NEET UG (2024)
Physics
Quiz-19

SECTION - A

1. The depth d at which the value of acceleration due to gravity is $1/6^{th}$ of the acceleration due to gravity at altitude R from surface of the earth is
(R : radius of earth)

(1) R (2) $\frac{23}{24}R$

(3) $2R$ (4) $\frac{14}{15}R$

2. The change in gravitational potential energy of a body of mass m when it is raised from earth surface to a height $5R$ above surface of earth is
(R : radius of earth)

(1) $\frac{mgR}{4}$ (2) mgR

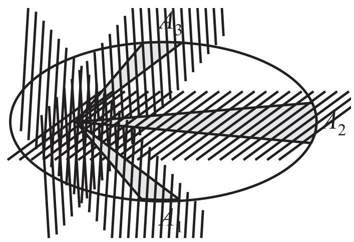
(3) $\frac{5}{6}mgR$ (4) $\frac{3}{4}mgR$

3. A satellite has kinetic energy K, potential energy U and total energy E. The value of $\frac{K+U}{K+U+E}$ will be

(1) $\frac{2}{3}$ (2) $\frac{1}{2}$

(3) $-\frac{2}{3}$ (4) $\frac{3}{2}$

4. A planet moving around the sun sweeps area A_1 in 24 hr, A_2 in 2 days and A_3 in 3 days. The relation between A_1, A_2 and A_3 is



(1) $A_1 = A_2 = A_3$ (2) $2A_1 = A_2 = 3A_3$

(3) $6A_1 = 3A_2 = 2A_3$ (4) $A_1 = 2A_2 = 3A_3$

5. The increase in length on stretching a wire is 0.05%. If its Poisson's ratio is 0.4, then its diameter

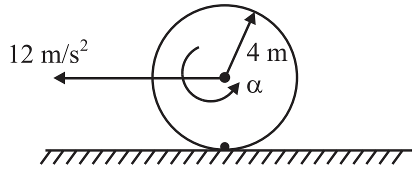
(1) Reduce by 0.02%
(2) Reduce by 0.1%
(3) Increase by 0.02%
(4) Decrease by 0.4%

6. If a body lying at 60° latitude feels weightlessness, then angular speed of the earth in this situation would be
(symbols have their usual meaning)

(1) $\frac{g}{R}$ (2) $\frac{2g}{R}$

(3) $2\sqrt{\frac{g}{R}}$ (4) $\sqrt{\frac{2g}{R}}$

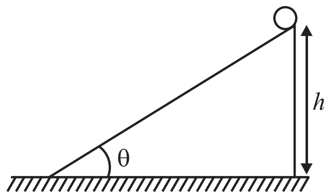
7. A sphere of radius 4 m rolls on a floor the acceleration of the centre of mass of sphere is $12\ m/s^2$. Angular acceleration α about its centre of mass is



(1) $2\ rad/s^2$ (2) $4 rad/s^2$

(3) $3\ rad/s^2$ (4) $1\ rad/s^2$

8. A hollow sphere of mass M and radius R is released from height h on an inclined plane. If Hollow sphere is rolling without slipping on the inclined then angular velocity of sphere when it reaches the bottom of inclined plane is



(1) $\frac{\sqrt{2gh}}{R}$ (2) $\sqrt{\frac{6gh}{5}}$

(3) $\frac{1}{R}\sqrt{\frac{7gh}{10}}$ (4) $\frac{1}{R}\sqrt{\frac{6gh}{5}}$

9. If an object is projected from surface of Earth with a speed 3 times of escape speed at surface of earth, then interstellar speed of object will be
(g = acceleration due to gravity at surface of earth, R = radius of earth)

(1) $\sqrt{2gR}$
(2) $4\sqrt{gR}$
(3) $3\sqrt{gR}$
(4) $\sqrt{gR}$

10. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with time period of revolution T. If the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$, then

(1) T is proportional to $R^{5/4}$

(2) T is proportional to $R^{7/4}$

(3) T is proportional to $R^{3/2}$

(4) T is proportional to R

11. If density of earth is ρ, radius is R_e then its gravitational field at distance $R_e/2$ from centre will be

(1) $\frac{2\pi G\rho R_e}{3}$ (2) $\frac{\pi G\rho R_e}{12}$

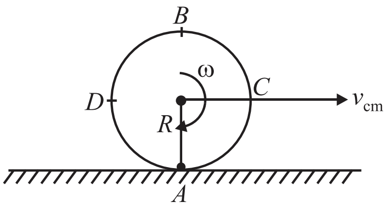
(3) $\frac{\pi G\rho R_e}{4}$ (4) $\frac{\pi G\rho R_e}{6}$

12. A uniform cube is subjected to volume compression. If each side is decreased by 1%, then bulk strain is

(1) 0.01 (2) 0.06

(3) 0.02 (4) 0.03

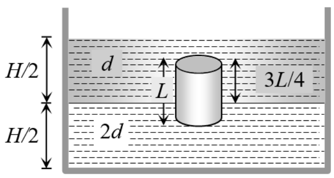
13. A ring of mass M and radius R is rolling without slipping, the velocity of point D as shown in the figure is



(1) v_{cm} (2) $2v_{cm}$

(3) Zero (4) $\sqrt{2}\,v_{cm}$

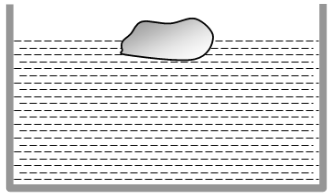
14. A homogeneous solid cylinder of length L ($L < H/2$). Cross-sectional area $A/5$ is immersed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid as shown in the fig. The lower density liquid is open to atmosphere having pressure P_0. Then density D of solid is given by



(1) $\frac{5}{4}d$ (2) $\frac{4}{5}d$

(3) d (4) $\frac{d}{5}$

15. A body floats in a liquid contained in a beaker. The whole system as shown falls freely under gravity. The upthrust on the body due to the liquid is



(1) Zero

(2) Equal to the weight of the liquid displaced

(3) Equal to the weight of the body in air

(4) Equal to the weight of the immersed portion of the body

16. An ice berg of density 900 Kg/m^3 is floating in water of density 1000 Kg/m^3. The percentage of volume of ice-cube outside the water is

(1) 20%

(2) 35%

(3) 10%

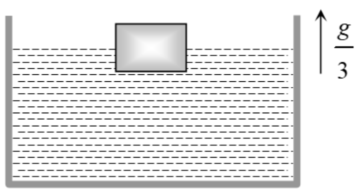
(4) 25%

17. In making an alloy, a substance of specific gravity s_1 and mass m_1 is mixed with another substance of specific gravity s_2 and mass m_2; then the specific gravity of the alloy is

(1) $\left(\frac{m_1+m_2}{s_1+s_2}\right)$ (2) $\left(\frac{s_1 s_2}{m_1+m_2}\right)$

(3) $\frac{m_1+m_2}{\left(\frac{m_1}{s_1}+\frac{m_2}{s_2}\right)}$ (4) $\frac{\left(\frac{m_1}{s_1}+\frac{m_2}{s_2}\right)}{m_1+m_2}$

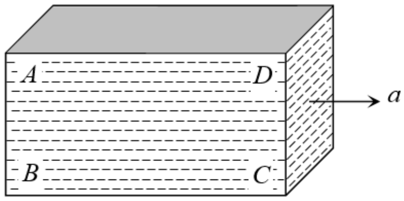
18. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with acceleration of $g/3$, the fraction of volume immersed in the liquid will be



(1) $\frac{1}{2}$ (2) $\frac{3}{8}$

(3) $\frac{2}{3}$ (4) $\frac{3}{4}$

19. A closed rectangular tank is completely filled with water and is accelerated horizontally with an acceleration a towards right. Pressure is (i) maximum at, and (ii) minimum at



(1) (i) B (ii) D (2) (i) C (ii) D
(3) (i) B (ii) C (4) (i) *B* (ii) *A*

20. The condition for a uniform spherical mass m of radius r to be a black hole is [G = gravitational constant and g = acceleration due to gravity]

(1) $(2Gm/r)^{1/2} \leq c$ (2) $(2Gm/r)^{1/2} = c$
(3) $(2Gm/r)^{1/2} \geq c$ (4) $(gm/r)^{1/2} \geq c$

21. The gravitational field due to a mass distribution is $E = K/x^3$ in the x-direction. (K is a constant). Taking the gravitational potential to be zero at infinity, its value at a distance x is

(1) K/x
(2) $K/2x$
(3) K/x^2
(4) $K/2x^2$

22. The escape velocity of a sphere of mass m from earth having mass M and radius R is given by

(1) $\sqrt{\dfrac{2GM}{R}}$

(2) $2\sqrt{\dfrac{GM}{R}}$

(3) $\sqrt{\dfrac{2GMm}{R}}$

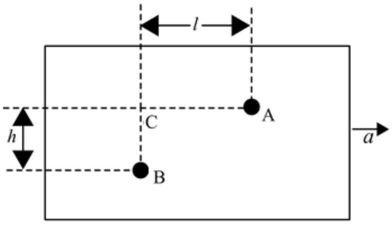
(4) $\sqrt{\dfrac{GM}{R}}$

23. What will be the acceleration due to gravity at height h if $h >> R$. Where R is radius of earth and g is acceleration due to gravity on the surface of earth

(1) $\dfrac{g}{\left(1+\dfrac{h}{R}\right)^2}$ (2) $g\left(1-\dfrac{2h}{R}\right)$

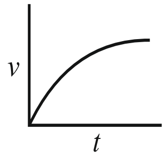
(3) $\dfrac{g}{\left(1-\dfrac{h}{R}\right)^2}$ (4) $g\left(1-\dfrac{h}{R}\right)$

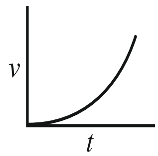
24. A sealed tank containing a liquid of density ρ moves with a horizontal acceleration a, as shown in the figure. The difference in pressure between the points A and B is

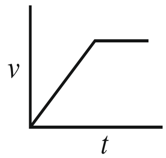


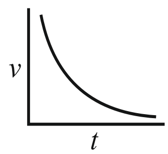
(1) $h\rho g$
(2) $l\rho a$
(3) $h\rho g - l\rho a$
(4) $h\rho g + l\rho a$

25. A piece of cork starts from rest at the bottom of a lake and floats up. It velocity v is plotted against time t. Which of the following best represents the resulting curve?

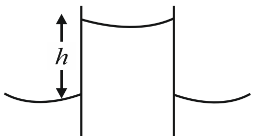
(1) 

(2) 

(3) 

(4) 

26. In a capillary rise experiment, radius of curvature of liquid surface is R. If approximate rise is h, then the surface tension of liquid is (Angle of contact is zero)



(1) $\dfrac{\rho ghR}{4}$ (2) $\dfrac{\rho ghR}{2}$
(3) Zero (4) ρghR

27. Eight raindrops each of radius R fall through air with terminal velocity 6 cm s^{-1}. What is the terminal velocity of the bigger drop formed by coalescing these drops together?

(1) 18 cm s^{-1} (2) 24 cm s^{-1}
(3) 15 cm s^{-1} (4) 20 cm s^{-1}

28. A body of density ρ is dropped from rest from a height h into a lake of density $\sigma(\sigma > \rho)$. The maximum depth the body sinks inside the liquid is (neglect viscous effect of liquid)

(1) $\frac{h\rho}{\sigma-\rho}$ (2) $\frac{h\sigma}{\sigma-\rho}$

(3) $\frac{h\rho}{\sigma}$ (4) $\frac{h\sigma}{\rho}$

29. A metal wire of length l and area of cross-section A is fixed between rigid supports at negligible tension. If this is cooled, the tension in the wire will be

(1) proportional to l
(2) inversely proportional to l
(3) independent of l
(4) independent of A

30. Two metal rods of the same length and area of cross-section are fixed end to end between rigid supports. The materials of the rods have Young modulii Y_1 and Y_2, and coefficients of linear expansion α_1 and α_2 and when the rods are cooled the junction between the rods does not shift if:

(1) $Y_1\alpha_1 = Y_2\alpha_2$ (2) $Y_1^2\alpha_1 = Y_2\alpha_2$

(3) $Y_1\alpha_1^2 = Y_2\alpha_2^2$ (4) $Y_1^2\alpha_1 = Y_2^2\alpha_2$

31. Two soap bubbles with radii r_1 and r_2 $(r_1 > r_2)$ come in contact. Their common surface has a radius of curvature r, then

(1) $r = \frac{r_1 + r_2}{2}$

(2) $r = \frac{r_1 r_2}{r_1 - r_2}$

(3) $r = \frac{r_1 r_2}{r_1 + r_2}$

(4) $r = \sqrt{r_1 r_2}$

32. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and other is a circular hole of radius R at a depth $4y$ from the top. When tank is completely filled with water, the quantities of water flowing out per second from both holes area same. The R is equal to

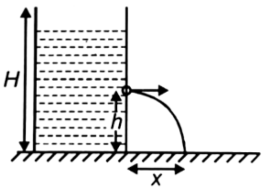
(1) $\frac{L}{\sqrt{2\pi}}$

(2) $2\pi L$

(3) L

(4) $\frac{L}{2\pi}$

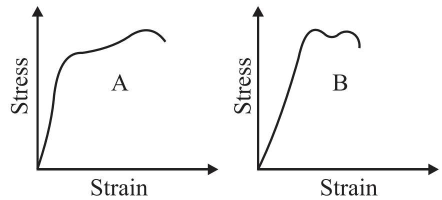
33. A drum, placed on floor, is filled with a liquid of almost no viscosity to a height H. A small opening is made at a height h from the base. The liquid jet strikes the floor at a distance x from the wall of the drum, then maximum value of x is



(1) $\frac{1}{2}(H-h)$ (2) H

(3) $\frac{1}{2}(H+h)$ (4) $\frac{hH}{x+h}$

34. The stress-strain graphs for materials A and B are shown in the figure. Choose the correct alternative



(1) Material A is stronger than material B
(2) Material B is stronger than material A
(3) The Young's modulus of A is greater than or equal to that of B
(4) The Young's modulus of B is greater than that of A

35. Two mercury drops (each of radius r) merge to form a bigger drop. The surface energy of the bigger drop, if T is the surface tension is

(1) $2^{5/3}\cdot\pi r^2 T$ (2) $4\pi r^2 T$

(3) $2\pi r^2 T$ (4) $2^{8/3}\pi r^2\cdot T$

SECTION - B

36. A long cylindrical glass vessel has a small hole of radius r at its bottom. The depth to which the vessel can be lowered vertically in a deep water bath (surface tension T) without any water entering inside is

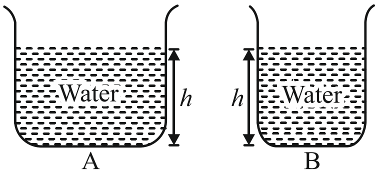
(1) $\frac{4T}{r\rho g}$

(2) $\frac{3T}{r\rho g}$

(3) $\frac{2T}{r\rho g}$

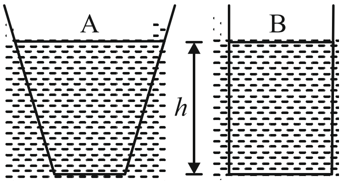
(4) $\frac{T}{r\rho g}$

37. From the adjacent figure, the correct observation is



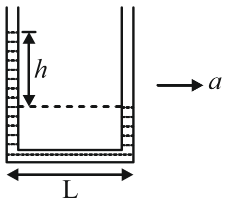
(1) Pressure on the bottom of tank A is greater than at the bottom of B
(2) Pressure on the bottom of the tank A is smaller than at the bottom of B
(3) Pressure depends on the shape of the container
(4) Pressure on the bottom of A and B is the same

38. Two vessels A and B of different shape have the same base area and are filled with water upto the same height h. The force exerted by water on the base is F_A for vessel A and F_B for vessel B. The respective weight of the vessels are W_A and W_B. Then



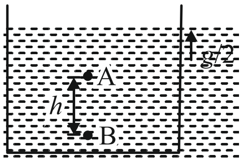
(1) $F_A > F_B$; $W_A > W_B$
(2) $F_A = F_B$; $W_A > W_B$
(3) $F_A = F_B$; $W_A < W_B$
(4) $F_A > F_B$; $W_A = W_B$

39. When at rest a liquid stands at the same level in the tubes shown in figure. But as indicated a height difference h occurs when the system is given an acceleration a towards the right. Here h is equal to



(1) $\frac{aL}{2g}$ (2) $\frac{gL}{2a}$
(3) $\frac{gL}{a}$ (4) $\frac{aL}{g}$

40. Find the pressure difference between A and B.



(1) $\frac{h\rho g}{2}$ (2) $\frac{3h\rho g}{2}$
(3) $\frac{5h\rho g}{2}$ (4) $h\rho g$

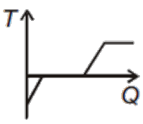
41. On the Celsius scale the absolute zero of temperature is at
(1) 0 °C   (2) –32 °C
(3) 100 °C   (4) –273.15 °C

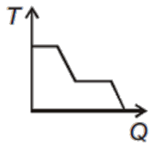
42. The readings of a bath of Celsius and Fahrenheit thermometers are in the ratio 2 : 5. The temperature of the bath is
(1) –26.66 °C   (2) 40 °C
(3) 45.71 °C   (4) 26.66 °C

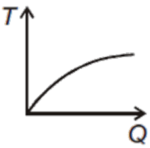
43. On heating a uniform metallic cylinder, length increases by 3 %. The area of cross-section of its base will increases by
(1) 1.5 %   (2) 3 %
(3) 9 %   (4) 6 %

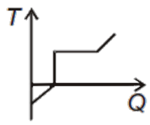
44. A metre rod of silver of length 100 cm, at 0 °C is heated to 100 °C It's length is increased by 0.19 cm. Coefficient of volume expansion of the silver rod is
(1) 5.7×10^{-5}/°C   (2) 0.63×10^{-5}/°C
(3) 1.9×10^{-5}/°C   (4) 16.1×10^{-5}/°C

45. A block of ice at –12 °C is slowly heated and converted into steam at 100 °C. Which of the following curves best represents the event?

(1) 

(2) 

(3) 

(4) 

46. The water equivalent of 20 g of aluminium (specific heat 0.2 cal g^{-1} °C^{-1}), is
(1) 40 g   (2) 4g
(3) 8g   (4) 160 g

47. 100 g of ice (latent heat 80 cal g^{-1}, at 0°C) is mixed with 100 g of water (specific heat 1 cal g^{-1} °C^{-1}) at 80 °C. The final temperature of the mixture will be
(1) 0 °C   (2) 40 °C
(3) 80 °C   (4) < 0 °C

48. 80 gm of water at 30 °C is poured on a large block of ice at 0 °C. The mass of ice that melts is
(1) 30 gm   (2) 80 gm
(3) 1600 gm   (4) 150 gm

49. Water falls from a height 500 m. What is the rise in temperature of water at bottom if whole energy remains in the water?

(1) 0.96 °C (2) 1.02 °C

(3) 1.19 °C (4) 0.23 °C

50. 10 gm of ice at –20 °C is kept into a calorimeter containing 10 gm of water at 10°C. The specific heat of water is twice that of ice. When equilibrium is reached, the calorimeter will contain

(1) 20 gm of water

(2) 20 gm of ice

(3) 10 gm ice and 10 gm of water

(4) 5 gm ice and 15 gm water

Solution

1. **(2)**

[Pg No. 132, NCERT Topic No. 7.5]

$$g_1 = \frac{g}{\left(1+\frac{h}{R}\right)^2} = \frac{g}{\left(1+\frac{R}{R}\right)^2} = \frac{g}{4}$$

$$g_2 = g\left(1-\frac{d}{R}\right)$$

$$g_2 = \frac{g_1}{6}$$

$$\Rightarrow g\left(1-\frac{d}{R}\right) = \frac{g}{4}\times\frac{1}{6}$$

$$\Rightarrow 1-\frac{d}{R} = \frac{1}{24}$$

$$\frac{d}{R} = 1-\frac{1}{24} = \frac{23}{24}$$

$$\Rightarrow d = \frac{23}{24}R$$

2. **(3)**

[Pg No. 134, NCERT Topic No. 7.7]

$$U = -\frac{GmM}{r}$$

$$\Delta U = \frac{-GmM}{r_2} + \frac{GmM}{r_1}$$

$$= \frac{-GmM}{6R} + \frac{GmM}{R} = \frac{5}{6}\frac{GMm}{R} = \frac{5}{6}mgR$$

3. **(2)**

[Pg No. 135, NCERT Topic No. 7.7]

$$K = \frac{GmM}{2R}$$

$$U = -\frac{GmM}{R} = -2K$$

$$E = -\frac{GmM}{2R} = -K$$

$$\frac{K+U}{K-U+E} = \frac{1}{2}$$

4. **(3)**

[Pg No. 132, NCERT Topic No. 7.5]

$$\frac{\Delta A}{\Delta t} = \text{ constant}$$

$$\Rightarrow \frac{A_1}{1} = \frac{A_2}{2} = \frac{A_3}{3}$$

$$\Rightarrow 6A_1 = 3A_2 = 2A_3$$

5. **(1)**

[Pg No. 174, NCERT Topic No. 8.5.4]

$$\text{Poisson's ratio} = \frac{\text{Lateral strain}}{\text{Longitudinal Strian}}$$

$$\therefore \quad \text{Lateral strain} = 0.4\times\frac{0.05}{100}$$

So reduced by 0.02%.

6. **(3)**

[Pg No. 136, NCERT Topic No. 7.9]

$$g' = g - \omega^2 \text{R}\cos^2 60^\circ$$

$$\Rightarrow 0 = g - \frac{\omega^2\text{R}}{4}$$

$$\Rightarrow \omega = 2\sqrt{\frac{g}{\text{R}}}$$

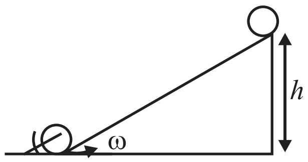
7. **(3)**

[Pg No. 121, NCERT Topic No. 6.2]

$$\alpha = \frac{a}{r} = 3\,\text{rad/s}^2$$

8. **(4)**

[Pg No. 122, NCERT Topic No. 6.2]



$$M.E_{\text{i}} = ME_f$$

$$Mgh = \frac{1}{2}I_{\text{com}}\omega^2 + \frac{1}{2}Mv^2$$

$$Mgh = \frac{1}{2}\times\frac{2}{3}MR^2\times\omega^2 + \frac{1}{2}Mv^2$$

$$\Rightarrow \omega = \frac{1}{R}\sqrt{\frac{6gh}{5}}$$

9. **(2)**

[Pg No. 133, NCERT Topic No. 7.6]

if $K = 3$

$$M.E_1 = M\cdot E_2$$

$$-\frac{GMm}{R} + \frac{1}{2}m\left(Kv_e\right)^2 = \frac{1}{2}mv^2 + (0)$$

$$-\frac{GMm}{R} + \frac{1}{2}\frac{K^2 2GMm}{R} = \frac{1}{2}mv^2$$

$$-\frac{2GM}{R} + \frac{K^2 2GM}{R} = v^2$$

$$v^2 = -2gR + K^2 2gR$$

$v = \sqrt{2gR(K^2 - 1)} = \sqrt{2gR(3^2 - 1)} = 4\sqrt{gR}$

10. (2)

[Pg No. 128, NCERT Topic No. 7.2]

$T \propto r^{\frac{n+1}{2}}, F \propto \frac{1}{r^n}$

$T \propto r^{\frac{\frac{5}{2}+1}{2}}$

$T \propto r^{\frac{7}{4}}$

11. (1)

[Pg No. 134, NCERT Topic No. 7.6]

$I = \frac{GM}{R_e^3} r = \frac{2\pi G\rho R_e}{3}$

12. (4)

[Pg No. 174, NCERT Topic No. 8.5.4]

$V = l^3$

$\frac{\Delta v}{v} = 3\frac{\Delta l}{l}$

$\frac{\Delta v}{v} = \frac{3\times 1}{100} = 3\% \;\; = 0.03$

Bulk strain = 0.03

13. (4)

[Pg No. 133, NCERT Topic No. 7.9]

$V_D = \sqrt{v_{cm}^2 + v_{cm}^2} = v_{cm}\sqrt{2}$

14. (1)

[Pg No. 181, NCERT Topic No. 9.2]

Weight of cylinder = upthrust due to both liquids

$V \times D \times g = \left(\frac{A}{5} \times \frac{3}{4}L\right) \times d \times g + \left(\frac{A}{5} \times \frac{L}{4}\right) \times 2d \times g$

$\Rightarrow \left(\frac{A}{5} \times L\right) \times D \times g = \frac{A \times L \times d \times g}{4}$

$\Rightarrow \frac{D}{5} = \frac{d}{4}$

$\therefore D = \frac{5}{4}d$

15. (1)

[Pg No. 181, NCERT Topic No. 9.2]

Upthrust $= V\rho_{\text{liquid}}(g - a)$

where, a = downward acceleration,

V = volume of liquid displaced

But for free fall $a = g \;\therefore$ Upthrust = 0

16. (3)

[Pg No. 181, NCERT Topic No. 9.2]

Let the total volume of ice-berg is V and its density is ρ. If this ice-berg floats in water with volume V_{in} inside it then

$V_{in}\sigma g = V\rho g$

$\Rightarrow V_{in} = \left(\frac{\rho}{\sigma}\right)V$ [σ = density of water]

or $V_{out} = V - V_{in} = \left(\frac{\sigma - \rho}{\sigma}\right)V$

$\Rightarrow \frac{V_{out}}{V} = \left(\frac{\sigma - \rho}{\sigma}\right) = \frac{1000 - 900}{1000} = \frac{1}{10}$

$\therefore V_{out} = 10\%$ of V

17. (3)

[Pg No. 180, NCERT Topic No. 9.1]

$\left[\text{As specific gravity of substance } = \frac{\text{density of substance}}{\text{density of water}}\right]$

Specific gravity of alloy

$= \frac{\text{Density of alloy}}{\text{Density of water}}$

$= \frac{\text{Mass of alloy}}{\text{Volume of alloy} \times \text{density of water}}$

$= \frac{m_1 + m_2}{\left(\frac{m_1}{\rho_1} + \frac{m_2}{\rho_2}\right) \times \rho_w}$

$= \frac{m_1 + m_2}{\frac{m_1}{\rho_1/\rho_w} + \frac{m_2}{\rho_2/\rho_w}} = \frac{m_1 + m_2}{\frac{m_1}{s_1} + \frac{m_2}{s_2}}$

18. (1)

[Pg No. 181, NCERT Topic No. 9.2]

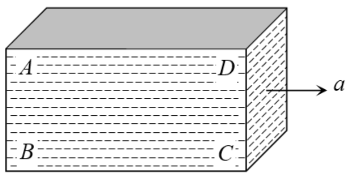
Fraction of volume immersed in the liquid

$V_{in} = \left(\frac{\rho}{\sigma}\right)V$ *i.e.* it depends upon the densities of the block and liquid.

So there will be no change in it if system moves upward or downward with constant velocity or some acceleration.

19. (1)

[Pg No. 181, NCERT Topic No. 9.2]



Due to acceleration towards right, there will be a pseudo force in a left direction. So the pressure will be more on rear side (Points A and B) in comparison with front side (Point D and C).

Also due to height of liquid column pressure will be more at the bottom (points B and C) in comparison with top (point A and D).
So overall maximum pressure will be at point B and minimum pressure will be at point D.

20. (3)

[Pg No. 184, NCERT Topic No. 7.7]

Escape velocity for that body $v_e = \sqrt{\frac{2Gm}{r}}$

v_e should be more than or equal to speed of light

i.e. $\sqrt{\frac{2Gm}{r}} \geq c$

21. (4)

[Pg No. 184, NCERT Topic No. 7.7]

Gravitational potential

$= \int E dx = \int_x^\infty \frac{K}{x^3} dx$

$= K\left(\frac{x^{-3+1}}{-3+1}\right)_x^\infty = \left|\frac{-K}{2x^2}\right|_x^\infty = \frac{K}{2x^2}$

22. (1)

[Pg No. 183, NCERT Topic No. 7.6]

Escape velocity does not depend on the mass of the projectile.

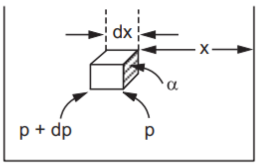
23. (1)

[Pg No. 184, NCERT Topic No. 9.3]

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

24. (4)

[Pg No. 184, NCERT Topic No. 9.3]



Consider an element of the liquid of width dx and area of cross-section α, at a distance x from the front of the tank.
Net force to the right on the element
$= (p + dp)\alpha - p\alpha = \alpha dp$.
$\therefore \alpha\, dp = (\rho\alpha\, dx)a$

or $\int_A^C dp = \int_A^C \rho a\, dx$

or $p_C - p_A = \rho a l$.

(Refer to the figure in the question to identify A, B, C.)

Also $p_B - p_C = \rho g h$

or $p_B - (p_A + \rho a l) = \rho g h$

or $p_B - p_A = h\rho g + l\rho a$.

25. (1)

[Pg No. 184, NCERT Topic No. 9.3]

As the cork moves up, the force due to buoyancy remains constant. As its speed increases, the retarding force due to viscosity increases, being proportional to the speed. Thus, the acceleration gradually decreases. The acceleration is variable, and hence the relation between velocity and time is not linear.

26. (2)

[Pg No. 193, NCERT Topic No. 9.6]

$P = P_0 - \rho g h$ P_0 = atmospheric pressure

$P_0 - P = \rho g h$ excess pressure of spherical surface

$\frac{2T}{R} = \rho g h$ $h = \frac{2T}{R\rho g}$

27. (2)

[Pg No. 196, NCERT Topic No. 9.5]

Terminal velocity $v_T = \frac{2}{9}\frac{R^2}{\eta}(\rho - \rho')g$

For the given material and liquid

$v_T \propto R^2$ (R = Radius of the raindrop)

When the eight raindrops combine together, let radius of new drop be R_1

Then, $\frac{4}{3}\pi R_1^3 = 8 \times \frac{4}{3}\pi R^3$

$\Rightarrow R_1 = 2R$

Thus $\frac{v_T}{v_{T_1}} = \left(\frac{R}{R_1}\right)^2 = \left(\frac{R}{2R}\right)^2$

$\frac{V_T}{V_{T_1}} = \frac{1}{4}$

$\Rightarrow V_{T_1} = 4V_T = 4 \times 6 = 24$ cm s^{-1}

(Given $V_T = 6$ cm s^{-1})

28. (1)

[Pg No. 277, NCERT Topic No. 11.5]

Velocity of body just before touching the lake surface is,

$v = \sqrt{2gh}$

Retardation in the lake,

$$a = \frac{\text{upthrust} - \text{weight}}{\text{mass}} = \frac{\sigma vg - \rho vg}{\rho V} = \left(\frac{\sigma - \rho}{\rho}\right) g$$

Maximum depth $d_{\max} = \frac{v^2}{2a} = \frac{h\rho}{\sigma - \rho}$

29. **(3)**

[Pg No. 277, NCERT Topic No. 11.5]

Let α = coefficient of thermal expansion, Y = Young modulus of the wire. If the wire were free to contract, its decrease in length would be $l\alpha t$, where t = decrease in temperature. To maintain constant length, $l\alpha t$ becomes the effective elongation.

$\therefore$ strain $= \frac{l\alpha t}{l} = \alpha t.$

Let T = tension $\therefore$ stress $= \frac{T}{A}.$

Using Y $= \frac{\text{stress}}{\text{strain}}$, $T = YA\alpha t.$

30. **(1)**

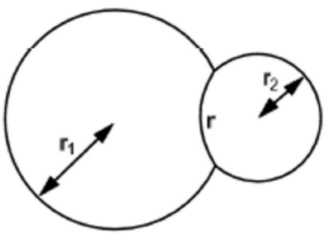
[Pg No. 194, NCERT Topic No. 9.6]

Tension must be the same in both the rods for their junction to be in equilibrium.

$Y_1 A\alpha_1 t = Y_2 A\alpha_2 t.$

31. **(2)**

[Pg No. 194, NCERT Topic No. 9.6]



Let p_0 = atmospheric pressure,

p_1 and p_2 = pressures insides the two bubbles.

$$p_1 - p_0 = \frac{4S}{r_1}, \quad p_2 - p_0 = \frac{4S}{r_2}$$

or $p_2 - p_1 = \frac{4S}{r_2} - \frac{4S}{r_1}$ = pressure difference across the common surface.

Let r = radius of curvature of the common surface.

$$\therefore p_2 - p_1 = \frac{4S}{r}.$$

$$\therefore \frac{4S}{r} = \frac{4S}{r_2} - \frac{4S}{r_1}.$$

32. **(1)**

[Pg No. 187, NCERT Topic No. 9.4]

$$Q_1 = Q_2$$

$$A_1 v_1 = A_2 v_2$$

$$L^2 \times \sqrt{2gy} = \pi R^2 \times \sqrt{2g.4y}$$

$$L^2 = 2\pi R^2$$

$$R = \frac{L}{\sqrt{2\pi}}$$

33. **(2)**

[Pg No. 187, NCERT Topic No. 9.4]

$$x = vt = \sqrt{2gh(H-h)}\sqrt{\frac{2h}{g}}$$

$$x = 2\sqrt{(H-h)h}$$

$$\frac{dx}{dh} = 2\frac{1}{dh}(Hh - h^2)^{1/2} = 2 \times 1(H - 2h)$$

$$2\sqrt{Hh - h^2}$$

For maximum $\frac{dx}{dh} = 0$

$$H - 2h = 0$$

$$h = \frac{H}{2}$$

$$x = 2\sqrt{Hh - h^2} = 2\sqrt{\frac{H^2}{2} - \frac{H^2}{4}}$$

$$x_{\max} = H$$

34. **(1)**

[Pg No. 187, NCERT Topic No. 9.4]

$$\theta_A > \theta_B$$

$$\because \tan\theta = Y$$

$$\tan\theta_A > \tan\theta_B$$

$$y_A > y_B$$

35. **(4)**

[Pg No. 193, NCERT Topic No. 9.6]

$$U = T(S.A)$$

$$U = T4\pi R^2$$

$\because\ 2\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$R = 2^{\frac{1}{3}} r$

$U = T4\pi(2^{1/3}r)^2 = 4\pi T 2^{2/3} r^2$

$= 2^2.2^{2/3}\pi r^2 T = 2^{8/3}\pi r^2 T$

36. (3)

[Pg No. 193, NCERT Topic No. 9.6]

$P - P_0 = \frac{2T}{r}$

$\because P = P_0 + \rho g h$

$P_0 + \rho g h - P_0 = \frac{2T}{r}$

$\rho g h = \frac{2T}{r}$

$h = \frac{2T}{\rho g r}$

37. (4)

[Pg No. 181, NCERT Topic No. 9.22]

$P = P_0 + \rho g h$

38. (2)

[Pg No. 181, NCERT Topic No. 9.22]

F = PA

$\because P = P_0 + \rho g h$

$F_A = F_B$

$W_A > W_B$

39. (4)

[Pg No. 182, NCERT Topic No. 9.22]

$\tan\theta = \frac{a}{g} = \frac{h}{L}$

$\frac{a}{g} = \frac{h}{L}$

$h = \frac{aL}{g}$

40. (2)

[Pg No. 189, NCERT Topic No. 9.4]

$P_A = P_0 + \rho g y + \rho a y$

$P_B = P_0 + \rho g(y+h) + \rho a(y+h)$

$P_B - P_A = \rho g h + \rho a h = \rho \times \frac{3}{2} g h$

41. (4)

[Pg No. 276, NCERT Topic No. 11.4]

$T_K = T_C + 273.15$

$\because\ T_K = 0$

$0 = T_C + 273.15$

$T_C = -273.15°\text{C}$

42. (3)

[Pg No. 276, NCERT Topic No. 11.4]

$T_C : T_F = 2:5$

$T_c = 2x, T_F = 5x$

$\frac{c}{100} = \frac{F-32}{180}$

$\frac{2x}{100} = \frac{5x-32}{180}$

$x = \frac{160}{7}$

$T_c = 2x = \frac{2\times 160}{7} = \frac{320}{7} = 45.71°\text{C}$

43. (4)

[Pg No. 278, NCERT Topic No. 11.5]

$\frac{\Delta l}{l} \times 100\% = 3\%$

$\alpha\Delta\theta \times 100\% = 3\%$

$\alpha = \frac{3}{100\Delta\theta} = \frac{0.03}{\Delta\theta}$

$\beta = 2\alpha = 2\times\frac{0.03}{\Delta\theta}$

$\frac{\Delta A}{A}\times 100\% = \beta\Delta\theta\times 100\%$

$= 2\times\frac{0.03}{\Delta\theta}\times\Delta\theta\times 100\%$

$= 6\%$

44. (1)

[Pg No. 277, NCERT Topic No. 11.5]

$\alpha = \frac{\Delta l}{l\Delta\theta} = \frac{0.19}{100\times 100} = 1.9\times 10^{-5}$

$\gamma = 3\alpha = 3\times 1.9\times 10^{-5} = 5.7\times 10^{-5}$

45. (1)

[Pg No. 278, NCERT Topic No. 11.6]

$\rightarrow$ 12°C ice $\rightarrow$ 0°C ice $\rightarrow$ 0°C water $\rightarrow$ 100°C water $\downarrow$ 100°C

Phase change $\rightarrow$ T = const.

$\Delta T = 0$

46. **(2)**

[Pg No. 278, NCERT Topic No. 11.6]

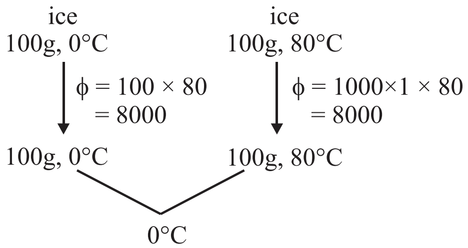
$M_w c_w \Delta\theta = M_{Al} C_{Al} \Delta\theta$

$M_w \times 1 = (20\text{ g}) \times 0.2$

$M_w = 4g$

47. **(1)**

[Pg No. 278, NCERT Topic No. 11.7]



48. **(1)**

[Pg No. 280, NCERT Topic No. 11.7]

Heat = loss = Heat gain

80 × 1 × (30.0) = m × 80

m = 30 gm

49. **(3)**

[Pg No. 282, NCERT Topic No. 11.7]

$mgh = mC\Delta\theta$

C = 1 cal/g°C = 4200 J/kg°C

$\Delta\theta = \frac{gh}{C} = \frac{10 \times 500}{420} = \frac{500}{420} = 1.19$

50. **(3)**

[Pg No. 281, NCERT Topic No. 11.7]

ice

10 gm, – 20°C

$\downarrow \phi = 10 \times \frac{1}{2} \times 20 = 100 \text{ cal}$

10 gm1, ice, 0°C

Water

100 gm, 10°C

$\downarrow \phi' = 10 \times 1 \times 10$

100 gm, 0°C, water