JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 11th **PAPER CODE :- CWT-11**
CHAPTER :- MECHANICAL PROPERTIES OF MATTER

ANSWER KEY

1.	(A)	**2.**	(D)	**3.**	(C)	**4.**	(A)	**5.**	(B)	**6.**	(C)	**7.**	(D)
8.	(D)	**9.**	(C)	**10.**	(C)	**11.**	(B)	**12.**	(D)	**13.**	(D)	**14.**	(B)
15.	(A)	**16.**	(A)	**17.**	(B)	**18.**	(A)	**19.**	(B)	**20.**	(C)	**21.**	8
22.	800	**23.**	80	**24.**	50	**25.**	1	**26.**	2	**27.**	5	**28.**	4
29.	12	**30.**	4										

SOLUTIONS

1. (A)

Sol. Area = 1 cm^2

$\Delta\ell = 1.1\ \ell - \ell$

$Y = 2 \times 10^{11}$

$\frac{F}{A} = Y\frac{\Delta\ell}{\ell}$

$F = AY\left(\frac{0.1\ell}{\ell}\right)$

$= 1 \times 10^{-4} \times 2 \times 10^{11} \times 0.1$

$= 2 \times 10^{6}$

2. (D)

Sol. Bulk strain = $\frac{\Delta v}{v}$

$v = L^3 \quad \Rightarrow \quad \frac{\Delta v}{v} = 3\frac{\Delta L}{L}$

$\Rightarrow \quad \frac{\Delta v}{v} = 3 \times 0.02$

$\Rightarrow \quad \frac{\Delta v}{v} = 0.06.$

3. (C)

Sol. $\frac{\Delta v}{v} = \frac{h\rho g}{B} \quad \Rightarrow \quad \frac{\Delta\rho}{\rho} = \frac{h\rho g}{B}$

$\Delta\rho = \frac{\rho^2 gh}{B}.$

4. (A)

Sol. $F = \eta\frac{x}{h}$

$\frac{500}{4\times16\times10^{-4}} = 2\times10^{6}\frac{x}{4\times10^{-2}}$

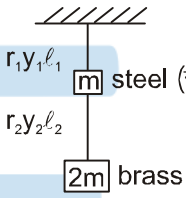
$\Rightarrow x = \frac{5\times10^{-2}}{32}m = 0.156\ cm$

5. (B)

Sol. $\frac{r_1}{r_2} = b$

$\frac{\ell_1}{\ell_2} = a$

$\frac{y_1}{y_2} = c$



$\Delta\ell_1 = \frac{(3mg)\ell_1}{A_1y_1}$

$\Delta\ell_2 = \frac{(2mg)\ell_2}{A_2y_2}$

$\frac{\Delta\ell_1}{\Delta\ell_2} = \frac{3\ell_1}{2\ell_2 A_1y_1}\times A_2y_2 = \frac{3}{2}\frac{a}{b^2c} = \frac{3a}{2b^2c}$

6. (C)

Sol. In either case he carries same mass and hence same weight. (Buoyant force is internal force of bucket and fish system)

$\Rightarrow$ (D) is true

7. (D)

Sol. Elastic energy stored in the wire is

$U = \frac{1}{2}\times$ stress $\times$ strain $\times$ volume

$= \frac{1}{2}\frac{F}{A}\times\frac{\Delta L}{L}\times AL$

$= \frac{1}{2}F\Delta L$

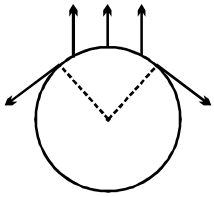
$= \frac{1}{2}\times 200 \times 1 \times 10^{-3} = 0.1\ J$

8. (D)

Sol. Dueto tension intermolecular distance will increase. So potential energy will increase and intermolecular force between molecules will decrease. This change in potential energy will produce heat by which temperature will increase.

9. (C)

Sol.



$2\sigma R\theta = 2T\frac{\theta}{2}$

$T = 2\sigma R$

$$\frac{T}{s} = Y \times \frac{(2\pi R - l)}{l} = \frac{Y}{l}\left(\frac{2\pi T}{2\sigma} - l\right)$$

$$Y = \frac{\pi TY}{\sigma l} - \frac{T}{s}$$

$$\Rightarrow T = \frac{Y\sigma l s}{\pi Y s - \sigma l}$$

10. (C)

Sol. $\rho g(H - h)$
because pressure varies with height.

11. (B)

Sol. 46.4×10^{-6} atm $= \frac{1}{\beta}$

$$\beta = \frac{1}{46.4 \times 10^{-6}} \Rightarrow \beta = \frac{P}{\Delta v / v}$$

$$\Rightarrow \frac{\Delta v}{v} = \frac{\Delta p}{\beta} = 46.4 \times 10^{-6}$$

12. (D)

Sol. $P - P_0 = \frac{4T}{R}$

$P = 2 \times 10^5$ N/m^2

13. (D)

Sol. $\frac{r_1}{r_2} = \frac{1}{2}$

PE (per unit volume) $= \frac{1}{2y}\left(\frac{F}{A}\right)^2$

PE $\propto 1/A^2$

$$\frac{PE_1}{PE_2} = \frac{A_2^2}{A_1^2} = 16 : 1$$

14. (B)

Sol. $F_{thrust} = \rho a v^2$
$F_{net} = F_1 - F_2 = ap[2g(h_1 - h_2)]$
$= ap(2gh)$.

15. (A)

Sol. Surface energy $= (8\pi r^2)T$

$$p = \frac{d}{dt}(8\pi r^2 T) = 8\pi T(2r\frac{dr}{dt})$$

$\Rightarrow \quad p \propto r$

16. (A)

Sol. As the oil is poured till it covers the object completely, pressure in water at all points keeps on increasing. As a result upward force on object exerted by water increases and the object moves up for the given duration. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

17. (B)

Sol. Tension in wire remains same

18. (A)

Sol. $V\rho g = 6\pi\eta rv + v\rho_\ell g$
$Vg(\rho - \rho_\ell) = 6\pi\eta rv$
$Vg(\rho - \rho_\ell') = 6\pi\eta' rv'$

$$V'\eta' = \frac{(\rho - \rho_\ell')}{(\rho - \rho_\ell)} \times v\eta$$

$$V' = \frac{(\rho - \rho_\ell')}{(\rho - \rho_\ell)} \times \frac{v\eta}{\eta'}$$

$$= \frac{(7.8 - 1.2)}{(7.8 - 1)} \times \frac{10 \times 8.5 \times 10^{-4}}{13.2}$$

$v' = 6.25 \times 10^{-4}$ cm/s.

19. (B)

Sol. Pressure exerted by fluid at closed end B is
$P = \rho g \ell$
$\therefore$ force exerted by fluid at closed end B is
$F = PA = \ell \rho g A_0$

20. (C)

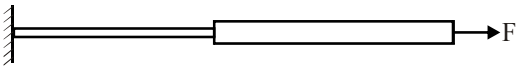
Sol. $R = 1.5\ g + B$

$= 1.5\ g + \left(\frac{0.5}{500}\right) 1000\ g$

$= 2.5\ g$

21. 8

Sol.



$$\frac{F}{A_1} = y\frac{\Delta\ell_1}{\ell}$$

$$\frac{F}{A_2} = y\frac{\Delta\ell_2}{\ell}$$

$\Delta\ell_1 + \Delta\ell_2 = 10$ mm

$$\frac{F\ell}{A_1 y} + \frac{F\ell}{4A_1 y} = 10 \text{ mm}$$

$$\frac{F\ell}{A_1 y} + \frac{F\ell}{4A_1 y} = 10 \text{ mm}$$

$$\Rightarrow \quad \frac{F\ell}{A_1 y} = 8 \text{ mm.}$$

22. 800

Sol. In both cases, Weight = Bouyant force

Initially, $\rho_b Vg = \rho_w \left(\frac{2}{3}V\right)g \Rightarrow \rho_b = \frac{2}{3}\rho_w$

After wards, $\rho_b Vg = \rho_{oil}\left(\frac{5V}{6}\right)g$

$$\Rightarrow \frac{2}{3}\rho_w = \rho_{oil} \times \frac{5}{6}$$

$$\Rightarrow \rho_{oil} = \frac{4}{5}\rho_w = \frac{4}{5} \times 100 = 800 \text{ kg/m}^3.$$

23. 80

Sol. In steady state,
$A_1v_1 = A_2v_2$

$\pi \times 2^2 \times 1 = \pi \times 1^2 \times \sqrt{2gh}$

$$\Rightarrow \quad h = \frac{16}{20} = 0.8 = 80 \text{ cm}$$

24. 50

Sol. $6\pi\eta rv = B = \frac{4}{3}\pi r^3 P_L g$

$$\eta = \frac{2}{9}r^2\frac{P_L g}{v}$$

$$= \frac{2}{9} \times \frac{(0.9)^2 \times 1.75 \times 1000}{0.7} = 50 \text{ poise}$$

25. 1

Sol. $F = ma$

$$\eta A\frac{v}{y} = ma$$

$$\eta = \frac{may}{Av} = \frac{may}{\pi D L v} = 1 \text{ Pas}$$

26. 2

Sol. $\tan\theta = \frac{a}{g} = \frac{1}{\sqrt{3}}$

$\theta = 30°$

$\sin\theta = \frac{1}{2}$

$\text{cosec}\,\theta = 2$

27. 5

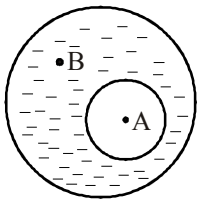
Sol. $v = \sqrt{2gh}$

$dx = \frac{1}{2}dmv^2 = \sqrt{2 \times 10 \times 1.25} = 5$

$\frac{dx}{dt} = \frac{1}{2}\frac{dx}{dt}v^2 = \frac{1}{2}\rho av^3 = \frac{1}{2} \times 10^3 \times 0.8 \times 10^{-4} \times 125$
$= 4 \times 10^{-2} \times 125 = 500 \times \omega^{-2} = 5$

28. 4

Sol. $P_B - P_0 = \frac{2T}{3R}$



$$P_A - P_B = \frac{2T}{R}$$

$$P_A - P_0 = \frac{2T}{R} + \frac{2T}{3R} = \frac{8T}{3R}$$

$$\frac{P_A - P_0}{P_B - P_0} = \frac{8}{2} = 4$$

29. 12

Sol. Change in tension = ΔT

$\therefore 2\Delta T \sin 37° = \Delta mg$

$$\Delta T = \frac{\Delta mg}{2\sin 37°}$$

$$\Delta l = \frac{\Delta T\, L}{AY}$$

But $\Delta l = L\alpha\Delta\theta$

$$\therefore \frac{\Delta mg}{2\sin 37°}\ \frac{L}{AY} = L\alpha\Delta\theta$$

$\Rightarrow$ $\Delta m = \alpha\,\Delta\theta \times A \times Y \times 2 \sin 37° / g$

$$= \frac{2\times10^{-5}\times10\times10^{-6}\times5\times10^{11}\times2\times3}{5\times10} = 12$$

30. 4

Sol. $p = \frac{2s}{r} = \frac{BdV}{V}$

$V = \frac{4}{3}\pi r^3$

$dV = 4\pi r^2 dr$

$$\frac{2s}{r} = B \times \frac{4\pi r^2 dr}{4/3\pi r^3}$$

$$dr = \frac{2s}{3B} = \frac{2\times0.075}{3\times1.25\times10^8}$$

$$= \frac{0.15}{3\times1.25} \times 10^{-8} = 4Å$$