

## SAFE HANDS &amp; IIT-ian's PACE

LEAP TEST-06 (NEET) ANS KEY Dt.14-12-2023

PHYSICS	
Q. NO.	[ANS]
1	A
2	D
3	A
4	C
5	B
6	D
7	BONUS
8	B
9	C
10	A
11	D
12	B
13	A
14	A
15	D
16	C
17	BONUS
18	B
19	A
20	C
21	D
22	B
23	B
24	C
25	C
26	B
27	D
28	A
29	B
30	C
31	C
32	D
33	B
34	A
35	BONUS
36	B
37	C
38	B
39	A
40	B
41	BD
42	B
43	B
44	BONUS
45	B

CHEMISTRY	
Q. NO.	[ANS]
46	A
47	D
48	B
49	A
50	B
51	A
52	B
53	A
54	B
55	C
56	D
57	D
58	B
59	A
60	D
61	A
62	C
63	D
64	B
65	B
66	A
67	A
68	D
69	A
70	C
71	C
72	C
73	B
74	A
75	D
76	A
77	A
78	A
79	C
80	A
81	B
82	C
83	C
84	B
85	A
86	C
87	C
88	D
89	D
90	A

BIOLOGY	
Q. NO.	[ANS]
91	D
92	A
93	C
94	B
95	A
96	A
97	B
98	C
99	C
100	D
101	B
102	C
103	A
104	B
105	B
106	B
107	B
108	C
109	C
110	B
111	D
112	D
113	A
114	A
115	C
116	A
117	A
118	B
119	D
120	A
121	C
122	C
123	B
124	D
125	B
126	A
127	A
128	D
129	A
130	B
131	C
132	B
133	D
134	B
135	B

BIOLOGY	
Q. NO.	[ANS]
136	C
137	B
138	D
139	D
140	B
141	B
142	C
143	C
144	D
145	D
146	D
147	A
148	C
149	D
150	C
151	B
152	D
153	D
154	C
155	B
156	A
157	C
158	A
159	A
160	C
161	A
162	B
163	C
164	A
165	A
166	C
167	A
168	C
169	A
170	C
171	D
172	D
173	D
174	C
175	B
176	D
177	A
178	C
179	D
180	A



### Single Correct Answer Type

1 (a)

$$v = \sqrt{2gR} \therefore \frac{v_1}{v_2} = \sqrt{\frac{g_1}{g_2} \times \frac{R_1}{R_2}} = \sqrt{g \times K} = (Kg)^{1/2}$$

2 (d)

Gravitational potential energy is given as

$$U = -\frac{GMm}{r}$$
$$U_1 = -\frac{GMm}{r_1}, U_2 = -\frac{GMm}{r_2}$$

As  $r_2 > r_1$ , hence,

$$U_1 - U_2 = GMm \left[ \frac{r_2 - r_1}{r_1 r_2} \right] \text{ is positive}$$

$$\text{ie, } U_1 > U_2$$

$$\text{or } U_2 < U_1$$

ie, gravitational potential energy increases.

3 (a)

$$g = \frac{4}{3}\pi G\rho R \Rightarrow g \propto \rho R \Rightarrow \frac{g_e}{g_m} = \frac{\rho_e}{\rho_m} \times \frac{R_e}{R_m}$$
$$\Rightarrow \frac{6}{1} = \frac{5}{3} \times \frac{R_e}{R_m} \Rightarrow R_m = \frac{5}{18}R_e$$

4 (c)

$$H = \frac{u^2}{2g} \Rightarrow H \propto \frac{1}{g} \Rightarrow \frac{H_B}{H_A} = \frac{g_A}{g_B}$$

$$\text{Now } g_B = \frac{g_A}{12} \text{ as } g \propto \rho R$$

$$\therefore \frac{H_B}{H_A} = \frac{g_A}{g_B} = 12$$

$$\Rightarrow H_B = 12 \times H_A = 12 \times 1.5 = 18m$$

5 (b)

Gravitational force provides the required centripetal force ie,

$$m\omega^2 R = \frac{GMm}{R^2}$$

$$\Rightarrow \frac{m4\pi^2}{T^2} = \frac{GMm}{R^2}$$

$$\Rightarrow T^2 \propto R^{7/2}$$

6 (d)

$$v_0 = \sqrt{\frac{GM}{r}} = \sqrt{\frac{gR^2}{R+h}}$$

7 (d)

Gravitational potential energy of body will be

$$E = \frac{GM_e m}{r}$$

$$\text{At } r = 2R,$$

$$E_1 = -\frac{GM_e m}{(2R)}$$

$$\text{At } r = 3R$$

$$E_2 = -\frac{GM_e m}{(3R)}$$

Energy required to move a body of mass  $m$  from on orbit of radius  $2R$  to  $3R$  is

$$\Delta E = \frac{GM_e m}{R} \left[ \frac{1}{2} - \frac{1}{3} \right] = \frac{GM_e m}{6R}$$

8 (b)

$$\frac{T^2}{r^3} = \text{constant} \Rightarrow T^2 r^{-3} = \text{constant}$$

9 (c)

$$\frac{T_{\text{mercury}}}{T_{\text{earth}}} = \left( \frac{r_{\text{mercury}}}{r_{\text{earth}}} \right)^{3/2} = \left( \frac{6 \times 10^{10}}{1.5 \times 10^{11}} \right)^{3/2} = \frac{1}{4}$$

(approx.)

$$\therefore T_{\text{mercury}} = \frac{1}{4} \text{ year}$$

10 (a)

As in case of elliptic orbit of a satellite mechanical energy

$E = -(GMm/2a)$  remains constant, at any position of satellite in the orbit,

$$\text{KE} + \text{PE} = -\frac{GMm}{2a} \quad \dots(i)$$

Now, if at position  $r$ ,  $v$  is the orbital speed of satellite

$$\text{KE} = \frac{1}{2} mv^2 \quad \text{and} \quad \text{PE} = -\frac{GMm}{r} \quad \dots(ii)$$

So, from Eqs. (i) and (ii), we have

$$\frac{1}{2} mv^2 - \frac{GMm}{r} = -\frac{GMm}{2a}, \text{ i.e., } v^2 = GM \left[ \frac{2}{r} - \frac{1}{a} \right]$$

11 (d)

$$\frac{K_A}{K_B} = \frac{r_B}{r_A} = \left( \frac{R + h_B}{R + h_A} \right) = \left( \frac{R + 2R}{R + R} \right) = \frac{3}{2}$$

12 (b)

From Kepler's third law of planetary motion

$$T^2 \propto R^3$$

Given,  $T_1 = 1, T_2 = 8, R_1 = R$

$$\therefore \frac{T_1^2}{T_2^2} = \frac{R_1^3}{R_2^3}$$

$$R_2^3 = R_1^3 \frac{T_2^2}{T_1^2}$$

$$R_2^3 = R_1^3 \times (8)^2$$

$$R_2^3 = R^3 \times (2^3)^2$$

$$\Rightarrow R_2 = R \times 4 = 4R$$

13 (a)

$g' = \frac{GM}{(R+h)^2}$ , acceleration due to gravity at height  $h$

$$\Rightarrow \frac{g}{9} = \frac{GM}{R^2} \cdot \frac{R^2}{(R+h)^2}$$

$$= g \left( \frac{R}{R+h} \right)^2$$

$$\Rightarrow \frac{1}{9} = \left( \frac{R}{R+h} \right)^2$$

$$\Rightarrow \frac{R}{R+h} = \frac{1}{3}$$

$$\Rightarrow 3R = R+h$$

$$\Rightarrow 2R = h$$

14 (a)

Since the gravitational field is conservative field, hence, the work done in taking a particle from one point to another in a gravitational field is path independent

15 (d)

At height  $h'$ ,  $\frac{g'}{g} = 1 - \frac{2h}{R} = \frac{90}{100}$

or  $\frac{2h}{R} = 1 - \frac{90}{100} = \frac{10}{100} = \frac{1}{10}$

or  $R = 20h = 20 \times 320 = 6400 \text{ km}$

At dept  $d$ ,  $\frac{g'}{g} = 1 - \frac{d}{R} = \frac{95}{100}$

or  $\frac{d}{R} = 1 - \frac{95}{100} = \frac{5}{100} = \frac{1}{20}$

or  $d = \frac{R}{20} = \frac{6400}{20} = 320 \text{ km}$

16 (c)

$$T = 2\pi \sqrt{\frac{r^3}{GM}} \Rightarrow T^2 = \frac{4\pi^2}{GM} (R + h)^3$$

$$\Rightarrow R + h = \left[ \frac{GMT^2}{4\pi^2} \right]^{1/3} \Rightarrow h = \left[ \frac{GMT^2}{4\pi^2} \right]^{1/3} - R$$

17 (b)

From Kepler's third law of planetary motion also known as law of periods

$$T^2 = kr^3$$

Where  $T$  is time period and  $r$  the mean distance from the sun. Hence, greater is the distance of planet from sun, greater is its period of revolution.

18 (b)

$v_e = \sqrt{2} v_o$ , i.e. if the orbital velocity of moon is increased by factor of  $\sqrt{2}$  then it will escape out from the gravitational field of earth

20 (c)

Force on the body =  $\frac{GMm}{x^2}$

To move it by a small distance  $dx$ ,

Work done =  $F dx = \frac{GMm}{x^2} dx$

Total work done =  $GMm \int_R^{R+h} \frac{dx}{x^2} = \left[ \frac{-GMm}{x} \right]_R^{R+h}$

$$= GMm \left[ \frac{1}{R} - \frac{1}{R+h} \right]$$

$$= \left[ \frac{(R+h) - R}{R(R+h)} \right] = \frac{GMmh}{R(R+h)}$$

$$\frac{GM}{R^3} \times \frac{mhR}{R+h} = \frac{gmhR}{R+h} = \frac{PRh}{R+h}$$

21 (d)

$$T = 2\pi \sqrt{\frac{l}{g}} \Rightarrow T \propto \frac{1}{\sqrt{g}} \Rightarrow \frac{T_p}{T_e} = \sqrt{\frac{g_e}{g_p}} = \sqrt{\frac{2}{1}} \Rightarrow T_p = \sqrt{2}T_e$$

22 (b)

$$\frac{d^2x}{dt^2} = -\alpha x \quad \dots(i)$$

We know,

$$a = \frac{d^2y}{dt^2} = -\omega^2 x \quad \dots(ii)$$

From Eqs.(i) and (ii), we have

$$\omega^2 = \alpha$$

$$\omega = \sqrt{\alpha}$$

or  $\frac{2\pi}{T} = \sqrt{\alpha}$

$\therefore T = \frac{2\pi}{\sqrt{\alpha}}$

23 (b)

Motion given here is SHM starting from rest

24 (c)

The average acceleration of a particle performing SHM over one complete oscillation is zero.

26 (b)

$$x = A \cos(\omega t + \theta);$$

$$\text{Velocity, } v = \frac{dx}{dt} = -A\omega \sin(\omega t + \theta)$$

$$= -A\omega \sqrt{1 - \cos^2(\omega t + \theta)}$$

$$= -A\omega \sqrt{1 - x^2/A^2} = -\omega \sqrt{A^2 - x^2}$$

$$\text{Here, } v = \pi \text{ cms}^{-1}, x = 1 \text{ cm}, \omega = \pi \text{ s}^{-1}$$

$$\text{So } \pi = -\pi \sqrt{A^2 - 1^2}$$

$$\text{or } (-1)^2 = A^2 - 1 \text{ or } A^2 = 2$$

$$\text{or } A = \sqrt{2} \text{ cm}$$

27 (d)

For simple harmonic motion,  $y = a \sin \omega t$

$$\therefore y = a \sin \left( \frac{2\pi}{T} \right) t \quad (\text{at } t=2 \text{ s})$$

$$y_1 = a \sin \left[ \left( \frac{2\pi}{16} \right) \times 2 \right]$$

$$= a \sin \left( \frac{\pi}{4} \right) = \frac{a}{\sqrt{2}} \quad \dots(i)$$

At  $t=4$  s or after 2 s from mean position.

$$y_1 = \frac{a}{\sqrt{2}}, \text{ velocity} = 4 \text{ ms}^{-1}$$

$$\therefore \text{Velocity} = \omega \sqrt{a^2 - y_1^2}$$

$$\text{or } 4 = \left( \frac{2\pi}{16} \right) \sqrt{a^2 - \frac{a^2}{2}} \quad [\text{From Eq. (i)}]$$

$$\text{or } 4 = \frac{\pi}{8} \times \frac{a}{\sqrt{2}}$$

$$\text{or } a = \frac{32\sqrt{2}}{\pi} \text{ m}$$

28 (a)

The given equation is written as,

$$y = 3 \sin \left( 100 t + \frac{\pi}{6} \right) \quad \dots(i)$$

The general equation of simple harmonic motion is written as

$$y = a \sin(\omega t + \phi) \quad \dots(ii)$$

Equating Eqs. (i) and (ii), we get

$$a = 3, \omega = 100$$

Maximum velocity,  $v = a\omega$

$$= 3 \times 100 = 300 \text{ ms}^{-1}$$

29 (b)

Length of the line = Distance between extreme positions of oscillation = 4 cm

So, Amplitude  $a = 2 \text{ cm}$

also  $v_{\max} = 12 \text{ cm/s}$

$$\therefore v_{\max} = \omega a = \frac{2\pi}{T} a$$

$$\Rightarrow T = \frac{2\pi a}{v_{\max}} = \frac{2 \times 3.14 \times 2}{12} = 1.047 \text{ s}$$

30 (c)

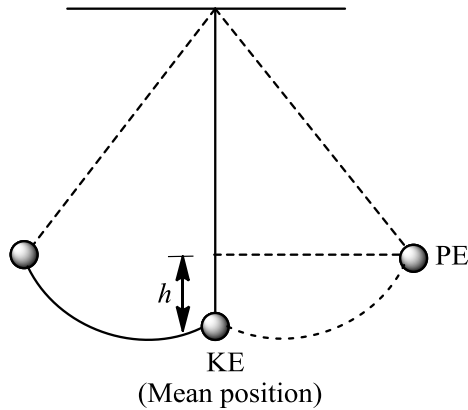
$$\text{When } t = \frac{T}{12}, \text{ then } x = A \sin \frac{2\pi}{T} \times \frac{T}{12} = \frac{A}{2}$$

$$\text{KE} = \frac{1}{2} m v^2 = \frac{1}{2} m \omega^2 (r^2 - x^2)$$

$$\begin{aligned}
&= \frac{1}{2} m\omega^2 \left( A^2 - \frac{A^2}{4} \right) \\
&= \frac{3}{4} \left( \frac{1}{2} m\omega^2 A^2 \right) \\
\text{PE} &= \frac{1}{2} m\omega^2 x^2 = \frac{1}{4} \left( \frac{1}{2} m\omega^2 A^2 \right) \\
\frac{\text{KE}}{\text{PE}} &= \frac{3}{1}
\end{aligned}$$

31 (c)

The bob possess kinetic energy at its mean position which gets converted to potential energy at height  $h$ . But the total energy remains converted.



Hence, we have

$$\text{KE} = \text{PE}$$

Let velocity of the bob at mean position be  $v$  and  $m$  be its mass, then we have

$$\frac{1}{2}mv^2 = mgh$$

$$\Rightarrow v = \sqrt{2gh}$$

$$\text{Putting } g = 9.8 \text{ ms}^{-2}, h = 0.1 \text{ m}$$

$$\therefore v = \sqrt{2 \times 9.8 \times 0.1} = 1.4 \text{ ms}^{-1}$$

32 (d)

$$y = a \sin \omega t; v = \frac{dy}{dt} = a\omega \cos \omega t$$

$$= a\omega \sin(\omega t + \pi/2)$$

$$\text{Acceleration } A = \frac{dv}{dt} = -\omega^2 a \sin \omega t$$

$$= \omega^2 a \sin(\omega t + \pi)$$

33 (b)

Maximum acceleration = Maximum velocity  $\times \pi$

$$\text{ie, } \omega^2 A = \pi \omega A$$

where  $A$  is amplitude and  $\omega$  is angular velocity.

$$\Rightarrow \omega = \pi$$

$$\Rightarrow \frac{2\pi}{T} = \pi$$

$$\Rightarrow T = 2 \text{ s}$$

34 (a)

At the time  $t = \frac{T}{4} = \frac{4}{4} = 1$  sec after passing from mean position, the body reaches at it's extreme position.

At extreme, position velocity of body becomes zero

35 (b)

$$y = 4 \cos^2 \left( \frac{t}{2} \right) \sin 1000 t$$

$$\Rightarrow y = 2(1 + \cos t) \sin 1000 t$$

$$\Rightarrow y = 2 \sin 1000 t + 2 \cos t \sin 1000 t$$

$$\Rightarrow y = 2 \sin 1000 t + \sin 999 t + \sin 1001 t$$

It is a sum of three S.H.M.

36 (b)

PE varies from zero to maximum. It is always positive sinusoidal function

37 (c)

$$y = A \sin PT + B \cos PT$$

Let  $A = r \cos \theta$ ,  $B = r \sin \theta$

$\Rightarrow y = r \sin(PT + \theta)$  which is the equation of SHM

38 (b)

$$n = \frac{1}{2\pi} \sqrt{\frac{g}{l}} \Rightarrow n \propto \frac{1}{\sqrt{l}} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{L_2}{2L_2}}$$

$$\Rightarrow \frac{n_1}{n_2} = \frac{1}{\sqrt{2}} \Rightarrow n_2 = \sqrt{2}n_1 \Rightarrow n_2 > n_1$$

$$\text{Energy } E = \frac{1}{2} m \omega^2 a^2 = 2\pi^2 m n^2 a^2$$

$$\Rightarrow \frac{a_1^2}{a_2^2} = \frac{m_2 n_2^2}{m_1 n_1^2} \quad [\because E \text{ is same}]$$

Given  $n_2 > n_1$  and  $m_1 = m_2 \Rightarrow a_1 > a_2$

39 (a)

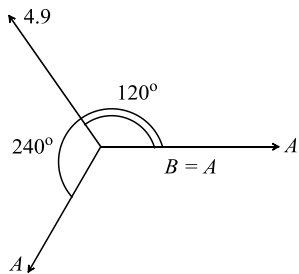
On the inclined plane, the effective acceleration due to gravity

$$g' = g \cos 30^\circ$$

$$= g \times \frac{\sqrt{3}}{2}$$

$$\therefore T = 2\pi \sqrt{\frac{l}{g'}} = 2\pi \sqrt{\frac{2l}{\sqrt{3}g}}$$

40 (b)



So  $B = A$ ,  $\phi = 240^\circ = \frac{4\pi}{3}$

**Assertion - Reasoning Type**

42 (b)

Acceleration due to gravity,

$$g' = g - R\omega^2 \cos^2 \lambda$$

At equator,  $\lambda = 0^\circ$  i.e.  $\cos 0^\circ = 1 \therefore g_e = g - R\omega^2$

At poles,  $\lambda = 90^\circ$  i.e.  $\cos 90^\circ = 0 \therefore g_p = g$

Thus,  $g_p = g_e = g - g + R\omega^2 = R\omega^2$

Also, the value of  $g$  is maximum at poles and minimum at equators

43 (b)

If root mean square velocity of the gas molecules is less than escape velocity from that planet (or satellite) then atmosphere will remain attached with that planet and if  $v_{rms} > u_{escape}$  then there will be no atmosphere on the planet. This is the reason for no atmosphere at moon



44 (c)

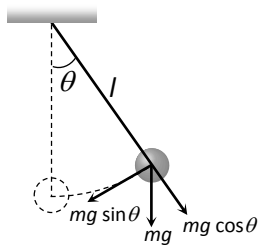
Amplitude of oscillation for a forced, damped oscillator is  $A = \frac{F_0/m}{\sqrt{(\omega^2 - \omega_0^2)^2 + (b\omega/m)^2}}$ , where  $b$  is constant related to the strength of the resistive force,  $\omega_0 = \sqrt{k/m}$  is natural frequency of undamped oscillator ( $b = 0$ )

When the frequency of driving force ( $\omega$ )  $\approx \omega_0$ , then amplitude  $A$  is very larger.

For  $\omega < \omega_0$  or  $\omega > \omega_0$ , the amplitude decreases

45 (b)

In simple pendulum, when bob is in deflection position, the tension in the string is  $T = mg \cos \theta + \frac{mv^2}{l}$ . Since the value of  $\theta$  is different at different positions, hence tension in the string is not constant throughout the oscillation



At end points  $\theta$  is maximum; the value of  $\cos \theta$  is least, hence the value of tension in the string is least. At the mean position, the value of  $\theta = 0^\circ$  and  $\cos 0^\circ = 1$ , so the value of tension is largest

Also velocity is given by  $v = \omega \sqrt{a^2 - y^2}$  which is maximum when  $y = 0$ , at mean position