SAFE HANDS & IIT-ian's PACE

MONTHLY MAJOR TEST-05 (JEE) ANS KEY Dt. 01-02-2023

PHYSICS		CHEMISTRY		MATHS	
Q. NO.	[ANS]	Q. NO.	[ANS]	Q. NO.	[ANS]
1	A	31	A	61	B
2	B	32	C	62	A
3	D	33	D	63	B
4	B	34	A	64	A
5	D	35	A	65	C
6	A	36	D	66	A
7	A	37	B	67	C
8	B	38	D	68	B
9	D	39	C	69	A
10	A	40	D	70	A
11	C	41	B	71	C
12	B	42	D	72	B
13	D	43	A	73	D
14	B	44	D	74	D
15	B	45	A	75	A
16	A	46	A	76	B
17	A	47	D	77	A
18	B	48	D	78	
19	D	49	A	79	A
20	C	50	D	80	C
21		51	4.34	81	7
22	5	52	2	82	16
23	3.33	53	9	83	11
24	30	54	122.4	84	2
25	13	55	36	85	5
26	1	56	941	86	775
27	1	57	0.2	87	4464
28	3	58	10	88	23
29	2	59	1.16	89	30
30	2	60	0.5	90	4

SAFE HANDS & IIT-ian's PACE

Monthly Major Test-05 (JEE) Physics Solutions

: HINTS AND SOLUTIONS :

Single Correct Answer Type

1**(a)**

Power = $\frac{\text{Work done}}{\text{Time}} = \left[\frac{ML^2T^{-2}}{T}\right] = [ML^2T^{-3}]$

3**(b)**

$F = \frac{m(v-u)}{t} = \frac{0.15[20-(-10)]}{0.1} = \frac{0.15\times30}{0.1} = 45\text{N}$

4**(d)**

Force $F = \frac{dp}{dt}$

$= v\left[\frac{dM}{dt}\right]$

$= \alpha\, v^2$

$\therefore \quad a = \frac{F}{M} = \frac{\alpha\, v^2}{M}$

5**(d)**

Pressure

$p = \frac{F}{A} = \frac{n\{mv-(mv)\}}{A} = \frac{2mnv}{A}$

$= \frac{2\times10^{-3}\times10^{4}\times10^{2}}{10^{-4}} = 2\times10^{7}\ \text{Nm}^{-2}$

6**(a)**

We know that the velocity of body is given by the slope of displacement – time graph so it is clear that initially slope of the graph is positive and after some time it becomes zero (corresponding to the peak of graph) and it will become negative

7**(a)**

$9y = \frac{1}{2}\times10\times3\times3$ or $\quad y = 5\text{m}$

Again, $n\times5 = \frac{1}{2}\times10\times1\times1 = 5$ or $n = 1$

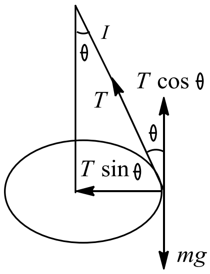
8**(b)**

If acceleration is variable (depends on time) then

$v = u + \int(f)dt = u + \int(a\,t)dt = u + \frac{a\,t^2}{2}$

9**(d)**

As is clear from figure



$T\sin\theta = \frac{mv^2}{r}, T\cos\theta = mg$

Dividing, we get

$\tan\theta = \frac{v^2}{rg} = \frac{r}{g}\left(\frac{2\pi}{T}\right)^2$

$\frac{2\pi}{T} = \sqrt{\frac{g\tan\theta}{r}} = \sqrt{\frac{g\tan\theta}{l\sin\theta}} = \sqrt{\frac{g}{l\cos\theta}}$

or $\ T = 2\pi\sqrt{\frac{l\cos\theta}{g}}$

10

(a)

$R = \frac{v^2\sin2\theta}{g} = 200, T = \frac{2v\sin\theta}{g} = 5$

Dividing, $\frac{v^2\times2\sin\theta\cos\theta}{g}\times\frac{g}{2v\sin\theta} = \frac{200}{5} = 40$

or $v\cos\theta = 40\text{ms}^{-1}$

It may be noted here that the horizontal component of the velocity of projection remains the same during the flight of the projectile

11

(c)

Maximum height, $H = \frac{u^2\sin^2\theta}{2g}$

Time of flight, $T = \frac{2u\sin\ \theta}{g}$

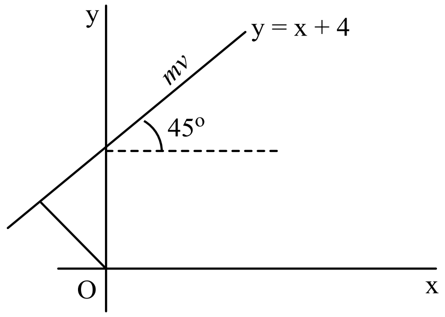
$\therefore \quad \frac{H}{T^2} = \frac{u^2\sin^2\theta/2g}{4u^2\sin^2\theta/g^2} = \frac{g}{8} = \frac{10}{8} = \frac{5}{4}$

12**(b)**

Angular momentum about origin

$$|\mathbf{L}| = |\mathbf{r} \times m\mathbf{v}|$$

$$= (4\cos 45°) \times (5) \times 3\sqrt{2}$$



$$= \frac{a}{\sqrt{2}} \times 5 \times 3\sqrt{2}$$

$$|\mathbf{L}| = 60 \text{ unit}$$

13**(d)**

When C collides with B then due to impulsive force, combined mass $(B + C)$ starts to move upward. Consequently the string becomes slack

14**(b)**

$f \propto \frac{1}{\mu-1}$ and $\mu \propto \frac{1}{\lambda}$

15**(b)**

The apparent depth of ink mark

$$= \frac{\text{real depth}}{\mu} = \frac{3}{3/2} = 2\ cm$$

Thus person views mark at a distance $= 2 + 2 = 4\ cm$

16**(a)**

$$\frac{1}{v} + \frac{1}{-600} = \frac{1}{20} \text{ or } \frac{1}{v} = \frac{31}{600}$$

Or $v = \frac{600}{31}\text{cm} = 19.35$

17**(a)**

$$I = \frac{L}{r^2}$$

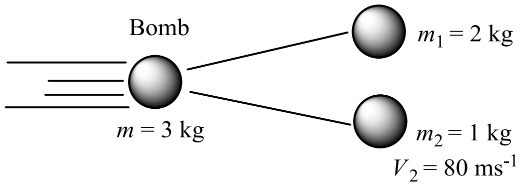
18**(b)**

From Hugen's principle, if the incident wavefront be parallel to the interface of the two media $(i = 0)$, then the refracted wavefront will also be parallel to the interface $(r = 0)$.

In other words, if light rays fall normally on the interface, then on passing to the second medium they will not deviate from their original path.

19**(d)**

From law of conservation of momentum, when no external force acts upon a system of two (or more) bodies, then the total momentum of the system remains constant.



Momentum before explosion =momentum after explosion.

since bomb v at rest, its velocity is zero, hence,

$$mv = m_1 v_1 + m_2 v_2$$

$$3 \times 0 = 2v_1 + 1 \times 80$$

$$or\ v_1 = -\frac{80}{2} = -40ms^{-1}$$

Total energy imparted is

$$\text{KE} = \frac{1}{2}\text{m}_1\text{v}_1^2 + \frac{1}{2}\text{m}_2\text{v}_2^2$$

$$= \frac{1}{2} \times 2 \times (-40)^2 + \frac{1}{2} \times 1 \times (80)^2$$

=1600+3200=4800J

=4.8kJ

20**(c)**

Kinetic energy $= \frac{1}{2}mv^2$

As both balls are falling through same height, therefore they possess same velocity.

$$\therefore \quad \frac{(\text{KE})_1}{(\text{KE})_2} = \frac{m_1}{m_2} = \frac{2}{4} = \frac{1}{2}$$

Integer Answer Type

23**(3.33)**

A = 3.0 kΩ, $\Delta\text{A} = 0.1\text{k}\Omega$

B = 9.0 kΩ, $\Delta\text{B} = 0.3\text{k}\Omega$

Now, equivalent parallel resistance R_p is given by,

$\frac{1}{R_p} = \frac{1}{A} + \frac{1}{B}$ ....(i)

$\therefore R_p = \frac{AB}{A+B} = \frac{3\times 9}{3+9}$

$R_p = 2.25 k\Omega$

Differentiating equation (i), we get,

$\frac{-\Delta R_p}{R_p^2} = \frac{-\Delta A}{A^2} - \frac{\Delta B}{B^2}$

$\therefore \Delta R_p = \Delta A\left(\frac{R_p}{A}\right)^2 + \Delta B\left(\frac{R_p}{B}\right)^2$

$= (0.1)\left(\frac{2.25}{3.0}\right)^2 + (0.3)\left(\frac{2.25}{9.0}\right)^2$

$= 0.05625 + 0.01875$

$\Delta R_p = 0.075\ k\Omega$

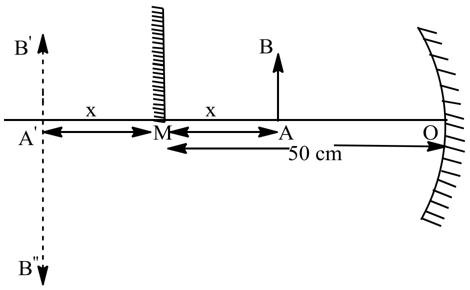
$\therefore$ Percentage error in equivalent resistance is,

$\frac{\Delta R_p}{R_p}\times 100 = \frac{0.075}{2.25}\times 100$

$= 3.33\%$

24 (30)

Let the object be at a distance x from the plane mirror.



The distance of object from concave mirror

$= u = -(50 - x)$

For the plane mirror, object and image distances are equal,

$\therefore A'M = AM = x$

$\therefore OA' = OM + A'M = 50 = x$

For the concave mirror, $v = -(50 + x)$

From mirror formula,

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\therefore \frac{1}{-16} = \frac{1}{-(50-x)} + \frac{1}{-(50+x)}$

$\therefore -\frac{1}{16} = \frac{-50-50}{(50^2 - x^2)}$

$\therefore 50^2 - x^2 = 16 \times 100$

$\therefore 50^2 - 1600 = x^2$

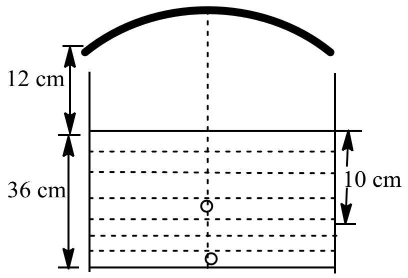
$\therefore x^2 = 2500 - 1600$

$= 900$

$\therefore x = 30$ cm

The object should be placed at a distance of 30 cm from the plane mirror.

25 (13)



As object is placed in water, the object distance from mirror will be apparent.

$\therefore$ Apparent distance $= \frac{\text{Real distance}}{\mu} = \frac{36}{4/3}$

$= 27$ cm

Distance of object from mirror

= Distance of mirror from water level + Apparent distance of object

$= 12 + 27 = 39$ cm

Similarly, distance of image from mirror

$= 12 + \frac{10}{4/3} = 12 + 7.5 = 19.5$ cm

For mirror, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Considering sign conventions for mirror,

$\therefore \frac{1}{-19.5} - \frac{1}{39} = \frac{1}{f}$

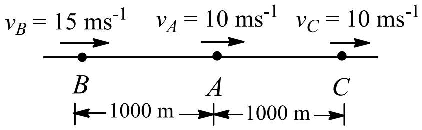
$\therefore \frac{1}{f} = \frac{-2-1}{39} = \frac{-3}{39}$

$\therefore f = -13$ cm

Neglecting negative sign, focal length = 13 cm

26(1)

The situation can be roughly shown in the figure. Let C take time t to overtake A



$d_{rel} = 1000$ m, $v_{rel} = (10 + 15) = 25\ ms^{-1}$

Here $t = \frac{d_{rel}}{v_{rel}} = \frac{1000}{25} = 40$ s

Let acceleration of B be a for overtaking

$d_{rel} = 1000$ m; $v_{rel} = 15 - 10 = 5\ ms^{-1}$

$d_{rel} = a$ and $t = 40$ s

Using $d_{\text{rel}} = u_{\text{rel}}t + \frac{1}{2}a_{\text{rel}}t^2$

$1000 = 5 \times 40 + \frac{1}{2}a(40)^2 \Rightarrow a = 1\ \text{ms}^{-2}$

27**(1)**

$v^2 = u^2 - 2gs$

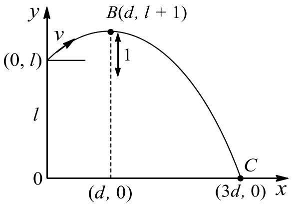
$0 = u^2 - (2)(10)$ will give $u = 10\ \text{ms}^{-1}$

Further, $v = u - gt$

$0 = 10 - (10)t$ gives $t = 1$s

28**(3)**

The horizontal and vertical components of the velocity are the same, let it be $u = v\cos 45°$



From A to B: $1 = \frac{u^2}{2g} \Rightarrow u^2 = 2g$

At B: $d = ut_1 \Rightarrow t_1 = d/u$

$1 = ut_1 - \frac{g}{2}t_1^2 = u\frac{d}{u} - \frac{g}{2}\frac{d^2}{u^2}$

$\Rightarrow 1 = d - \frac{g}{2}\frac{d^2}{u^2} \Rightarrow 1 = d - \frac{gd^2}{4g}$

$\Rightarrow 4 = 4d - d^2 \Rightarrow d^2 - 4d + 4 = 0$

$\Rightarrow d = 2\ \text{m}$

At C: $3d = ut_2 \Rightarrow t_2 = \frac{3d}{u}$

$-l = ut_2 - \frac{1}{2}gt_2^2 = u \cdot \frac{3d}{4} - \frac{g}{2}\frac{9d^2}{4^2} = 3d - \frac{9gd^2}{4g}$

$= 3d - \frac{9d^2}{4} = 3 \times 2 - \frac{9}{4} \times 4 = 6 - 9 = -3$

$\Rightarrow l = 3$ m

29**(2)**

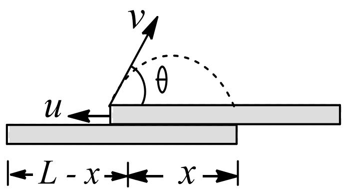
$AB = 2\,R\cos\theta$

$AB = \frac{1}{2}g\cos\theta t^2 \Rightarrow 2\,R\cos\theta = \frac{1}{2}g\cos\theta t^2$

$2\sqrt{\frac{R}{g}} = t \Rightarrow 2\sqrt{\frac{10}{10}} = t = 2\text{s}$

30 **(2)**

Apply conservation of momentum in horizontal direction:



$mv\cos\theta - \text{mu} = 0 \Rightarrow u = v\cos\theta$

$L - x = ut, x = v\cos\theta t$

Solve to get, $x = \frac{L}{2}$

$x = \frac{v^2\sin 2\theta}{g} \Rightarrow \frac{L}{2} = \frac{v^2\sin 2\theta}{g}$

$\Rightarrow v = \sqrt{\frac{gL}{2\sin\theta}}$ for minimum $v, \sin 2\theta = 1$

$v_{\min} = \sqrt{\frac{gL}{2}} = \sqrt{\frac{10\times5}{2}} = 2\sqrt{5}$ m/s, Hence n =2