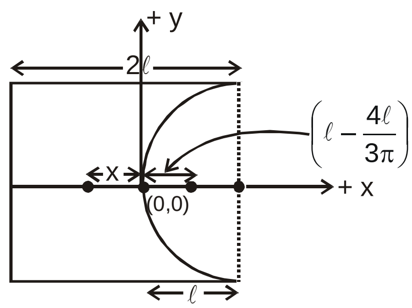
or $0.1\ Mg + f_s = 0.2\ Mg \quad \Rightarrow \quad f_s = 0.1\ Mg$ ...... (1)

Equation of motion for 4 M, $\frac{F}{2} - f_s = 4M \times 0.2Mg$

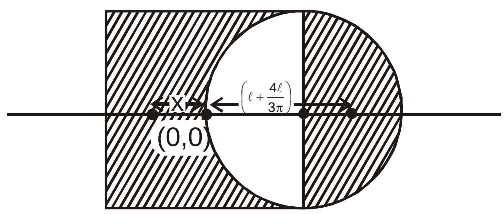
Here 4 M has same acceleration as platform.

$\frac{F}{2} = 0.8Mg + f_s = 0.9\ Mg$ (From (i) $\Rightarrow$ F = 1.8 Mg

16. **Sol. (A)** Let CM of only square without semicircular portion is at distance x right side from origin then



$$\left(M - \frac{M}{4\ell^2} \times \frac{\pi\ell^2}{2}\right) x = \frac{M}{4\ell^2} \times \frac{\pi\ell^2}{2}\left(\ell - \frac{4\ell}{3\pi}\right)$$



$$x = \frac{\frac{\pi}{8}\left(1 - \frac{4}{3\pi}\right)\ell}{\left(1 - \frac{\pi}{8}\right)} = \frac{(3\pi - 4)\ell}{3(\pi - 8)}$$

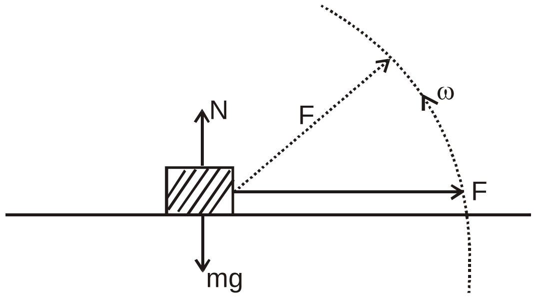
Now, $X_{CM} = M\dfrac{M\left(1-\frac{\pi}{8}\right)(-)\frac{(3\pi-4)\ell}{3(\pi-8)}+\frac{\pi M}{8}\cdot\left(\ell+\frac{4\ell}{3\pi}\right)}{M}$ = $\dfrac{\ell}{3}=4$ cm

17. **Sol. (C)** We can write $\vec{F}=40\{(\cos\omega t)\hat{i}+(\sin\omega t)\hat{j}\}$

where ω = 2 rad/sec.

$\Rightarrow$ F_x = 40 cos 2t & F_y = 40 sin 2t

Here F_y, N & mg balances each other



So $F_x = m\dfrac{dV}{dt}$ = 40 cos 2t

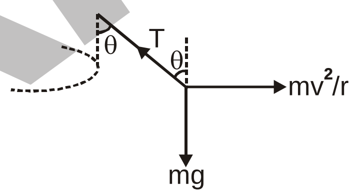
integrating mV = 40 $\left.\dfrac{\sin 2t}{2}\right|_0^{t=\frac{\pi}{4\omega}}$

5 × V = 40 × $\dfrac{1}{2\sqrt{2}}$ $\Rightarrow$ V = $2\sqrt{2}$

$\therefore$ $\dfrac{V^2}{8}=1$ Ans.

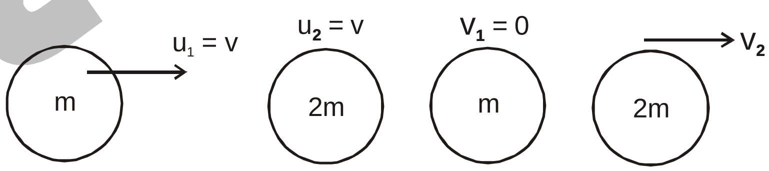
18. **Sol. (B)** $x_{CM}=\dfrac{2\times 0+3\times\ell+4\times\frac{\ell}{2}}{4+2+3}$

19. **Sol. (C)**



Relative to car, balance forces.

20. **Sol. (C)**



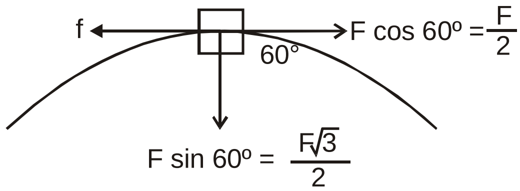
$mv + 2m(0) = m(0) + 2mv_2$

$v_2 = \dfrac{v}{2}$

$e = -\left[\dfrac{v_2-v_1}{u_2-u_1}\right] = -\left[\dfrac{\frac{v}{2}-0}{0-v}\right] = \dfrac{1}{2}$ = 0.5

21. **Sol. (0001)** $f \rightarrow$ Force of air resistance

$a_t = \dfrac{dv}{dt} = 0$, so tangential force = zero



$f = \dfrac{F}{2}$

only centipetal acn is there

$F \sin 60^o = m\,(a_{net}) = \dfrac{mv^2}{R}$

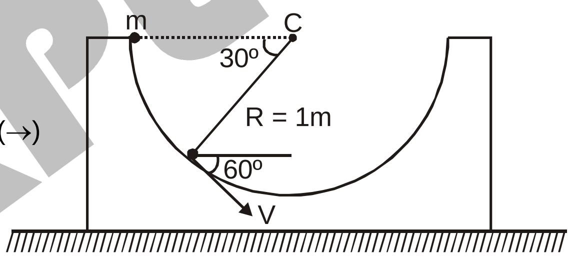
$\dfrac{F\sqrt{3}}{2} = (10 \times 10^{-3})\left(10\sqrt{3}\right)$

$F = \dfrac{2}{10}$

Power of f = fv = $\left(\dfrac{F}{2}\right)v$ = 1 watt

22. **Sol. (0002)** $V = \omega R = 12$m/s

relative horizontal velocity of boll w.r.t wedge = 6m/s
conserve mom in horizontal direction.
If horizontal velocity of wedge w.r.t ground is V_1 ($\leftarrow$),
the horizontal velocity of mass m w.r.t. ground is $(6 - V_1)(\rightarrow)$



$(2m)\,V_1 = m\,(6 - V_1)$
$2V_1 = 6 - V_1$
$V_1 = 2$m/s

23. **Sol. (0006)** $\dfrac{1}{2}(2m)v^2 = \dfrac{1}{2}\left[(k)\dfrac{d^2}{4}\right]$ (Energy conservation)

Where v is the velocity of lower block after having elastic collision with particle.

$V = \left(\dfrac{2m}{m+2m}\right)V_0$ (V_0 is the minimum velocity of mass m)

$V = \dfrac{2V_0}{3} \rightarrow$ Put in above equation $V_0^{\,2} = \dfrac{gkd^2}{32m}$

$V_0 = 6$m/s

24. **Sol. (0008)** Net force = $(F - kx)$

KE = work done $= \int_0^x (F - kx)\,dx$

KE = $Fx - \frac{1}{2}kx^2$

K max when $\frac{d(KE)}{dx} = 0$ or $x = \frac{F}{k}$ and max KE = $Fx - \frac{1}{2}kx^2 = \frac{F^2}{k} - \frac{1}{2}k\left(\frac{F^2}{K^2}\right) = \frac{F^2}{2k} = 4$

$F^2 = 8k$ and $F = kx$ or $x = \frac{F}{k} = 1$ meter

$F = k$

we have F = 8 Newton

25. **Sol. (0002)** No external force

So V_{com} = const = $\frac{m_1V + m_2V_2}{m_1 + m_2} = \frac{(3\times 2)+(2\times 2)}{5}$ = 2 kg m/s