PRACTICE SET -5

1. A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the centre of the sphere is:
   a. 0 V
   b. 10 V
   c. Same as at point 5 cm away from the surface
   d. Same as at point 25 cm away from the surface
2. A parallel plate condenser has a capacitance $50\mu F$ in air and $110\mu F$ when immersed in an oil. The dielectric constant $'k'$ of the oil is:
   a. 0.45 b. 0.55 c. 1.10 d. 2.20
3. A parallel plate condenser is connected with the terminals of a battery. The distance between the plates is 6 mm. If a glass plate (dielectric constant $K = 9$) of 4.5 mm is introduced between them, then the capacity will become:
   a. 2 times b. The same c. 3 times d. 4 times
4. The temperature coefficient of resistance for a wire is $0.00125/°C$. At 300 K its resistance is 1 ohm. The temperature at which the resistance becomes 2 ohm is:
   a. 1154 K b. 1100 K c. 1400 K d. 1127 K
5. A carbon resistor has colour strips as violet, yellow brown and golden. The resistance is:
   a. 641 Ω b. 741 Ω c. 704 Ω d. 407 Ω
6. A magnet of magnetic moment M is situated with its axis along the direction of a magnetic field of strength B. The work done in rotating it by an angle of 180^o will be:
   a. $-MB$ b. $+MB$
   c. 0 d. $+2MB$
7. The intensity of magnetic field is H and moment of magnet is M. The maximum potential energy is:
   a. MH b. 2 MH
   c. 3 MH d. 4 MH
8. Field inside a solenoid is
   a. Directly proportional to its length
   b. Directly proportional to current
   c. Inversely proportional to total number of turns
   d. Inversely proportional to current
9. The magnetic moment of a current carrying loop is $2.1\times10^{-25} amp\times m^2$. The magnetic field at a point on its axis at a distance of 1Å is:
   a. $4.2\times10^{-2} weber/m^2$ b. $4.2\times10^{-3} weber/m^2$
   c. $4.2\times10^{-4} weber/m^2$ d. $4.2\times10^{-5} weber/m^2$
10. A 50 turns circular coil has a radius of 3 cm, , it is kept in a magnetic field acting normal to the area of the coil. The magnetic field B increased from 0.10 tesla to 0.35 tesla in 2 milliseconds. The average induced e.m.f. in the coil is:
    a. 1.77 volts b. 17.7 volts
    c. 177 volts d. 0.177 volts
11. A small coil is introduced between the poles of an electromagnet so that its axis coincides with the magnetic field direction. The number of turns is n and the cross sectional area of the coil is A. When the coil turns through 180^o about its diameter, the charge flowing through the coil is Q. The total resistance of the circuit is R. What is the magnitude of the magnetic induction?
    a. $\frac{QR}{nA}$ b. $\frac{2QR}{nA}$ c. $\frac{Qn}{2RA}$ d. $\frac{QR}{2nA}$
12. If instantaneous current is given by $i = 4\cos(\omega t + \phi)$ amperes, then the r.m.s. value of current is:
    a. 4 amperes b. $2\sqrt{2}$ amperes
    c. $4\sqrt{2}$ amperes d. zero amperes
13. In LCR circuit, the capacitance is changed from C to 4C. For the same resonant frequency, the inductance should be changed from L to:
    a. 2L b. L / 2
    c. L / 4 d. 4 L
14. A concave mirror and a converging lens (glass with μ = 1.5) both have a focal length of 3 cm when in air. When they are in water $\left(\mu = \frac{4}{3}\right)$, their new focal lengths are:
    a. f_{Lens} = 12 cm, f_{Mirror} = 3 cm
    b. f_{Lens} = 3 cm, f_{Mirror} = 12 cm
    c. f_{Lens} = 3 cm, f_{Mirror} = 3 cm
    d. f_{Lens} = 12 cm, f_{Mirror} = 12 cm
15. Light is incident normally on a diffraction grating through which first order diffraction is seen at 32°. The second order diffraction will be seen at:
    a. 84° b. 48°
    c. 64° d. None of these
16. Doppler shift for the light of wavelength 6000 Å emitted from the sun is 0.04 Å. If radius of the sun is 7×10^8 m then time period of rotation of the sun will be:
    a. 30 days b. 365 days
    c. 24 hours d. 25 days

17. A plane monochromatic light falls normally on a diaphragm with two narrow slits separated by a distance d = 2.5 mm. A fringe pattern is formed on the screen placed at D = 100 cm behind the diaphragm. If one of the slits is covered by a glass plate of thickness $10\mu m,$ then distance by which these fringes will be shifted will be:

a. 2 mm **b.** 3 mm **c.** 4 mm **d.** 5 mm

18. The magnetic field between the plates of a parallel plate capacitor is given by: $B = \frac{\mu_0 Ir}{2\pi R^2}$, when

a. $r \geq R$ **b.** $r \leq R$ **c.** $r < R$ **d.** $r = R$

19. The energy contained in a small volume through which an electromagnetic wave is passing, oscillates with

a. zero frequency
b. one-fourth frequency of wave
c. one-third frequency of wave
d. double frequency of wave

20. Wavelength of a 1 keV photon is $1.24\times10^{-9}\,m$. What is the frequency of 1 MeV photon?

a. $1.24\times10^{15}\,Hz$ **b.** $2.4\times10^{20}\,Hz$
c. $1.24\times10^{18}\,Hz$ **d.** $2.4\times10^{23}\,Hz$

21. Monochromatic light of wavelength 3000 Å is incident on a surface area $4 cm^2$. If intensity of light is 150 mW/m^2, then rate at which photons strike the target is:

a. 3×10^{10} / sec **b.** 9×10^{13} / sec
c. 7×10^{15} / sec **d.** 6×10^{19} / sec

22. When neon is used in Bainbridge mass spectrograph it is found that the lighter isotope Ne^{20} reaches the photographic plate at a distance 10 cm form the slit. The distance at which the heavier isotope Ne^{22} strikes the plate is:

a. 11 cm **b.** 9 cm
c. 4.5 cm **d.** 24 cm

23. The energy of electron in first excited state of H-atom is $-3.4\,eV$ its kinetic energy is:

a. – 3.4 eV **b.** + 3.4 eV **c.** – 6.8 eV **d.** 6.8 eV

24. The nuclide ^{131}I is radioactive, with a half-life of 8.04 days. At noon on January 1, the activity of a certain sample is 60089. The activity at noon on January 24 will be:

a. 75 Bq **b.** Less than 75 Bq
c. More than 75 Bq **d.** 150 Bq

25. After five half lives what will be the fraction of initial substance:

a. $\left(\frac{1}{2}\right)^{10}$ **b.** $\left(\frac{1}{2}\right)^{5}$
c. $\left(\frac{1}{2}\right)^{4}$ **d.** $\left(\frac{1}{2}\right)^{3}$

26. The electron density of E, F_1, F_2 layers of ionosphere is 2×10^{11}, 5×10^{11} and $8\times10^{11}\,m^{-3}$ respectively. What is the ratio of critical frequency for reflection of radiowaves?

a. 2 : 4 : 3 **b.** 4 : 3 : 2
c. 2 : 3 : 4 **d.** 3 : 2 : 4

27. A TV tower has a height of 50 m. The maximum distance up to which TV transmission can be received is approximately equal to: (radius of earth = 6.4×10^6 m)

a. 5 km **b.** 25 km **c.** 100 km **d.** 250 km

28. Temperature can be expressed as a derived quantity in terms of any of the following:

a. Length and mass **b.** Mass and time
c. Length, mass and time **d.** None of these

29. If the vector $6\hat{i} - 3\hat{j} - 6\hat{k}$ is decomposed into vectors parallel and perpendicular to the vector $\hat{i} + \hat{j} + \hat{k}$ then the vectors are:

a. $-\left(\hat{i} + \hat{j} + \hat{k}\right)$ and $7\hat{i} - 2\hat{j} - 5\hat{k}$

b. $-2\left(\hat{i} + \hat{j} + \hat{k}\right)$ and $8\hat{i} - \hat{j} - 4\hat{k}$

c. $+2\left(\hat{i} + \hat{j} + \hat{k}\right)$ and $4\hat{i} - 5\hat{j} - 8\hat{k}$

d. None

30. The position vector of a particle is $\vec{r} = (a\cos\omega t)\hat{i} + (a\sin\omega t)\hat{j}$. The velocity of the particle is:

a. Parallel to the position vector
b. Perpendicular to the position vector
c. Directed towards the origin
d. Directed away from the origin

31. A particle moving with a uniform acceleration along a straight line cover distances a and b in successive interval of p and q second. The acceleration of the particle is:

a. $\frac{pq(p+q)}{2(bp-aq)}$ **b.** $\frac{2(aq+bp)}{pq(p-q)}$

c. $\frac{(bp-aq)}{pq(p-q)}$ **d.** $\frac{2(bp-aq)}{pq(p+q)}$

32. A particle is projected with velocity υ_0 along x-axis. The deceleration on the particle is proportional to the square of the distance from the organic, i.e., $a = \alpha x^2$. The distance at which the particle stops is:

a. $\sqrt{\frac{3\upsilon_0}{2\alpha}}$ b. $\left(\frac{3\upsilon_0}{2\alpha}\right)^{1/3}$

c. $\sqrt{\frac{3\upsilon_0}{2\alpha}}$ d. $\left(\frac{3\upsilon_0}{2\alpha}\right)^{1/3}$

33. A ball of mass 0.2 *kg* moves with a velocity of 20 *m*/*sec* and it stops in 0.1 *sec*; then the force on the ball is:

a. 40 *N* **b.** 20 *N* **c.** 4 *N* **d.** 2 *N*

34. The linear momentum p of a body moving in one dimension varies with time according to the equation $p = a + bt^2$ where, a and b are positive constants. The net force acting on the body is:

a. A constant **b.** Proportional to t^2

c. Inversely proportional to t **d.** Proportional to t

35. A force of 5 *N*, making an angle θ with the horizontal, acting on an object displaces it by $0.4m$ along the horizontal direction. If the object gains kinetic energy of 1 *J,* the horizontal component of the force is:

a. 1.5 *N* **b.** 2.5 *N*

c. 3.5 *N* **d.** 4.5 *N*

36. Work done in raising a box depends on:

a. How fast it is raised

b. The strength of the man

c. The height by which it is raised

d. None of the above

37. If the increase in the kinetic energy of a body is 22%, then the increase in the momentum will be:

a. 22% **b.** 44%

c. 10% **d.** 300%

38. A particle moves in a circular path with decreasing speed. Choose the correct statement:

a. Angular momentum remains constant

b. Acceleration $(\vec{a})$ is towards the centre

c. Particle moves in a spiral path with decreasing radius

d. The direction of angular momentum remains constant

39. *A* particle executing simple harmonic motion along y-axis has its motion described by the equation $y = A\sin(\omega t + B)$. The amplitude of the simple harmonic motion is:

a. A **b.** B **c.** $A + B$ **d.** $\sqrt{A^2 + B^2}$

40. A particle is vibrating in a simple harmonic motion with an-amplitude of 4 *cm*. At what displacement from the equilibrium position, is its energy half potential and half kinetic?

a. 1 *cm* **b.** $\sqrt{2}$ *cm*

c. 3 *cm* **d.** $2\sqrt{2}$ *cm*

41. If the mass of earth is 80 times of that of a planet and diameter is double that of planet and '*g*' on earth is $9.8\,\text{m/s}^2$, then the value of '*g*' on that planet is:

a. $4.9\,\text{m/s}^2$ **b.** $0.98\,\text{m/s}^2$

c. $0.49\,\text{m/s}^2$ **d.** $49\,\text{m/s}^2$

42. If both the mass and the radius of the earth decrease by 1%, the value of the acceleration due to gravity will:

a. Decrease by 1% **b.** Increase by 1%

c. Increase by 2% **d.** Remain unchanged

43. In a satellite orbiting the earth, a coin is immersed in a jar of water and released. It will:

a. rise **b.** sink

c. remain where left **d.** oscillate

44. A wooden ball of density ρ is immersed in water of density α to depth h and released. The height H above the surface of water up to which the ball will jump out of water is:

a. $\frac{\sigma}{\rho}h$ **b.** $\left(\frac{\sigma}{\rho} - 1\right)h$

c. h **d.** zero

45. The interatomic distance for a metal is $3 \times 10^{-10}\,m$. If the interatomic force constant is $3.6 \times 10^{-9}\,N/Å$, then the Young's modulus in N/m^2 will be:

a. 1.2×10^{11} **b.** 4.2×10^{11}

c. 10.8×10^{-19} **d.** 2.4×10^{10}

46. Heat is supplied to a diatomic gas at constant pressure. The ratio of ΔQ : ΔU : ΔW is

a. 5 : 3 : 2 **b.** 7 : 5 : 2

c. 2 : 3 : 5 d. 2 : 5 : 7

47. The specific heat of air at constant volume is 0.172 Cal g-1 °C-. The change in internal energv when 5 g of air is heated from 0°C to 4°C at constant volume is

a. 28.8 J **b.** 14.4 J

c. 7.2 J **d.** 3.51 J

48. If R is universal gas constant, the amount of heat needed to raise the temperature of 2 moles of an ideal monatomic gas from 273 K to 373 K when no work is done is

a. $100R$ **b.** $150R$
c. 300R **d.** 500R

49. Which of the following is not a thermodynamic coordinate?
a. Gas constant (R) **b.** Pressure (P)
c. Volume (V) **d.** Temperature (T)

50. Which is an intensive property?
a. Volume **b.** Mass
c. Refractive index **d.** Weight

Answers and Solutions

1. **(b)** Since potential inside the hollow sphere is same as that on the surface.

2. **(d)** $C_{medium} = K\,C_{air} \Rightarrow K = \dfrac{C_{medium}}{C_{air}} = \dfrac{110}{50} = 2.20$

3. **(c)** $C \propto \dfrac{1}{d} \Rightarrow \dfrac{C_{medium}}{C_{air}} = \dfrac{d}{d-t+\dfrac{t}{K}}$

$$= \frac{6}{6-4.5+\dfrac{4.5}{9}} = \frac{6}{2} = 3$$

4. **(d)** $\dfrac{\rho_1}{\rho_2} = \dfrac{(1+\alpha t_1)}{(1+\alpha t_2)} \Rightarrow \dfrac{1}{2} = \dfrac{(1+0.00125\times 27)}{(1+0.00125\times t)}$

$\Rightarrow$ $t = 854°C \Rightarrow T = 1127K$

5. **(b)** Using standard colour codes.
Violet = 7, yellow = 4, brown = 1 and gold = 5 % (tolerance)
So $R = 74\times 10^1 \pm 5\% \;= 740 \pm 5\%$
So its value will be nearest to 741 Ω.

6. **(d)** Work done $MB(\cos\theta_1 - \cos\theta_2)$
$\theta_1 = 0°$ and $\theta_2 = 180°$
$\Rightarrow$ $W = MB\left(\cos 0 - \cos 180\right) = 2MB$

7. **(a)** Potential energy: $U = -MB\cos\theta$
$\Rightarrow$ $U_{\max} = MH(\text{at}\,\theta = 180°)$

8. **(b)** $B = \mu_o n i$

9. **(a)** Field at a point x from the centre of a current carrying loop on the axis is:

$$\text{B} = \frac{\mu_0}{4\pi}\cdot\frac{2M}{x^3} = \frac{10^{-7}\times 2\times 2.1\times 10^{-25}}{(10^{-10})^3}$$
$$= 4.2\times 10^{-32}\times 10^{30} = 4.2\times 10^{-2} W/m^2$$

10. **(b)** $e = -\dfrac{N(B_2 - B_1)A\cos\theta}{\Delta t}$

$$= -\frac{500\times(0-0.1)\times 100\times 10^{-4}\cos 0}{0.1} = 5V$$

11. **(d)** Induced charge: $Q = -\dfrac{NBA}{R}(\cos\theta_2 - \cos\theta_1)$

$$= -\frac{NBA}{R}(\cos 180^o - \cos 0^o)$$

$\Rightarrow$ $B = \dfrac{QR}{2NA}$

12. **(b)** $i_{r.m.s.} = \dfrac{i_o}{\sqrt{2}} = \dfrac{4}{\sqrt{2}} = 2\sqrt{2}\ ampere$

13. **(c)** $\omega = \dfrac{1}{\sqrt{L_1C_1}} = \dfrac{1}{\sqrt{L_2C_2}} \Rightarrow L_2 = \dfrac{L_1}{4}$

14. **(a)** Focal length of lens will increase by four times (*i.e.,* 12 cm*)* while focal length of mirror will not affected by medium.

15. **(d)** For second order diffraction,
$\sin\theta 2 = \dfrac{2\lambda}{d} = 2\sin\theta 1 \;= 2\sin 32° > 1$
That is not possible. Hence, there is no second order diffraction.

16. **(d)** Doppler shift, $d\lambda = \dfrac{v}{c}x\lambda = R_{\varpi}\left(\dfrac{\lambda}{c}\right)$

or $R\left(\dfrac{2\pi}{T}\right)\dfrac{\lambda}{c} = d\lambda$

Substituting values for all parameter, we get

or $T = \dfrac{R\times 2\pi}{d\lambda}\times\dfrac{\lambda}{c} \Rightarrow$ T = 25 days

17. **(a)** $\dfrac{xd}{D}(\mu-1)t \Rightarrow x = \dfrac{(\mu-1)\,tD}{d}$

Or $x = \dfrac{(1.5-1)\times 10^{-3}\times 100}{0.25} = 0.2\,cm$

18. **(c)** Consider a closed loop of radius r in a region between the plates around the line joining centre of two || plates of capacitor, where $r < R$. If I_D is the total displacement current, then current threading the loop is $I_D = \dfrac{I_D}{\pi R^2}\times\pi r^2$.
Using Ampere's circuital law we have:

$$\oint \vec{B}\cdot\vec{dl} = \mu_0 I_D \text{ or } B2\pi r = \mu_0\frac{I_D r^2}{R^2}$$

Or $B = \dfrac{\mu_0 I_D r}{2\pi R^2}$.

19. **(d)** Use method of dimensions. Equating the dimensions of two sides we note the relation (a) is dimensionally correct.

20. **(b)** $E = h\nu \Rightarrow \nu = \frac{E}{h} = \frac{1\times10^{6}\times1.6\times10^{-19}}{6.6\times10^{-34}} = 2.4\times10^{20}\ Hz$

21. **(b)** $\frac{n}{t} = \frac{IA\lambda}{hc} = \frac{150\times10^{-3}\times4\times10^{-4}\times3\times10^{-7}}{6.6\times10^{-34}\times3\times10^{8}} = 9\times10^{13}\ \frac{1}{\text{sec}}$

22. **(a)** In Bainbridge mass spectrograph, particles have same velocity.

so, $r = \frac{mv}{qB} \Rightarrow d(=2r) = \frac{2mv}{qB}$

As q, B and v are same

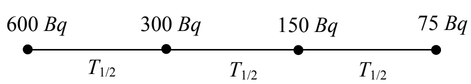
$\therefore\ D \propto m \Rightarrow \frac{D_2}{D_1} = \frac{m_2}{m_1}$

or $.D_2 = \frac{m_2}{m_1}D_1 = \frac{22}{20}\times10 = 11\text{cm}$

23. **(b)** Kinetic energy = |Total energy|

24. **(c)** Number of days from January 1st to January 24th = 23 days.

Number of half lives $n = \frac{23}{8.04} = 2.86(<3)$



In three half lives activity becomes 75 *Bq*, but the given number of half lives are lesser than 3 so activity becomes greater than 75 *Bq*.

25. **(c)** The activity $\left(-\frac{dN}{dt}\right) = \lambda N$

$\Rightarrow\ N = \left(-\frac{dN}{dt}\right)\left(\frac{T_{1/2}}{\log_e 2}\right)$

Taking the ratio of this expression for ^{240}Pu to this same expression for ^{243}Am,

$$\frac{N_{Pu}}{N_{Am}} = \frac{\left(-\frac{dN_{Pu}}{dt}\right)(T_{1/2})_{Pu}}{\left(-\frac{dN_{Am}}{dt}\right)(T_{1/2})_{Am}} = \frac{(5\mu ci)\times(6560y)}{(4.45\mu ci)\times(7370y)} = 1$$

i.e. the two samples contains equal number of nuclei.

26. **(c)** $f_c \propto (N)^{1/2} \Rightarrow (f_c)_E : (f_c)_{F_1} : (f_c)_{F_2}$

$= (2\times10^{11})^{1/2} : (5\times10^{11})^{1/2} : (8\times10^{11})^{1/2}$

$= 2 : 3 : 4$

27. **(b)** Maximum range, $d_{\max} = \sqrt{2Rh} = \sqrt{2\times6.4\times10^{6}\times50}$

$= 25.3\times10^{3}\text{m} = 25.3\text{km}$

28. **(d)** Because temperature is a fundamental quantity.

29. **(a)** A vector $\vec{a}$ which is decomposed into parallel and perpendicular to the vector $\vec{b}$ is $\left(\frac{\vec{a}\,.\vec{b}}{\vec{b}^2}\right)\ \vec{a} - \left(\frac{\vec{a}.\vec{b}}{\vec{b}^2}\right)\vec{b}$ or

$\frac{\vec{b}\times(\vec{a}\times\vec{b})}{\vec{b}^2}$

30. **(b)** $\vec{r} = (a\cos\omega t)\hat{i} + (a\sin\omega t)\hat{j}$

$\vec{v} = \frac{d\vec{r}}{dt} = -a\,\omega\sin\omega t\,\hat{i} + a\,\omega\cos\omega t\,\hat{j}$

As $\vec{r}.\vec{v} = 0$ therefore velocity of the particle is perpendicular to the position vector.

31. **(b)** According to problem when $s = a, t = p$

$\therefore\ s = ut + \frac{1}{2}ft^2$ (where, f = acceleration)

or $a = up + \frac{fp^2}{2}$

For $s = b, t = q$

$b = uq + \frac{fq^2}{2}$

After solving equation (1) and (2),

$f = \frac{2(aq - bp)}{pq(p-q)}$

32. **(d)** $a = \frac{d\upsilon}{dt} = \frac{d\upsilon}{dx}\cdot\frac{dx}{dt} = \upsilon\frac{d\upsilon}{dx} = \alpha x^2$ (given)

$\therefore\ \int_{\upsilon_0}^{0}\upsilon\,dx = -\alpha\int_{0}^{S}x^2\,dx$

$\left[\frac{\upsilon^2}{2}\right]_{\upsilon_0}^{0} = -\alpha\left[\frac{x^3}{3}\right]_0^S ; \frac{\upsilon_0^2}{2} = \frac{\alpha S^3}{3}$

or $S = \left[\frac{3\upsilon_0^2}{2\alpha}\right]^{1/3}$

33. **(d)** $R = m(g+a) = m(g+g) = 2mg$

34. **(d)** $F = \frac{dp}{dt} \equiv \frac{d}{dt}(a+bt^2) = 2bt\ \therefore F \propto t$

35. **(b)** Work done on the body = K.E. gained by the body

$Fs\cos\theta = 1$

$\Rightarrow \quad F\cos\theta = \frac{1}{s} = \frac{1}{0.4} = 2.5N$

36. **(c)** Work in raising a box
= (weight of the box) × (height by which it is raised)

37. **(c)** $P = \sqrt{2mE}$. If m is constant then

$\frac{P_2}{P_1} = \sqrt{\frac{E_2}{E_1}} = \sqrt{\frac{1.22E}{E}}$

$\Rightarrow \quad \frac{P_2}{P_1} = \sqrt{1.22} = 1.1$

$\Rightarrow \quad P_2 = 1.1P_1$

$\Rightarrow \quad P_2 = P_1 + 0.1P_1 = P_1 + 10\%$ of P_1

So the momentum will increase by 10%

38. **(d)** $\vec{L} = m(\vec{r} \times \vec{v})$

Direction of $(\vec{r} \times \vec{v})$, hence the direction of angular momentum remains the same.

$\therefore$ Correct answer is (d).

39. **(a)** The amplitude is a maximum displacement from the mean position.

40. **(d)** Let x be the point where K.E. = P.E.

Hence $\frac{1}{2}m\omega^2(a^2 - x^2) = \frac{1}{2}m\omega^2 x^2$

$\Rightarrow \quad 2x^2 = a^2 \Rightarrow x = \frac{a}{\sqrt{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2}\ cm$

41. **(c)** $g_p = g_e\left(\frac{M_p}{M_e}\right)\left(\frac{R_e}{R_p}\right)^2 = 9.8\left(\frac{1}{80}\right)(2)^2$

42. **(b)** As $g = \frac{GM}{R^2}$ therefore, 1% decrease in mass will decreases the value of g by 1%. But 1% decrease in radius will increase the value of g by 2%.
As a whole value of g increase by 1%.

43. **(c)** In a satellite bodies are weightless; so upthrust is zero.

44. **(b)** W_{ball} < force of buoyancy; so ball in liquid experience an upward force given by:

$f = B - W = V\sigma g - V\rho g$

If a upward acceleration, then $(V\rho)a = V\sigma g - V\rho g$

$\Rightarrow \quad a = \frac{(\sigma - \rho)}{\rho}g$

Velocity of ball at surface,

$v^2 = u^2 - 2ah = 0 + 2\left(\frac{\sigma - \rho}{\rho}\right)gh$

If H is the height above water surface, then $u' = v$ and $v' = 0$ so formula $v^2 = u^2 - 2gH$ gives $0 = v^2 - 2gH$

$\Rightarrow \quad H = \frac{v^2}{2g} = \frac{2(\sigma - \rho)}{\rho}\frac{gh}{2g}$

$= \left(\frac{\sigma - \rho}{\rho}\right)h = \left(\frac{\sigma}{\rho} - 1\right)h$

45. **(a)** $Y = \frac{3.6 \times 10^{-9}\, N/\mathring{A}}{3 \times 10^{-10}\, m} = 1.2 \times 10^{11}\, N/m^2$

46. **(b)** For a diatomic gas, $C_V = \frac{5}{2}R, C_P = \frac{7}{2}R$

$\Delta Q = nC_P\Delta T = n\left(\frac{7}{2}R\right)\Delta T$

$\Delta U = nC_V\Delta T = n\left(\frac{5}{2}R\right)\Delta T$

$\Delta W = \Delta Q - \Delta U = nR\Delta T$

$\therefore \ \Delta Q : \Delta U : \Delta W = \frac{7}{5} : \frac{5}{2} : 1$ or 7 : 5 : 2

47. **(b)** As constant volume, $dW = PdV = P \times 0 = 0$
$dQ = mC_V\Delta T = 5 \times 0.172 \times 4$ cal
$= 5 \times 0.172 \times 4 \times 4.2$ J = 14.4 J
$\therefore$ dU = dQ – dW = 14.4 – 0 = 14.4 J.

48. **(c)** As no work is done, therefore, $\Delta W = 0$
According to first law of thermodynamics

$\Delta Q = \Delta U + \Delta W = \Delta U = nC_V\Delta T = n\left(\frac{R}{\gamma - 1}\right)\Delta T$

Here, n = 2, $\gamma = \frac{5}{3}$

$\Delta T = T_2 - T_1 = (373 - 273) = 100$ K

$\Delta Q = 2 \times \frac{R}{\left(\frac{5}{3} - 1\right)} \times 100 = 300$ R

49. **(a)** Pressure (P), volume (V) and temperature *(T)* are the thermodynamic co-ordinates used to describe the state of the system whereas gas constant (R) is a universal gas constant whose value is 8.314 J $mo^{-1}K^{-1}$

50. **(c)** An intensive property is that which does not depend on the quantity of matter or mass of the system. Refractive index is an intensive property. Volume, mass and weight are extensive properties.

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