SAFE HANDS & IIT-ian's PACE

MONTHLY MAJOR TEST -05 (NB-15 NEET) ANS KEY Dt. 01-02-2023

PHYSICS		CHEMISTRY		BOTANY		ZOOLOGY	
Q. NO.	[ANS]	Q. NO.	[ANS]	Q. NO.	[ANS]	Q. NO.	[ANS]
1	D	51	C	101	B	151	A
2	B	52	B	102	D	152	B
3	C	53	B	103	A	153	B
4	D	54	D	104	B	154	D
5	D	55	C	105	C	155	B
6	A	56	A	106	A	156	A
7	D	57	D	107	C	157	D
8	B	58	D	108	D	158	C
9	B	59	A	109	C	159	D
10	A	60	A	110	C	160	C
11	B	61	A	111	C	161	B
12	B	62	C	112	A	162	D
13	B	63	C	113	B	163	D
14	B	64	A	114	D	164	A
15	D	65	D	115	D	165	A
16	A	66	B	116	B	166	C
17	A	67	A	117	D	167	B
18	B	68	A	118	D	168	D
19	B	69	A	119	B	169	A
20	C	70	B	120	B	170	D
21	B	71	A	121	D	171	D
22	A	72	D	122	B	172	C
23	A	73	B	123	D	173	A
24	A	74	D	124	D	174	B
25	B	75	A	125	C	175	C
26	D	76	D	126	C	176	B
27	D	77	C	127	B	177	B
28	A	78	D	128	B	178	C
29	D	79	A	129	B	179	C
30	D	80	A	130	D	180	B
31	D	81	A	131	C	181	B
32	C	82	C	132	C	182	A
33	D	83	C	133	D	183	C
34	B	84	D	134	D	184	D
35	B	85	D	135	D	185	A
36	C	86	B	136	A	186	B
37	C	87	B	137	A	187	A
38	A	88	C	138	B	188	B
39	C	89	D	139	D	189	B
40	A	90	D	140	D	190	C
41	D	91	D	141	C	191	C
42	B	92	B	142	D	192	B
43	C	93	A	143	D	193	B
44	C	94	C	144	B	194	C
45	A	95	A	145	D	195	D
46	A	96	C	146	A	196	A
47	C	97	A	147	B	197	B
48	D	98	A	148	C	198	A
49	A	99	D	149	B	199	A
50	A	100	A	150	D	200	B

SAFE HANDS & IIT-ian's PACE

Monthly Major Test-05 (NEET) Physics Solutions

: ANSWER KEY :

1)	d	2)	b	3)	c	4)	d	29)	d	30)	d	31)	d	32)	c
5)	d	6)	a	7)	d	8)	b	33)	d	34)	b	35)	b	36)	c
9)	b	10)	a	11)	b	12)	b	37)	c	38)	a	39)	c	40)	a
13)	b	14)	b	15)	d	16)	a	41)	d	42)	b	43)	c	44)	c
17)	a	18)	b	19)	b	20)	c	45)	a	46)	a	47)	c		
21)	b	22)	a	23)	a	24)	a	48)	d	49)	a	50)	a		
25)	b	26)	d	27)	d	28)	a								

Single Correct Answer Type

1 **(d)**

The linear momentum of the particle will be

$$p = \sqrt{p_x^2 + p_y^2} = 2\sqrt{\cos^2 t + \sin^2 t} = 2 \text{ unit}$$

It the clear that p is constant hence, the angle between **F** and **p** is $90°$.

2 **(b)**

Velocity $u = 72 \text{ kmh}^{-1} = 20 \text{ ms}^{-1}$

$a = \mu g = 0.5 \times 10 \text{ ms}^{-2}$

From $v^2 = u^2 - 2as$

$\therefore (0)^2 = (20)^2 - 2 \times 0.5 \times 10 \times s$

$\therefore s = \frac{20 \times 20}{2 \times 0.5 \times 10}$ or $s = 40\text{m}$

3 **(c)**

As $m_1 : m_2 : m_3 = 1:1:3$

and momentum is conserved,

$\therefore \sqrt{p_1^2 + p_2^2 + p_3^2} = 3v_3$

$\sqrt{1 \times 39^2 + 1 \times 39^2} = 3v_3$

$39\sqrt{2} = 3v_3$

$v_3 = \frac{39\sqrt{2}}{3} = 13\sqrt{2}\text{ms}^{-1}$

4 **(d)**

$\frac{dm}{dt} = 0.1\, kg / \text{sec}$; Mass of the rocket = $100\, kg$

$v = 1\, km/\text{sec} = 1000\, m/\text{sec}$

$F = \frac{d(mv)}{dt} = m\frac{dv}{dt} - v\frac{dm}{dt} = 0$ as the mass is decreasing

$100a - 1000 \times 0.1 = 0$

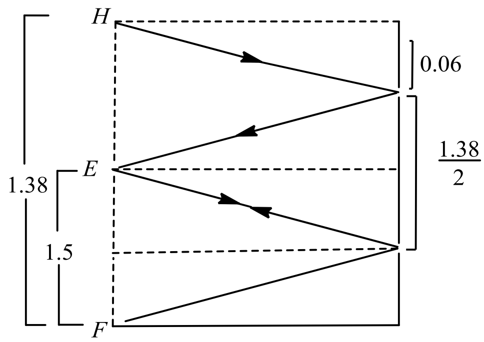
$a = +1\, m/s^2$

5 **(d)**

As the springs are light in weight, therefore, tension in both springs will be same. So, both springs will show same reading 8 kg.

6 **(a)**

From the figure, it is clear that eye is at 1.38 m from the foot. Rays from foot can enter eye after reflection at M_2, whose height from ground



Again, eye is at 1.5 – 1.38 = 0.12 m from heat. Rays from head can enter eye after reflection at M_1, whose height above eye is

$\frac{0.12}{2} = 0.06 \text{ m}$

$\therefore$ Minimum length of mirror

= 0.69 + 0.06 = 0.75 m

8 **(b)**

$r_1 = 10 \text{ cm}, r_2 = 8 \text{ cm}$

$\frac{I_1}{I_2} = \frac{64}{100}, 1 - \frac{I_1}{I_2} = 1 - \frac{64}{100}$

Or $\frac{I_2 - I_1}{I_2} = \frac{36}{100}$

Or $\frac{I_2 - I_1}{I_2} \times 100 = 36\%$

9 **(b)**

Sodium light gives emission spectrum having two yellow lines

11 **(b)**

At the time of sunrise and sunset, the sun is near the horizon. The rays from the sun have to travel a larger part of the atmosphere. As $\lambda_b < \lambda_r$, and intensity of scattered light $\propto \frac{1}{\lambda^4}$, therefore, most of the blue light is scattered away, only red colour, which is least scattered enters our eyes and appears to come from the sun. Hence, the sun looks red both at the time of sunrise and sunset.

12 **(b)**

$C^2LR = [C^2L^2] \times \left[\frac{R}{L}\right] = [T^4] \times \left[\frac{1}{T}\right] = [T^3]$

As $\left[\frac{L}{R}\right] = T$ and $\sqrt{LC} = T$

13 **(b)**

Bulk modulus $K = \frac{\text{normal stress}}{\text{volumetric strain}}$

$$= \frac{F/A}{-\Delta V/V}$$

$$= -\frac{FV}{A\,\Delta V}$$

Now, $\frac{F}{A} = p$

$\therefore \quad K = \frac{pV}{\Delta V}$

As volumetric strain is dimensionless.

$\therefore$ Dimensions of $K =$ dimensions of normal stress

$\Rightarrow \quad [K] = [\mathrm{ML^{-1}T^{-2}}]$

14 **(b)**

Frequency = $\frac{1}{T} = [M^0 L^0\, T^{-1}]$

15 **(d)**

Time period of a simple pendulum is

$$T = 2\pi\sqrt{\frac{L}{g}} \Rightarrow g = \frac{4\pi^2 L}{T^2}$$

$$\therefore \frac{\Delta g}{g} \times 100 = \left(\frac{\Delta L}{L} + 2\frac{\Delta T}{T}\right) \times 100 = 1\% + 2 \times 2\% = 5\%$$

17 **(a)**

Let $v \propto \sigma^a \rho^b \lambda^c$

Equating dimensions on both sides,

$[M^0 L^1 T^{-1}] \propto [MT^{-2}]^a [ML^{-3}]^b [L]^c$

$\propto [M]^{a+b} [L]^{-3b+c} [T]^{-2a}$

Equating the powers of $\mathrm{M, L, T}$ on both sides, we get

$a + b = 0$

$-3b + c = 1$

$-2a = -1$

Solving, we get

$a = \frac{1}{2}, b = -\frac{1}{2}, c = -\frac{1}{2}$

$\therefore\ v \propto \sigma^{1/2}\, \rho^{-1/2}\, \lambda^{-1/2}$

$\therefore\ v^2 \propto \frac{\sigma}{\rho\lambda}$

18 **(b)**

$\vec{A} = A\hat{A} = B\hat{B}$. let θ be the angle between $\vec{A}$ and $\vec{B}$.

As per question,

$$\cos\alpha = \frac{(A\hat{A} + B\hat{B}).(A\hat{B} + B\hat{A})}{|A\hat{A} + B\hat{B}||A\hat{B} + B\hat{A}|}$$

or $\cos\alpha = \frac{2AB + (A^2+B^2)\cos\theta}{(\sqrt{A^2+B^2+2AB}\cos\theta)^2}$

or $2AB + (A^2 + B^2)\cos\theta = (A^2 + B^2)\cos\alpha + 2AB\cos\theta\cos\alpha$

or $2AB(1 - \cos\alpha\cos\theta)$

$= (A^2 + B^2)(\cos\alpha - \cos\theta)$

or $\frac{2AB}{A^2+B^2} = \frac{\cos\alpha - \cos\theta}{1 - \cos\alpha\cos\theta}$

or $\frac{2AB}{(A^2+B^2)} = \frac{\cos\alpha - \cos\theta}{1 - \cos\alpha\cos\theta}$

or $\frac{2AB + (A^2+B^2)}{(A^2+B^2) - AB}$

$= \frac{(\cos\alpha\cos\theta) + (1 - \cos\alpha\cos\theta)}{(1 - \cos\alpha\cos\theta) + (\cos\alpha\cos\theta)}$

or $\frac{(A+B)^2}{(A-B)^2} = \frac{(1+\cos\alpha)(1-\cos\theta)}{(1+\cos\theta)(1-\cos\alpha)}$

$= \frac{\tan^2\theta/2}{\tan^2\theta/2}$

or $\tan\frac{\alpha}{2} = \left(\frac{A-B}{A+B}\right)\tan\frac{\theta}{2}$

19 **(b)**

$\vec{S} = (10\hat{i} - 2\hat{j} + 7\hat{k}) - (6\hat{i} + 5\hat{j} - 3\hat{k})$

$= 4\hat{i} - 7\hat{j} + 10\hat{k}$

$\vec{W} = \vec{F} \cdot \vec{S}$

$= (10\hat{i} - 3\hat{j} + 6\hat{k}) \cdot (4\hat{i} - 7\hat{j} + 10\hat{k})$

$= (40 + 21 + 60)$J=121 J

20 **(c)**

Because horizontal velocity is same for coin and the observer. So relative horizontal displacement will be zero

21 **(b)**

Difference in $\mathrm{KE} = \frac{1}{2}m\left[(\sqrt{5gr})^2 - \sqrt{gr}\right]^2$

$= 2mgr = 2 \times 1 \times 10 \times 1 = 20$ J

22 **(a)**

The maximum velocity for a banked road with friction,

$$v^2 = gr\left(\frac{\mu + \tan\theta}{1 - \mu\tan\theta}\right)$$

$$\Rightarrow v^2 = 9.8 \times 1000 \times \left(\frac{0.5+1}{1-0.5\times 1}\right) \Rightarrow v$$
$$= 172 m/s$$

23 **(a)**

$$I = \int \cos^2 3x \, dx$$
$$I = \int \frac{1}{2}(1+\cos 6x)dx$$
$$I = \frac{1}{2}\left(x + \frac{\sin 6x}{6}\right) + c$$

24 **(a)**

Here, $\vec{v_1}$=30km h^{-1} due north $= \overrightarrow{OA}$

$\vec{v_2} = 40 kmh^{-1}$ due east $= \overrightarrow{OB}$

Change in velocity in 20 s

$\Delta\vec{v} = \vec{v_2} - \vec{v_1} = \vec{v_2} + (-\vec{v_1})$

$= \overrightarrow{OB} + \overrightarrow{OC} = \overrightarrow{OD}$

$|\Delta\vec{v}| = \sqrt{v_2^2 + v_1^2} = \sqrt{40^2 + 30^2}$

$= 50 \text{ kmh}^{-1}$

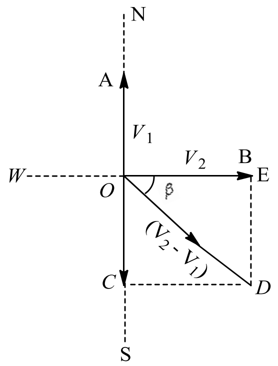
Acceleration , $\vec{a} = \frac{|\Delta \vec{v}|}{\Delta t}$

$= \frac{50}{20} = 2.5 \text{ kmh}^{-2}$

Tan $\beta = \frac{v_1}{v_2} = \frac{30}{40}$

$= 0.75 = \tan 37°$

$\therefore \beta = 37°$ north of east



25 **(b)**

$R^2 = P^2 + P^2 + 2P^2\cos\theta$ or $R^2 = 2P^2 + 2P^2\cos\theta$

or $R^2 = 2P^2(1+\cos\theta)$

or $R^2 = 2P^2\left(1 + 2\cos^2\frac{\theta}{2} - 1\right)$

or $R^2 = 4P^2\cos^2\frac{\theta}{2}$

or $R = 2P\cos\frac{\theta}{2}$

26 **(d)**

$$h = ut - \frac{1}{2}gt^2$$
$$= 10 \times 1 - \frac{1}{2} \times 10 \times 1$$
$$= 10 - 5 = 5m$$

27 **(d)**

If t_1 and t_2 are time of ascent and descent respectively then time of flight $T = t_1 + t_2 = \frac{2u}{g}$

$$\Rightarrow u = \frac{g(t_1+t_2)}{2}$$

28 **(a)**

$$S_n = u + \frac{a}{2}(2n-1) \Rightarrow S_3 = 0 + \frac{4/3}{2}(2\times 3 - 1)$$
$$\Rightarrow S_3 = \frac{10}{3} m$$

29 **(d)**

Body reaches the point of projection with same velocity

30 **(d)**

$$u = at, x = \int u\,dt = \int at\,dt = \frac{at^2}{2}$$

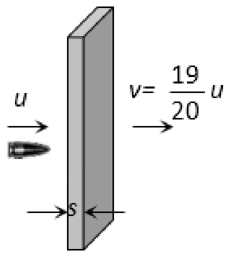
For $t = 4$ sec, $x = 8a$

31 **(d)**

$$U \propto x^2 \Rightarrow \frac{U_2}{U_1} = \left(\frac{x_2}{x_1}\right)^2 = \left(\frac{0.1}{0.02}\right)^2 = 25 \therefore U_2$$
$$= 25\,U$$

32 **(c)**

Let the thickness of one plank be s



If bullet enters with velocity u then it leaves with velocity

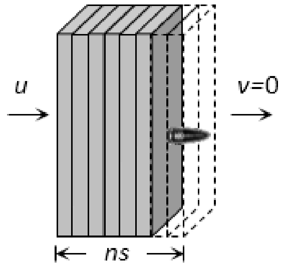
$$v = \left(u - \frac{u}{20}\right) = \frac{19}{20}u$$

From $v^2 = u^2 - 2as$

$$\Rightarrow \left(\frac{19}{20}u\right)^2 = u^2 - 2as \Rightarrow \frac{400}{39} = \frac{u^2}{2as}$$

Now if the n planks are arranged just to stop the bullet then again from

$$v^2 = u^2 - 2as$$



$0 = u^2 - 2ans$

$\Rightarrow n = \frac{u^2}{2as} = \frac{400}{39}$

$\Rightarrow n = 10.25$

As the planks are more than 10 so we can consider $n = 11$

33 **(d)**

Using conservation of linear momentum, we have

$mv_0 = mv + 2mv$

Or $v = \frac{v_0}{3}$

Using conservation of energy, we have

$\frac{1}{2}mv_0^2 = \frac{1}{2}kx_0^2 + \frac{1}{2}(3m)v^2$

Where x_0=compression in the spring ,

$\therefore mv_0^2 = kx_0^2 + (3m)\,\frac{v_0^2}{9}$

Or $kx_0^2 = mv_0^2 - \frac{mv_0^2}{3}$

Or $kx_0^2 = \frac{2mv_0^2}{3}$

$\therefore k = \frac{2mv_0^2}{3x_0^2}$

34 **(b)**

According to question, $\frac{1}{2}m_A v_A^2 = \frac{1}{2}m_B v_B^2$

$\Rightarrow \frac{v_A}{v_B} = \sqrt{\frac{m_B}{m_A}} = \sqrt{\frac{5}{20}} = \frac{1}{2}$

Using Impulse Momentum

$\frac{F\Delta t_A}{F\Delta t_B} = \frac{m_A \Delta v_A}{m_B \Delta v_B} \Rightarrow \frac{\Delta t_A}{\Delta t_B} = \frac{20}{5} \times \frac{1}{2} = 2$

35 **(b)**

Power delivered to the body

$P = F.v = mav$

Since, body undergoes one dimensional motion and is initially at rest, so

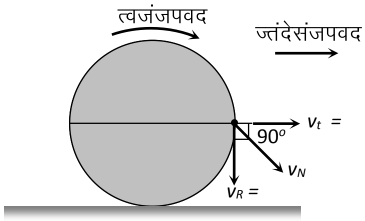
$v = 0 + at$

$\therefore P = ma^2 t$ or $P \propto t$

36 **(c)**

v_t = velocity due to translator motion

v_R = velocity due to rotational motion



$v_N = \sqrt{v_t^2 + v_R^2} = \sqrt{v^2 + v^2} = \sqrt{2v} = 2\sqrt{2}m/s$

37 **(c)**

Kinetic energy $E = \frac{L^2}{2I}$

If angular momenta are equal, then $E \propto \frac{1}{I}$

Kinetic energy $E = K$ (given in problem)

If $I_A > I_B$ then $K_A < K_B$.

38 **(a)**

In the pulley arrangement $|\vec{a}_1| = |\vec{a}_2| = a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) g$

But $\vec{a}_1$ is in downward direction and in the upward direction ie, $\vec{a}_2 = -\vec{a}_1$

$\therefore$ Acceleration of centre of mass

$$\vec{a}_{CM} = \frac{m_1\vec{a}_1 + m_2\vec{a}_2}{m_1 + m_2}$$

$$= \frac{m_1\left[\frac{m_1 - m_2}{m_1 + m_2}\right] g - m_2\left[\frac{m_1 - m_2}{m_1 + m_2}\right] g}{(m_1 + m_2)}$$

$$= \left[\frac{m_1 - m_2}{m_1 + m_2}\right]^2 g$$

39 **(c)**

Momentum of 6 kg piece p_2 = momentum of 3 kg piece

$p_1 = m_1 v_1 = 3 \times 16 = 48$ kg ms^{-1}

Kinetic energy of 6 kg piece $K_2 = \frac{p_2^2}{2m_2} = \frac{4 \times 48}{2 \times 8} = 192$ J.

40 **(a)**

Velocity of bullet at highest point of its trajectory = 50 $\cos\theta$ in horizontal direction.

As bullet of mass m collides with pendulum bob of mass $3m$ and two stick together, their common velocity

$$v' = \frac{m_1 50 \cos\theta}{m + 3n} = \frac{25}{2}\cos\theta \text{ms}^{-1}$$

As now under this velocity v' pendulum bob goes up to an angel 120°, hence

$$\frac{v'^2}{2g} = h = l(1 - \cos 120°) = \frac{10}{3}\left[1 - \left(f - \frac{1}{2}\right)\right] = 5$$

$\Rightarrow \; v'^2 = 2 \times 10 \times 5 = 100$ or $v' = 10$

Comparing two answer of v', we get

$\frac{25}{2}\cos\theta = 10 \Rightarrow \cos\theta = \frac{4}{5}$ or $\theta = \cos^{-1}\left(\frac{4}{5}\right)$

Matrix Match Type

41 **(d)**

(1) Planck's constant

$$[h] = \frac{[E]}{[v]}$$

$$= \frac{[\text{ML}^2\text{T}^{-2}]}{[\text{T}^{-1}]} = [\text{ML}^2\text{T}^{-1}]$$

(2) Gravitational constant

$$[G] = \frac{[Fr^2]}{[m_1 m_2]}$$

$$= \frac{[\text{MLT}^{-2}][\text{L}^2]}{[\text{M}^2]}$$

$$= [\text{M}^{-1}\text{L}^3\text{T}^{-2}]$$

(3) Bulk modulus

$$[B] = \frac{[\text{Normal stress}]}{[\text{Volumetric strain}]}$$

$$= [\text{ML}^{-1}\text{T}^{-2}]$$

(4) Coefficient of viscosity,

$$\eta = \frac{[F]}{[A][dvdy]} = \frac{[\text{MLT}^{-2}][\text{L}]}{[\text{L}^2][\text{LT}^{-1}]}$$

$$= [\text{ML}^{-1}\text{T}^{-1}]$$

Assertion - Reasoning Type

42 **(b)**

In uniform circular motion of a body the speed remains constant but velocity changes as direction of motion changes

As linear momentum = mass × velocity, therefore linear momentum of a body changes in a circle

On the other hand, if the body is moving uniformly along a straight line then its velocity remains constant and hence acceleration is equal to zero. So force is equal to zero

43 **(c)**

As ω (angular velocity) has the dimension of $[T^{-1}]$ not $[T]$

44 **(c)**

Cross product of vectors is anticommutative. Therefore, $\vec{\mathbf{v}} = \vec{\omega} \times \vec{\mathbf{r}} = -\vec{\mathbf{r}} \times \vec{\omega}$. Choice (c) is correct

45 **(a)**

The body is able to move in a circular path due to centripetal force. The centripetal force in case of vehicle is provided by frictional force. Thus if the value of frictional force μmg is less than centripetal force, then it is not possible for a vehicle to take a turn and the body would overturn

Thus condition for safe turning of vehicle is, $\mu mg \geq \frac{mv^2}{r}$