SAFE HANDS & IIT-ian's PACE

MONTHLY MAJOR TEST-07 (NB-15 NEET) ANS KEY Dt. 05-05-2023

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

PHYSICS SOLUTIONS

01. R = $\frac{V}{I} = \frac{20 \pm 1}{2.5 \pm 0.5}$ = 8 ± ΔR

the error in the measurement is

= $\frac{\Delta V}{V} + \frac{\Delta I}{I} = \frac{1}{20} + \frac{0.5}{2.5}$ = 0.05 + 0.2

= 0.25

ΔR = 0.25 R = 0.25 × 8 = 2

Thus the resistance of the wire with the error is = 8 ± 2 ohm.

Hence correct answer is (C).

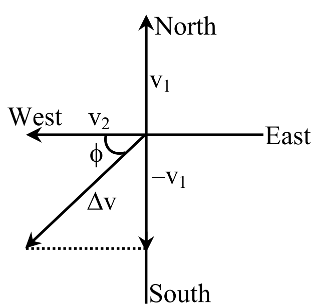
02. As shown in fig for quarter revolution

$\Delta\vec{v} = \vec{v}_2 - \vec{v}_1$ and θ = 90º,

So $\Delta\vec{v} = \sqrt{v^2 + v^2} = (\sqrt{2})v$

ϕ = tan⁻ $\left(\frac{v}{v}\right)$ = 45º

$\Delta\vec{v} = \sqrt{2}v$ south west.



Hence correct answer is (A).

03. Car covers a distance s before coming to rest using relation as $v^2 = u^2 + 2as$

⇒ s = $\frac{20 \times 20}{4 \times 2}$ = 50 m

To avoid the clash the remaining distance 100 – 50 = 50 m must be covered by the car with uniform velocity 20 m/s during the reaction time Δt.

Hence $\frac{50}{\Delta t}$ = 20 or Δt = $\frac{50}{20}$ = 2.5 sec

Hence correct answer is (B)

04. Let s be the distance between that two spots. Also assume that the velocity of the motor boat in still water is v and the velocity of flow of water is u.

Then , for downward journey,

$s/t_1 = v + u$ ...(1)

For upward journey,

$s/t_2 = v - u$ ...(2)

Adding eq. (1) to (2),

$s/t_1 + s/t_2 = 2v$

or t = $\frac{s}{v} = \frac{2t_1t_2}{(t_1 + t_2)} = \frac{2 \times 8 \times 12}{(8 + 12)}$ = 9.6 hr

Hence correct answer is (B)

05. Let the ball B hits the ball A after t sec

The X-component of velocity of A is

v_0 cos 37º = 700 cos 37º

The X-compoment of position of B is

300 cos 37º

The collision will take place when the X-coordinate of A is the same as that of B.

As the collision takes place at a time t, hence

700 cos 37º × t = 300 cos 37º

or t = (300/700) = (3/7) sec

In this time the ball B has fallen through a distance

y = – 1/2 gt^2 (Free fall of body B)

= – 1/2 × 980 × $(3 / 7)^2$ = – 90 cm

Hence the ball B falls a distance 90 cm

Hence correct answer is (B)

06. Total mass = 80 + 40 = 120 kg

The rope cannot with stand this load so the fire man should slide down the rope with some acceleration

∴ The maximum tension = 100 × 9.8 N

m(g – a) = tension,120 (9.8–a) =100 × 9.8

$\Rightarrow$ a = 1.63 m/s^2

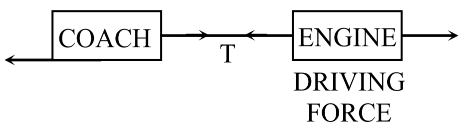
Hence correct answer is (C)

07. The engine, coach, coupling and resistance are, shown in fig

Driving force = 4500 N

Opposing force (Resistance)

$= \frac{(5+4)10^4}{100}$ = 900 N



Resultant force = 4500 – 900 = 3600 N

Mass of engine and coach = 9 × 10^4 kg

According to Newton's law, F = ma

$\therefore$ 3600 = 9 × 10^4 a

or a = (3600) / (9 × 10^4) = 0.04 m/sec^2

So acceleration of the train = 0.04 m/sec^2

Now considering the equilibrium of the coach only, we have

(T – R) = 4 × 10^4 × 0.04 ($\because$ F = ma)

or $T - \frac{4\times10^4}{100}$ = 4 × 10^4 × 0.04,

T = 4 × 10^4 × 0.04 + 4 × 10^2

= 1600 + 400 = 2000 N

Hence correct answer is (A)

08. b

09. Δk = W (Work energy theorem)

$\left(\frac{1}{2}mv^2 - 0\right)$ = FS

$\frac{1}{2}$ mv^2 = μmgS

$S = \frac{v^2}{2\mu g}$ v $\rightarrow$ same

$\mu \rightarrow$ same

S $\rightarrow$ same

10. Let m_1 and m_2 be the masses of electron and hydrogen atom respectively. If u_1 and v_1 be the initial and final velocities of electron, then

initial kinetic energy of electron

$K_i = \left(\frac{1}{2}\right) m u_1^2$

final kinetic energy of electron

$K_f = \left(\frac{1}{2}\right) m v_1^2$

Fractional decrease in K.E.,

$\frac{K_i - K_f}{K_i} = 1 - \frac{v_1^2}{u_1^2}$ .... (1)

For such a collision, we have

$v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1$

$\therefore \frac{v_1}{u_1} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)$ ....(2)

From eqs. (1) and (2) we have

$\frac{K_i - K_f}{K_i} = 1 - \left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2$

$= \frac{4m_1m_2}{(m_1 + m_2)^2}$

or $\frac{K_i - K_f}{K_i} = \frac{4(m_2/m_1)}{(1 + m_2/m_1)^2}$

$= \frac{4 \times 1850}{(1+1850)^2}$

= 0.00217 = 0.217%

11. a

12. $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$\frac{1}{2}k(.3)^2 = \frac{1}{2}(242 \times 10^4)\left(7.2\times\frac{5}{18}\right)^2$

$k = 107.5 \times 10^6$

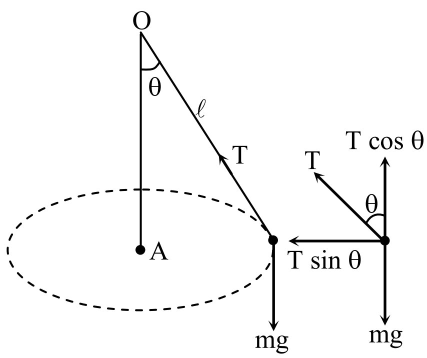
$U = \frac{1}{2}\ (.15)^2$

$= \frac{1}{2} \times 107.5 \times 10^6 \times (.15)^2$

$= 1.21 \times 10^6$ J

$= 121 \times 10^4$ J

13.



From figure

$T\cos\theta = mg$ ....(1)

$T\sin\theta = \frac{mv^2}{r} = \frac{mv^2}{\ell\sin\theta}$ .... (2)

From eq. (1) $T = \frac{mg}{\cos\theta}$

When the string is horizontal, θ must be 90º i.e., cos 90º = 0

$\therefore\ T = \frac{mg}{0} = \infty$

Thus the tension must be infinite which is impossible, so the string can not be in horizontal plane.

The maximum angle θ is given by the breaking tension of the string in the equation T cos θ = m.g

Here T (Maximum) = 8 N and m = 0.4 kg

$\therefore\ 8\cos\theta = 0.4 \times g = 0.4 \times 10 = 4$

$\cos\theta = (4/8) = \frac{1}{2}$, θ = 60º

The angle with horizontal = 90º – 60º = 30º

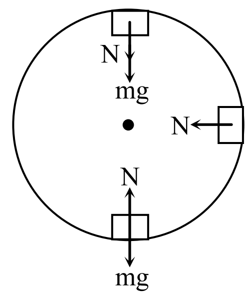
From equation (2), $8\sin 60º = \frac{0.4 \times v^2}{4\sin 60^o}$

$v^2 = \frac{32\sin^2 60^o}{0.4} = 80\sin^2 60º$

$\Rightarrow\ v = \sqrt{80}\ \sin 60º = 7.7$ m/sec

Hence correct answer is (A)

14. See fig, Here v = 360 km/hr = 100 m/sec



At lower point, $N - mg = \frac{mv^2}{R}$,

N = weight of the flyer = $mg + \frac{mv^2}{R}$

$N = 70 \times 10 + \frac{70\times(10000)}{500} = 2100$ N

At upper point, $N + mg = \frac{mv^2}{R}$,

$N = \frac{mv^2}{R} - mg = 1400 - 700 = 700$ N

At middle point, $N = \frac{mv^2}{R} = 1400$ N

Hence correct answer is (D)

15. As the belt does not slip, velocity of A = velocity B

i.e. $v_A = v_B$ or $r_A\omega_A = r_B\omega_B$

Given, $r_A = 20$ cm, $r_B = 30$ cm

and $\omega_B = 2\pi \times 100/60$ rad/sec

So, $20\ \omega_A = 30 \times 2\pi \times 100/60$

$= 100\ \pi$

or $\omega_A = 5\pi$ rad/sec

We know that, $\omega = \omega_0 + \alpha t$ or

$t = \frac{\omega}{\alpha}$ (as $\omega_0 = 0$)

$\therefore\ t = \frac{5\pi}{3.14} = 5$ sec

16. $I_A = \frac{m_A r_A^2}{2}$ and

$I_B = \frac{m_B r_B^2}{2}$,

$\therefore\ \frac{I_A}{I_B} = \frac{r_A^2}{r_B^2}$

($\because m_A = m_B$) ....(1)

Now, $m_A = \pi r_A^2 t\, d_A$

$m_B = \pi r_B^2 t\, d_B$

So, $\pi r_A^2 t d_A = \pi r_B^2 t\, d_B$

or $\frac{r_A^2}{r_B^2} = \frac{d_B}{d_A}$ .... (2)

From equations (1) and (2)

$\frac{I_A}{I_B} = \frac{d_B}{d_A}$. As $d_A > d_B$ hence $I_A < I_B$

17. According to conservation of angular momentum,

Angular momentum before collision = Angular momentum after collision ....(i)

Angular momentum of cylinder before collision

$J_1 = I\omega = (1/2)\, mR^2\, \omega$

$= (1/2) \times 2 \times 0.04 \times 3 = 0.12$ J.sec

Now from (i)

$J_{cyl} + m_p vR = (I + mR^2)\, \omega$

$\Rightarrow\ \omega = \frac{0.12 + 0.5 \times 5 \times 0.2}{(1/2) \times 2 \times 0.04 + 0.5 \times 0.04}$

$= 10.3$ rad/sec

Now energy of system before collision

$E = (1/2)\, I\omega^2 + (1/2)\, mv^2$

$= (1/2) \times (1/2) \times 2 \times 0.04 \times 9 + (1/2) \times 0.5 \times 25 = 6.43$ J

Energy of system after collision

$E' = (1/2)\, I'\omega'^2 = (1/2) \times (1/2\, M + m)\, R^2 \omega^2$

$= (1/2) \times (1/2 \times 2 + 0.5) \times 0.04 \times (10.32)^2$

$= 3.18$ J

Now $E - E_1 = 6.43 - 3.18 = 3.25$ J

18. (A)

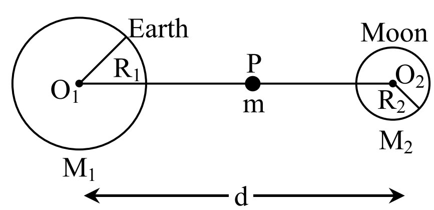
$$\frac{T^2}{r^3} = \frac{\left(\frac{2\pi r}{v_0}\right)^2}{r^3} = \frac{(2\pi r)^2}{r^3} \frac{1}{GM} r = \frac{4\pi^2}{GM}$$

$$\left[\therefore\ \frac{m v_0^2}{r} = \frac{GMm}{r^2},\ v_0^2 = \frac{GM}{r}\right]$$

Slope of $T^2 - r^3$ curve $= \tan\theta$

$$= \frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

19. (A) The P.E of the mass at d/2 due to the earth and moon is



$$U = -2\frac{GM_1 m}{d} - 2\frac{GM_2 m}{d}$$

or $U = -\frac{2Gm}{d}(M_1 + M_2)$

(Numerically)

$$\frac{1}{2} m V_e^2 = U$$

$$\Rightarrow\ V_e = 2\sqrt{\frac{G}{d}(M_1 + M_2)}$$

20. T = $\frac{PV}{R}$

at V = b, P = $\frac{a}{(1+1)}$ = $\frac{a}{2}$

∴ T = $\frac{ab}{2R}$

21. Using PV = nRT, we note that

$P_1V = nRT_1$

$P_1 (1.005)V = nR (T_1 + 2)$

(note $\Delta P = P_2 - P_1 = 0.005\ P_1$ and

ΔT = 2ºC = 2K

Dividing we get 1.005 = $\frac{T_1+2}{T_1}$

or $0.00T_1 = 2 \Rightarrow T_1 = 400$

Thus in 0ºC, t_1 = 400 – 273 = 127ºC.

22. As the bubble rises the pressure gets reduced for constant temperature, if P is the standard atmospheric pressure, then

$(P + \rho gh) V_0 = PV$

or $V = V_0\left(1+\frac{\rho gh}{P}\right)$

23. Q = $\frac{KA(Q_1-Q_2)t}{x}$

$\Rightarrow$ 4800 x 80 = $\frac{K\times3600\times100\times3600}{10}$

$\Rightarrow$ K = 0.003 cal/cm/ºC

24. ∵ Percentage increase in the amount of radiations emitted

∴ $\frac{E_2-E_1}{E_1}\times 100 = \frac{(1.5T_1)^4-T_1^4}{T_1^4}\times 100$

$\Rightarrow \frac{E_2-E_1}{E_1}\times 100 = [(1.5)^4 - 1] \times 10$

$\frac{E_2-E_1}{E_1}\times 100 = 400\%$

Hence the correct answer is (B)

25. Given t_W = 2 min, t_{alco}= 1 min

m_W = 50g, m_{alco} = 50 × 0.8 40g

S_W = 1 in cgs units, W = 2g

Therefore,

$\frac{dQ}{dt_A} = \frac{dQ}{dt_W}$

$\frac{m_AS_A+W}{t_A} = \frac{m_WS_W+W}{t_W}$

$\frac{40S_A+2}{1} = \frac{50\times1+2}{2}$

$80S_A + 4 = 50 + 2$

$S_A = \frac{48}{80}$

$S_A = \frac{6}{10}$ = 0.6 cal/gºC

26. Here, length of the rod,

Δx = 20 cm = 20×10^{-2} m

Diameter = 2 cm,

radius = r = 1 cm = 10^{-2} m

Area of cross section

a = $\pi r^2 = \pi(10^{-2})^2\ \pi$ sq. m

ΔT = 100 – 0 = 100°C

Mass of ice melted, m = 25g

As L = 80 cal.g–1

Heat conducted, ΔQ = mL = 25 × 80

= 2000 cal = 2000 × 4.2J

Δt = 5 min = 300 s

From $\frac{\Delta Q}{\Delta t} = KA\frac{\Delta T}{\Delta x}$

$K = \frac{2000\times4.2\times20\times10^{-2}}{300\times10^{-4}\pi\times100}$

$=1.78 Js^{-1}m^{-1}\ °C^{-1}$

27. The total surface area of the walls

= 2(60 cm × 60 cm + 60 cm × 30 cm + 60

cm × 30 cm)

= 1.44 m^2.

The thickness of the walls = 1.5 cm = 0.015 m.

The rate of heat flow into the box is

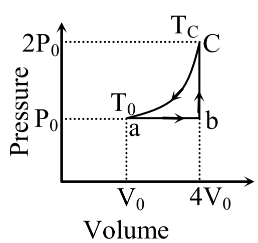
$\frac{\Delta Q}{\Delta t} = \frac{KA(\theta_1 - \theta_2)}{x}$

$= \frac{(0.04 W/m-^{o}C)(1.44 m^2)(40^{o}C)}{0.015 m}$ =154 W.

The rate at which the ice melts is

$= \frac{154 W}{3.36 \times 10^5 J/kg}$ = 0.46 g/s.

28.



$\because \frac{Pv}{T}$ = nR = constant

For any state of an ideal gas. Therefore

$\frac{P_a V_a}{T_a} = \frac{P_c V_c}{T_c}$ or $\frac{P_0 V_0}{T_0} = \frac{2P_0 4V_0}{T_c}$

T_c = $8T_0$

Thus change in internal energy

ΔU = $nC_V\Delta T$

$= 1 \times \frac{3}{2} \times R \times 7T_0 = \frac{21}{2} RT_0$

= 10.5 RT_0

29. Efficiency of Carnot engine

$\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{300}{900} = 2/3$

$\therefore$ η = 66.6 %

30. Coefficient of cubical expansion of metal is given by

$\gamma = \frac{\Delta V}{Vt}$

$\frac{\Delta V}{V} = \frac{0.12}{100}$, t = 20°C

$\therefore \gamma = \frac{0.12}{100 \times 20} = 6.0 \times 10^{-5}$ per °C

Coefficient of linear expansion

$\alpha = \frac{\gamma}{3} = \frac{6.0 \times 10^{-5}}{3} = 2.0 \times 10^{-5}$ Per °C

31. Let D_0 and D_t be diameters of hole at 0°C and t°C respectively.

Circumference of hole at 0°C

$\ell = 2\pi r_0 = \pi D_0$

Circumference of hole at t = 100° C

$\ell t = 2\pi r_t = \pi D_t$

From relation $\ell_t = \ell_0 (1 + \alpha . t)$, we get

$\pi D_t = \pi D_0(1 + 2.3 \times 10^{-5} \times 100)$

D_t = 2.54 (1 + 0.0023)

= 2.5458 cm.

32. Let mass of hot water = m kg

mass of cold water

= (20 – m) kg

Heat taken by cold water

= (20 – m) × 1 × (35 – 10)

Heat given by hot water

= m × 1 × (100 –35)

Law of mixture gives

Heat given by hot water

= Heat taken by cold water

m × 1 × (100 – 35) = (20 – m) × (35 – 10)

65 m = (20 – m) × 25

65 m = 500 – 25 m

or 90 m = 500

$m = \frac{500}{90} = 5.56$ kg

33. Let final temperature be = θ

Heat taken by ice = $m_1L + m_1c_1\Delta\theta_1$

$= 5 \times 80 + 5 \times 1\,(\theta - 0)$

$= 400 + 5\theta$

Heat given by water at 40°C

$= m_2c_2\Delta\theta_2 = 20 \times 1 \times (40 - \theta)$

$= 800 - 20\,\theta$

As Heat given = Heat taken

$800 - 20\,\theta = 400 + 5\,\theta$

$20\,\theta = 400$

$\theta = \frac{400}{25} = 16°$ C

34. a

35. The image will be formed by the plane mirror at a 30 cm behind it, while the image by convex mirror will be formed at 10 cm behind the convex mirror. Since for convex mirror u = –50 cm as shown in figure.

v = 10 cm

$\frac{1}{f} = \frac{1}{-50} + \frac{1}{10} = \frac{-1+5}{50} = \frac{4}{50}$

$f = \frac{50}{4} = 12.5$ cm

Therefore the radius of curvature of convex mirror is

r = 2 f = 25 cm

Hence correct answer is (B).

36. Let the mass is represented by M then

M = f (V, F, T)

Assuming that a function is product of power functions of V, F and T

$M = KV^x F^y T^z$

Where K is a dimension less constant of proportionality. The above equation dimensionally becomes.

$[M] = [LT^{-1}]^x\,[MLT^{-2}]^y\,[T]^2$

i.e. $[M] = [M^y]\,[L^{x+y}\,T^{-x-2y+z}]$

So equation becomes

$[M] = [M^y\,L^{x+y}\,T^{-x-2y+z}]$

For dimensionally correct expression,

y = 1, x + y = 0 and – x – 2y + z = 0

$\Rightarrow$ x = –1, y = 1 and z = 1.

therefore $M = KV^{-1}FT$.

Hence correct answer is (B).

37. Let $\hat{n}_1$ and $\hat{n}_2$ are the two unit vectors, then the sum is

$\mathbf{n}_s = \hat{n}_1 + \hat{n}_2$

or $n_s^2 = n_1^2 + n_2^2 + 2n_1n_2\cos\theta$

$= 1 + 1 + 2\cos\theta$

since it is given that n_s is also a unit vector, therefore

$1 = 1 + 1 + 2\cos\theta$

or $\cos\theta = -\frac{1}{2}$ or $\theta = 120°$

Now the difference vector is

$\mathbf{n}_d = \mathbf{n}_1 - \mathbf{n}_2$

or $n_d^2 = n_1^2 + n_2^2 - 2n_1n_2\cos\theta$

$= 1 + 1 - 2\cos(120°)$

$= 2 - 2(-1/2) = 2 + 1 = 3$

$\therefore$ $n_d = \sqrt{3}$

Thus the correct answer is (B)

38. $h = -ut + 1/2\ gt^2 \Rightarrow 65 = -12t + 5t^2$

$\Rightarrow 5t^2 - 12t - 65 - 0 \Rightarrow t = 5$ sec

Hence correct answer is (C)

39. Force causing the acceleration

$= 400 - 200 = 200N$

mass of the boy $= 200/9.8$

hence acceleration $= F/m = \frac{200}{200} \times 9.8$

$= 9.8\ m/s^2$

Hence correct answer is (A)

40. We know that

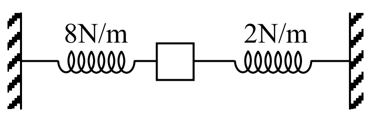
Time period $= \frac{\text{Circumference}}{\text{Critical speed}} = \frac{2\pi r}{\sqrt{gr}}$

$= \frac{2 \times 22 \times 4}{7 \times \sqrt{10 \times 4}} = 4$ sec

Hence correct answer is (D)

41. $\because\ n = \frac{1}{2\pi}\sqrt{\frac{k_1 + k_2}{m}} = \frac{1}{2\pi}\sqrt{\frac{8+2}{0.1}} = \frac{5}{\pi}$

$= 1.6\ sec^{-1}$



Hence correct answer is (D)

42. (B)

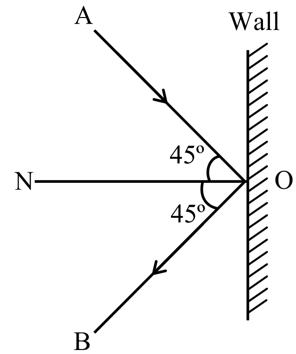
The resultant gravitational force on each particle provides it the necessary centripetal force

$\therefore\ \frac{mv^2}{r} = \sqrt{F^2 + F^2 + 2F^2\cos 60^o} = \sqrt{3}\ F,$

But. $r = \frac{\sqrt{3}}{2}\ l \times \frac{2}{3} = \frac{\ell}{\sqrt{3}},$

$\therefore\ v = \sqrt{\frac{GM}{\ell}}$

43. [A]



The molecule strikes the wall along AO and rebound along OB such that

$\angle AON = \angle NOB = 45^o$

The change in component momentum of each H_2 molecule in a perpendicular direction the wall $= \Delta P = 2\ mv\cos\theta$, where mv = momentum of molecule

$\therefore\ \Delta P = (3.32 \times 10^{-27}) \times 10^3 \cos 45^o$

$\Rightarrow\ \Delta P = 4.692 \times 10^{-24}$ kg m/sec

Force exerted by N molecules on the wall

$= \Delta P \times N$

it A is the area of the wall on which the molecule strike, then pressure

$P = F/A = \frac{N \times \Delta P}{A} = \frac{10^{23} \times 4.692 \times 10^{24}}{2 \times 10^{-4}}$

$= 2.347 \times 10^3\ N/m^2$

44. [C] $\therefore\ \nu = \sqrt{\frac{\gamma P}{\rho}}$

$P = 1.013 \times 10^5\ N/m^2$, $\rho = 1.3 kg/m^3$, $\nu = 330$ m/s

$\gamma = \frac{\nu^2 P}{\rho} = 1.4$

Let f be the number of degree of freedom then

$C_v = f\ R/2$ and $C_p = fR/2 + R = R\ (1 + f/2)$

$\therefore\ \gamma = \frac{C_P}{C_V} = \frac{2+f}{f} = 1.4$

(f = 5)

45. (B) The work done against the force of friction

$= \mu R \times$ displacement $= 0.2 \times 2 \times 9.8 \times 2$ (in one second)

$= (0.2 \times 2 \times 9.8 \times 2) \times 5$ (in 5 second)

= 39. 2J

Heat generated $= \frac{39.2}{4.2} = 9.33$ cal

46. .(B) Retardation due to air $= \frac{g}{10}$.

When air resistance is absent

$\Rightarrow T = \frac{u\sin\theta}{g}$

$\Rightarrow T \propto \frac{1}{g}$

Now if air resistance is considered then

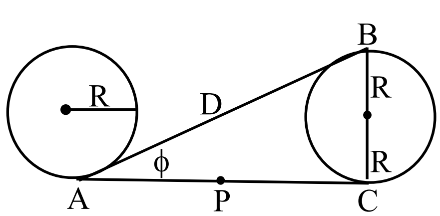
$T' \propto \frac{1}{g+g/10} \propto \frac{10}{11g}$

$\therefore \frac{T-T'}{T} = \frac{\frac{1}{g}-\frac{10}{11g}}{1/g} = \frac{1}{11}$

$\therefore$ % age change $= \frac{T-T'}{T} \times 100 = \frac{100}{11}$

≈ 9 % decrease

47. In accordance with fig during the half revolution of the wheel, the point A covers πR = (AC) horizontal distance while 2R (= BC) vertical distance,



So here $P = \pi R$; $\theta = 2R$ and $\pi = 90º$

So $D = \sqrt{(\pi R)^2 + (2R)^2} = R\sqrt{\pi^2+4}$

and $\phi = \tan^{-1}\left[\frac{2R}{\pi R}\right] = \tan^{-1}\left[\frac{2}{\pi}\right]$

i.e. displacement has magnitude $R\sqrt{\pi^2+4}$ and makes an angle $\tan^{-1}\left(\frac{2}{\pi}\right)$ with x-axis.

Hence correct answer is (B).

48. $v_x = dx/dt = 2ct$, $v_y = dy/dt = 2bt$

$\therefore v = \sqrt{v_x^2 + v_y^2} = 2t\sqrt{c^2+b^2}$

Hence correct answer is (D)

49. $R = ut \Rightarrow t = R/u = 12/8$

Now h $= (1/2)\, gt^2$

$= (1/2) \times 9.8 \times (12/8)^2 = 11$ m

Hence correct answer is (A)

50. **(A)**