SAFE HANDS & IIT-ian's PACE

MONTHLY MAJOR TEST-06 (JEE) ANS KEY Dt. 03-03-2023

PHYSICS		CHEMISTRY		MATHS	
Q. NO.	[ANS]	Q. NO.	[ANS]	Q. NO.	[ANS]
1	B	31	B	61	B
2	C	32	D	62	A
3	B	33	A	63	C
4	B	34	B	64	B
5	A	35	C	65	A
6	D	36	D	66	B
7	A	37	A	67	A
8	D	38	A	68	A
9	A	39	B	69	A
10	D	40	B	70	
11	A	41	B	71	B
12	D	42	C	72	B
13	C	43	C	73	C
14	C	44	C	74	A
15	D	45	B	75	C
16	A	46	C	76	A
17	A	47	C	77	C
18	C	48	D	78	C
19	C	49	D	79	A
20	C	50	A	80	A
21	6	51	3	81	4
22	4	52	50	82	11
23	-10.8	53	12.2	83	4
24	80	54	1.16	84	7
25	8	55	4	85	13
26	30	56	14	86	3
27	1.8	57	1	87	4
28	7	58	5	88	26
29	2	59	2	89	1
30	8	60	1.7	90	2

: ANSWER KEY :

1)	b	2)	c	3)	b	4)	b	21)	6	22)	4	23)	-10.8
5)	a	6)	d	7)	a	8)	d	24)	80				
9)	a	10)	d	11)	a	12)	d	25)	8	26)	30	27)	1.8
13)	c	14)	c	15)	d	16)	a	28)	7				
17)	a	18)	c	19)	c	20)	c	29)	2	30)	8		

: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(b)**

Impulse is given by the product of force and time. Form Newton's second law

$$F = ma = m\frac{\Delta v}{\Delta t}$$

$$\Longrightarrow \quad F\Delta t = m\Delta v$$

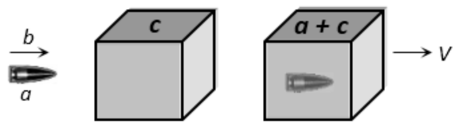
= change in the momentum of the body.

2 **(c)**

$$T = \frac{T_0}{[1-(v^2/c^2)]^{1/2}}$$

By substituting $T_0 = 1$ day and $T = 2$ days we get $v = 2.6 \times 10^8\ ms^{-1}$

3 **(b)**



Initially bullet moves with velocity b and after collision bullet get embedded in block and both move together with common velocity

By the conservation of momentum

$$\Rightarrow a \times b + 0 = (a+c)V \Rightarrow V = \frac{ab}{a+c}$$

4 **(b)**

$$\frac{I_1}{I_2} = \left(\frac{M_1}{M_2}\right)\left(\frac{R_1}{R_2}\right)^2 = \frac{1}{2} \times \left(\frac{2}{1}\right)^2 = 2$$

5 **(a)**

$$\alpha = \frac{\omega}{t} = \frac{2\pi n}{t} = \frac{2\pi\left(\frac{540}{60}\right)}{6} = 3\pi\ rad/s^2$$

6 **(d)**

$\mathbf{L} = m(\mathbf{r} \times \mathbf{v})$

Direction of $(\mathbf{r} \times \mathbf{v})$, hence the direction of angular momentum remains the same.

7 **(a)**

$\overrightarrow{F_1} = F_1\hat{j}$; $\overrightarrow{F_1} \times \overrightarrow{F_2}$ is equal to zero only I angle between $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ is either 0° or 180°. So $\overrightarrow{F_2}$ will be $4\hat{j}$.

8 **(d)**

$T_1 = 277°C = 277 + 273 = 550$ K

$T_2 = 67°C = 67 + 273 = 340$ K

Temperature of surrounding

$$T = 27°C = 27 + 273 = 300 \text{ K}$$

Ratio of loss of heat$=\frac{T_1^4 - T^4}{T_2^4 - T^4}$

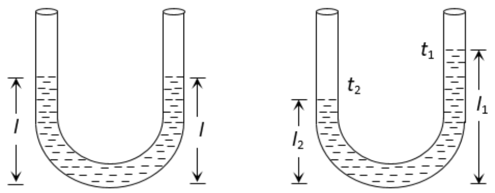
$$= \frac{\left(\frac{T_1}{T}\right)^4 - 1}{\left(\frac{T_2}{T}\right)^4 - 1} = \frac{\left(\frac{550}{300}\right)^4 - 1}{\left(\frac{340}{300}\right)^4 - 1} = \frac{9.5}{0.5} = \frac{19}{1}$$

9 **(a)**

Thermal conductivity is independent of temperatures of the wall, it is a constant for the material, so it will remain unchanged

11 **(a)**

Suppose, height of liquid in each arm before rising the temperature is l.



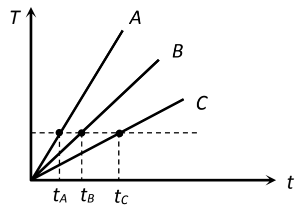
With temperature rise height of liquid in each arm increases $i.e. l_1 > l$ and $l_2 > l$

Also $l = \frac{l_1}{1+\gamma t_1} = \frac{l_2}{1+\gamma t_2}$

$$\Rightarrow l_1 + \gamma l_1 t_2 = l_2 + \gamma l_2 t_1 \Rightarrow \gamma = \frac{l_1 - l_2}{l_2 t_1 - l_1 t_2}$$

13 **(c)**

Substances having more specific heat take longer time to get heated to a higher temperature and longer time to get cooled.



If we draw a line parallel to the time axis then it cuts the given graphs at three different points. Corresponding points on the times axis shows that

$t_C > t_B > t_A \Rightarrow C_C > C_B > C_A$

14 **(c)**

$$\frac{E_2}{E_1} = \left(\frac{T_2}{T_1}\right)^4 \Rightarrow \frac{E_2}{20} = \left(\frac{2T}{T}\right)^4 = 16 \Rightarrow E_2$$
$$= 320\ kcal/m^2 min$$

15 **(d)**

$$\frac{Q_1}{Q_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{273+27}{273+927}\right)^4 = \left(\frac{1}{4}\right)^4 = \frac{1}{256}$$

16 **(a)**

At minimum deviation $(\delta = \delta_m)$

$r_1 = r_2 = \frac{A}{2} = \frac{60°}{2} = 30°$ (for both colours)

17 **(a)**

Power of combination $P = P_1 + P_2$

$= +20 - 10 = +10D$

$F = \frac{1}{P} = \frac{1}{10}$m =10 cm

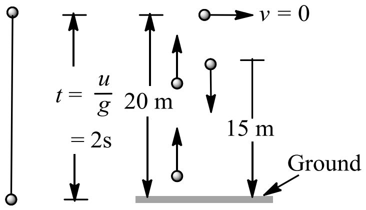
For image at infinity

$M = \frac{D}{F} = \frac{25}{10} = 2.5$

18 **(c)**

$[X] = [F] \times [\rho] = [MLT^{-2}] \times \left[\frac{M}{L^3}\right] = [M^2L^{-2}T^{-2}]$

19 **(c)**



Position of balls

$h_1 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 1^2 = 5$m

$h_2 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 2^2 =$20m

From ground, 5m, 20m, 15m (shown in figure)

20 **(c)**

$h_{n^{th}} = u - \frac{g}{2}(2n - 1)$

$h_{5^{th}} = u - \frac{10}{2}(2 \times 5 - 1) = u - 45$

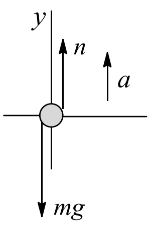
$h_{6^{th}} = u - \frac{10}{2}(2 \times 6 - 1) = u - 55$

Given $h_{5^{th}} = 2 \times h_{6^{th}}$. By solving we get $u = 65\ m/s$

Integer Answer Type

21 **(6)**

Consider the forces on the person:



$\sum F_y = ma_y$

$n - mg = ma$

$n = 1.6\,mg$ so $a = 0.60\text{ g} = 6\text{ ms}^{-2}$

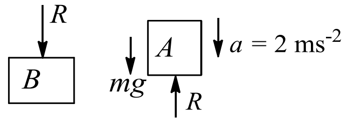
$v^2 = u^2 + 2as$

$\Rightarrow\ v^2 = 0^2 + 2 \times 6 \times 3$

$v = 6\text{ ms}^{-1}$

22 **(4)**

Let A apply a force R on B



Then B also applies an opposite force R on A as shown in figure

For A:

$mg - R = ma$

$\Rightarrow R = m(g - a) = 0.5[10 - 2] = 4$ N

23 **(-10.8)**

Mass of ball, m = 180 g = 0.18 kg

Initial speed of ball = u = 108 km/hr

= 30 m/s

As ball bounces back with same velocity (elastic collision),

∴ v = −30 m/s

Change in momentum in this process Δ p is ,

$\Delta p = mv - mu$

$= m(v - u)$

$= 0.18(-30 - 30)$

$= -10.8$ kg m/s

From Newton's second law of motion,

$F = \frac{\Delta p}{\Delta t}$

For $\Delta t = 0.001$ s

$\therefore F = \frac{-10.8}{0.001} = -10.8 \times 10^3$ N

24 **(80)**

In first case according to principle of calorimetry,

Heat lost by liquid A = heat gained by liquid B

$\therefore m_A c_A \Delta T_A = m_B c_B \Delta T_B$

$\therefore 100 \times c_A(100 - 90) = 50 \times c_B(90 - 75)$

$\therefore 1000c_A = 50 \times 15c_B$

$\therefore 4c_A = 3c_B$

Similarly, in second case,

$100 \times c_A(100 - T) = 50 \times c_B(T - 50)$

$\therefore 4c_A(100 - T) = 2c_B(T - 50)$

Using equation (i),

$3c_B(100 - T) = 2c_B(T - 50)$

$\therefore 300 - 3T = 2T - 100$

$\therefore 5T = 400$

$\therefore T = 80\ ^\circ C$

25 **(8)**

Let power lost to surrounding is Q

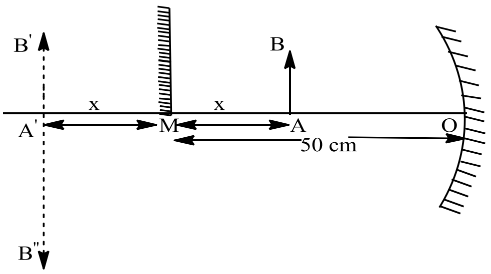
$$16 - Q = \left(\frac{dm}{dt}\right) S(10)$$

And $32 - Q = 3\left[\left(\frac{dm}{dt}\right) S(10)\right]$

$\Rightarrow \frac{32-Q}{16-Q} = 3 \Rightarrow Q = 8\text{W}$

26 **(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,

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

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

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

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

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

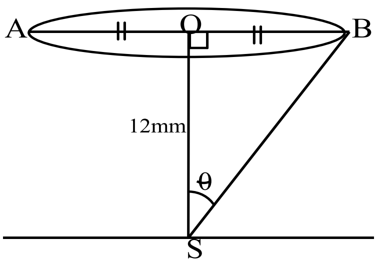
$\therefore x^2 = 2500 - 1600$

$= 900$

$\therefore x = 30$ cm

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

27 **(1.8)**



As the light is passing from optically denser medium to rarer medium, θ is the critical angle.

From Pythagoras theorem,

$SB = \sqrt{SO^2 + OB^2} = \sqrt{12^2 + 9^2} = 15$ mm

$$\therefore \sin\theta = \frac{OB}{SB} = \frac{9}{12} = \frac{3}{4}$$

$$\text{But, } \sin\theta = \frac{\mu_2}{\mu_1} = \frac{\mu}{2.4}$$

$$\therefore \frac{3}{4} = \frac{\mu}{2.4}$$

$\Rightarrow \mu = 1.8$

28 **(7)**

$E(t)=A^2 e^{-at}$

Taking natural logarithm on both sides,

$ln\ (E) = 2/n\ (A)+(-at)$

Differentiating both sides,

$$\frac{dE}{E} = 2\left(\frac{\Delta A}{A}\right) + (-a dt)$$

As errors always add up for maximum error,

$$\therefore \frac{dE}{E} = 2\frac{dA}{A} + a\left(\frac{dt}{t}\right) \times t$$

Here, $\frac{dA}{A} = 1.7\%, \frac{dt}{t} = 1.5\%, t == 6$ s,

$a = 0.4 s^{-1}$

$\therefore \% \frac{dE}{E} = (2 \times 1.7\%) + (0.4) \times (1.5\%) \times 6$

$= 3.4\% + 3.6\%$

$= 7\%$

29 **(2)**

Taking upward direction as positive, let us work in the frame of lift. Acceleration of ball relative to lift $= (g + a)$ downward, so $a_{real} = -(g + a)$, initial velocity: $u_{rel} = v$, final velocity: $v_{rel} = -v$ as the ball will reach the man with same speed w.r.t lift

Apply $v_{rel} = u_{rel} + a_{rel}t \Rightarrow -v = v + (-g - a)t \Rightarrow t = 2$ s

30 **(8)**

$t_1 = t_2 - t, v_1 = v_2 = v, S = \frac{1}{2}a_1 t_2^1, S = \frac{1}{2}a_2 t_2^2$

$v_1 = a_1 t_1, v_2 = a_2 t_2 \Rightarrow v_2 + v = a_1 t_1$

$$\Rightarrow a_2 t_2 + v = a_1 t_1 = a_1 t_2 \Rightarrow t_2 = \frac{v + a_1 t}{a_1 - a_2}$$

$$\sqrt{\frac{a_2}{a_1}} = \frac{t_1}{t_2} = 1 - \frac{t}{t_2} \Rightarrow \sqrt{\frac{a_2}{a_1}} = 1 - \frac{t(a_1 - a_2)}{(v + a_1 t)}$$

$$\Rightarrow \frac{\sqrt{a_2}}{\sqrt{a_1}} = \frac{v + a_2 t}{v + a_1 t} \Rightarrow \sqrt{a_2}\, v + a_1\sqrt{a_2}\, t$$

$$= v\sqrt{a_1} + a_2\sqrt{a_1}t$$

$\Rightarrow v = \left(\sqrt{a_1 a_2}\right)t = 8\ \text{ms}^{-1}$