ANSWER KEY (AIPMT-1999)

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans	1	2	1	1	3	2	1	1	1	2	3	1	1	2	3	1	3	2	4	3
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans	1	4	1	1	2	1	1	1	3	4	2	3	3	2	1	1	3	2	1	3
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans	4	1	2	3	1	1	1	1	1	1	1	2	1	4	3	2	3	3	2	1
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans	1	2	1, 2	1	3	3	1	2	2	3	1	1	3	1	4	1, 2	3	1	2	2, 3
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans	4	2	1	1	2	2	3	1	2	4	2	3	2	1	1	1	2	1	3	
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans	1	4	2	2	4	1	1	1	2	4	2	1	2	3	1	3	2	3	1	2
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans	1	3	3	2	4	2	3	1	1	4	3	2	4	2	1	1	2	1	1	1
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans	2	1	1	2	1	2	1	1	3	4	4	1	1	3	4	3	1	2	2	4
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans	3	2	1	1	1	3	2	4	3	2	4	1	2	1	1	2	4	4	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans	4	1	1	3	4	2	4	1	2	3	3	1	3	2	1	1	1	3	3	2

HINTS & SOLUTIONS

1. $V = \frac{4}{3}\pi R^3$; $\frac{\Delta V}{V} = \frac{3\Delta R}{R}$

% change in volume = 3 × 0.1 = 0.3%

2. $h = \frac{1}{2}gt^2$ …… (i)

$\frac{h}{2} = \frac{1}{2}g(t-1)^2$ …… (ii)

$\frac{1}{4}gt^2 = \frac{1}{2}g(t-1)^2$

$\frac{t}{\sqrt{2}} = t - 1$

$t\left(1 - \frac{1}{\sqrt{2}}\right) = 1$

$t = \frac{\sqrt{2}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}$

$t = \sqrt{2}\,(\sqrt{2}+1)$

$t = 2 + \sqrt{2}$

3. Let initial speed of man of mass m be u then

$KE_{man} = \frac{1}{2}mu^2$ & $KE_{boy} = 2 \times \frac{1}{2}mu^2 = mu^2$

Now if man increases his speed by 1 m/s^{-1} then

$KE_{man} = \frac{1}{2}m(u+1)^2 = KE'_{boy} = mu^2$

$\Rightarrow \frac{u+1}{u} = \sqrt{2}$

$\Rightarrow u = \frac{1}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = (\sqrt{2}+1)\ ms^{-1}$.

4. $\text{Time} = \frac{\text{Relative horizontal distance}}{\text{Relative horizontal velocity}}$

$= \frac{x}{u\cos 60^\circ + \frac{u}{\sqrt{3}}\cos 30^\circ} = \frac{x}{u}$

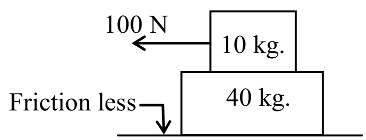
5. $t = \sqrt{x} + 3$

$x = (t-3)^2$

$v = \frac{dx}{dt} = 2(t-3) = 0$

at t = 3, $x = (3-3)^2 = 0$

6.

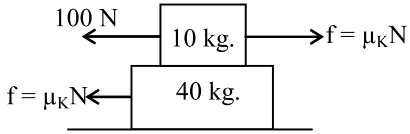


Let the net acceleration of the slab be **a** limiting friction

$F_S = \mu mg = 0.6 \times 10 \times 9.8 = 58.8$ N

100 N > 58.8 N

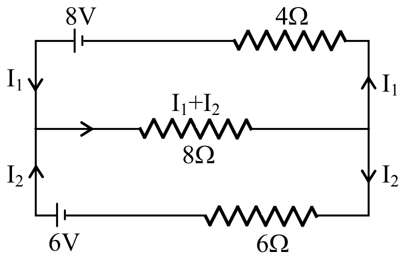
i.e. slab will accelerate with different acceleration.



$f = 40a$

$0.4 \times 10 \times 9.8 = 40a \Rightarrow a = 0.98\ m/s^2$

7. **Method-I**



$-8(I_1 + I_2) - 4I_1 + 8 = 0$ … (i)

$-8(I_1 + I_2) - 6I_2 + 6 = 0$ … (ii)

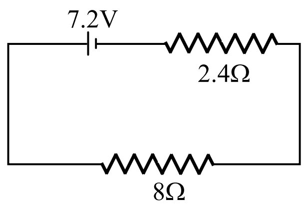
Solving eq^n. (i) and (ii), we get

$I_1 = \frac{8}{13},\ I_2 = \frac{1}{13}$

Current in $8\Omega = I_1 + I_2 = 0.69A$

Method-II

Given circuit can be reduced to

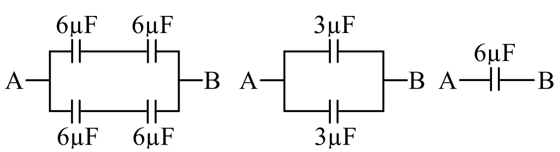


$$E_{net} = \frac{\frac{8}{4}+\frac{6}{6}}{\frac{1}{4}+\frac{1}{6}} = 7.2 \text{ volt}$$

$$\frac{1}{R_{net}} = \frac{1}{4}+\frac{1}{6} = \frac{10}{24} \Rightarrow R_{net} = 2.4\Omega$$

$$\Rightarrow I = \frac{7.2}{10.4} = 0.69\ A$$

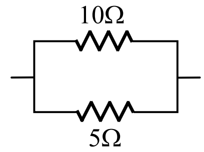
8. Here bridge is balanced then 20μF becomes ineffective.



Therefore $C_{AB} = 6\mu F$

9. $P = VI = V^2/R$, voltage constant

$P \propto 1/R$



then power in 10Ω will be 10W when I constant then

$P = I^2R$

$P \propto R$

$$\frac{P'}{10} = \frac{4}{10} \Rightarrow P' = 4W$$

10. For maximum power consumption –

$R = r = 6\Omega$

11. $\because \quad q = \frac{\Delta\phi}{R} \quad \therefore q \propto (\Delta t)^o$

12. Magnetic field at the centre of coil $B = \frac{\mu_0 iN}{2a}$

$$= \frac{4\pi\times10^{-7}\times5\times50}{2\times10/100} = 1.57 \times 10^{-3}\ T$$

$= 1.57$ mT.

13. Given :

$8V_{tiny} = V_{big}$

$$8\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$2r = R$

$$V_{tiny} = \frac{Kq}{r}$$

$$V_{big} = \frac{K\times8q}{R}$$

$$V_{big} = \frac{8Kq}{2r}$$

$V_{big} = 4V_{tiny}$

$V_{big} = 4 \times 10 \quad \Rightarrow \quad 40$ V

14. Work done by source

$$= E \times q = E\left(\frac{\Delta\phi}{R}\right) = E\ \frac{LI_0}{R}$$

$$= \left(\frac{E}{R}\right)LI_0 = (I_0)LI_0 = LI_0^2$$

$= 0.04 \times (5)^2 = 1.0$ J

16. $V = \frac{Q\times E\times t}{m}$

$V \propto E$

So Ans. $\frac{V}{2}$

17. $T = 2\pi\sqrt{I/MB_H}$; $B_H = 0$ at poles

$B_H = \text{max}$ at equator

$B_H \uparrow \;\; \Rightarrow T \downarrow$

18. $Y = \overline{A}B + A\overline{B} = A \oplus B$

Ex – OR Gate

A	B	A + B	A ⊕ B
0	0	0	0
1	0	1	1
0	1	1	1
1	1	1	0

19. Zener diode $\rightarrow$ DC voltage stabilizer.

20. Unbiased PN junction

Deplation layer $\rightarrow$ static ions

21. $$f = \frac{(2n-1)v}{4\ell}$$

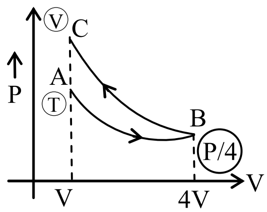
$$\ell = \frac{(2n-1)v}{4f} = \frac{(2n-1)\times 330}{4\times 330} = \frac{(2n-1)}{4}$$

$$\ell = \frac{1}{4}\text{ m}, \; \frac{3}{4}\text{ m} = 25\text{ cm}, 75\text{ cm}.$$

$\therefore$ Minimum height of water column

= 125 – 75 = 50 cm

22. For isothermal process



$P_A V_A = P_B V_B$

$PV = P_B(4V)$

$$P_B = \frac{P}{4}$$

for adiabatic process

$$P_B V_B^{\gamma} = P_C V_C^{\gamma}$$

$$P_c = \frac{P}{4}\left(\frac{4V}{V}\right)^{1.5} = \frac{P}{4}\times 8 = 2P$$

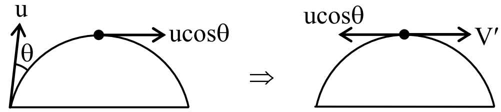
23. According to stefan's law –

$$\frac{R'}{R} = \frac{(400)^4-(200)^4}{(600)^4-(200)^4} = \frac{4^4-2^4}{6^4-2^4}$$

$$= \frac{(4^2+2^2)(4^2-2^2)}{(6^2+2^2)(6^2-2^2)} = \frac{20\times 12}{40\times 32}$$

$$R' = \frac{3}{16}R$$

24.



Before After

$$mu\cos\theta = -\frac{mu}{2}\cos\theta + \frac{m}{2}v'$$

$v' = 3u\cos\theta$

25 Amplitude of damped oscillation at time t

$x = x_0 e^{-\lambda t}$ Where λ is a constant

after 20 sec

$$\frac{x_0}{3} = x_0 e^{-\lambda(20)} \Rightarrow e^{-\lambda(20)} = \frac{1}{3} \qquad \text{..... (1)}$$

After 40 sec

$x' = x_0 e^{-\lambda(40)} \Rightarrow x_0 e^{-\lambda(2\times 20)}$

from (1)

$$x' = x_0\left(\frac{1}{3}\right)^2 = \frac{x_0}{9}$$

26. $W = \frac{1}{2}Kx^2$, $\quad F = -Kx$

$$W = \frac{1}{2}K \cdot \frac{F^2}{K^2} = \frac{F^2}{2K}$$

$$W \propto \frac{1}{K} \Rightarrow \frac{W_A}{W_B} = \frac{K_B}{K_A} = \frac{K_B}{2K_B} = \frac{1}{2}$$

27. $\because\; T = 2\pi\sqrt{\frac{M}{K}} \quad \therefore Mg = K\ell$

Therefore $T = 2\pi\sqrt{\frac{(M+m)\ell}{Mg}}$

28. $$n = \frac{1}{2\pi}\sqrt{\frac{g_{eff.}}{\ell}}$$

In a freely falling lift $g_{eff} = g - g = 0$ then $n = 0$

29. $$C_{PPC} = \frac{\epsilon_0 \epsilon_r A}{d} \Rightarrow C' = 6C$$

$$E_{PPC} = \frac{q}{\epsilon_0 \epsilon_r A} \Rightarrow E' = \frac{E}{6}$$

32. $$K.E._{max.} = \frac{hc}{\lambda} - \phi$$

Then K.E. will be greater than 0.5 eV

33. $(K.E.)_e = E_{ph}$

$$\frac{1}{2}mv^2 = \frac{hc}{\lambda ph} \Rightarrow \frac{1}{2}\left(\frac{h}{\lambda_e v}\right)v^2 = \frac{hc}{\lambda ph}$$

$$\frac{\lambda_e}{\lambda ph} = \frac{v}{2c} \qquad c > v$$

$\lambda ph > \lambda_e$

34. Total energy of electron

= K.E. + Rest Mass energy

K.E. = 3.555 – 0.51 = 3.045 MeV

35. $r = \frac{\sqrt{2mqV_{acce}}}{qB}$

$r \propto \sqrt{m}$

$\frac{m_1}{m_2} = \left(\frac{r_1}{r_2}\right)^2$

37. decay constant $= \frac{0.693}{T_{1/2}} = \frac{0.693}{77}$

$= 0.009/\text{day}$

38. $\mu = \frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$

$\frac{\pi}{2} - \frac{A}{2} = \frac{A}{2} + \frac{\delta_m}{2}$

$\Rightarrow \quad \delta_m = 180 - 2A$

39. $Q = \frac{K_1A(\theta_1 - \theta)t}{d} = \frac{K_2A(\theta - \theta_2)t}{d}$

Or $\quad K_1\theta_1 - K_1\theta = K_2\theta - K_2\theta_2$

$K_1\theta_1 + K_2\theta_2 = K_1\theta + K_2\theta$

$\theta = \frac{K_1\theta_1 + K_2\theta_2}{K_1 + K_2}$

40. $< v >_{time} = \frac{\int vdt}{\int dt} = \frac{\int_0^T atdt}{\int_0^T dt} = \frac{aT}{2}$

$< v >_{space} = \frac{\int vds}{\int ds} = \frac{\int v\frac{ds}{dt}dt}{\int \frac{ds}{dt}dt}$

$= \frac{\int_0^T v^2dt}{\int_0^T vdt} = \frac{\int_0^T a^2t^2dt}{\int_0^T atdt} = \frac{2}{3}aT$

$\frac{< v >_{space}}{< v >_{time}} = \frac{2aT/3}{aT/2} = \frac{4}{3}$

42. $V_0 = \sqrt{\frac{GM}{r}}$; M = mass of earth

$V_0 \propto \frac{1}{\sqrt{r}}$ then $V_R > V_1$

43. $g = \frac{GM}{R^2}$ or $g \propto \frac{M}{R^2}$

$g_M = \frac{M_M}{M_E} \times \left(\frac{R_E}{R_M}\right)^2 \times g_E$

$= \frac{1}{81} \times (3.7)^2 \times 9.8 = \frac{9.8}{6} = 1.65 \text{ m/s}^2$

44. Let natural length of spring be λ_0

then according to question

$4 = K(a - \ell_0)$

$5 = K(b - \ell_0)$

$\Rightarrow \ell_0 = 5a - 4b$; $k = \frac{1}{b - a}$

Now if we apply 9 N force then

$9 = k(\ell - \ell_0) \quad \Rightarrow 9 = \frac{1}{(b-a)}[\ell - 5a + 4b]$

$\Rightarrow \ell = 5b - 4a$

45. $\vec{v} = \vec{w} \times \vec{r}$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 3 \\ 1 & 1 & 1 \end{vmatrix}$

$= \hat{i}(-2-3) - \hat{j}(1-3) + \hat{k}(1+2)$

$= -5\hat{i} + 2\hat{j} + 3\hat{k}$

46. The centre of mass of the stick fall through 0.3 m. According to law of conservation of energy

$\frac{1}{2}I\omega^2 = mgh$

$\frac{1}{2}\frac{m\ell^2}{3}\frac{V^2}{\ell^2} = mgh \qquad (\because v = \omega\ell)$

Here $h = \ell/2 = 0.3$m

$V = \sqrt{6gh} = \sqrt{6 \times 9.8 \times 0.3} = 4.2$ m/s

47. $\lambda = \frac{c}{v} = \frac{3 \times 10^8}{10 \times 10^6} = 30$ meter

48. $R = \frac{u^2 \sin 2\theta}{g}$, $\quad t_1 = \frac{2u\sin\theta}{g}$

$t_2 = \frac{2u\sin(90^\circ - \theta)}{g} = \frac{2u\cos\theta}{g}$

$\because \qquad t_1t_2 = \frac{4u^2\sin\theta\cos\theta}{g} = \frac{2R}{g}$

or $\qquad t_1t_2 \propto R$

49. Compound microscope $M = m_0 \times m_e$

$M = \frac{F_0}{u + F_0} \times m_e$

$\Rightarrow \qquad 95 = \frac{1/4}{-1/3.8 + 1/4}m_e$

$\Rightarrow \qquad 95 = 19m_e \quad \Rightarrow m_e = \frac{95}{19} = 5$