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Physics mock test 8 2022-23

Time : 75 Min	Phy : Full Portion Paper	Marks : 200

Hints and Solutions

01) Ans: **C)** 4 : 1

Sol: Using, $V_{big} = n^{2/3}\, v_{small} \Rightarrow \frac{V_{Big}}{v_{small}} = (8)^{2/3} = \frac{4}{1}$

02) Ans: **C)** 9 m/s

Sol: Wave velocity, $v = \upsilon\lambda = \left(\frac{54}{60}\right) \times 10 = 9\ m/s$

03) Ans: **A)** $\sqrt{a} : \sqrt{b}$

Sol: Here, $h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{2h/g}$

$\therefore t_a = \sqrt{\frac{2a}{g}}$ and $t_b = \sqrt{\frac{2b}{g}} \Rightarrow \frac{t_a}{t_b} = \sqrt{\frac{a}{b}}$

04) Ans: **D)** $(111101)_2$

Sol: Here,

$(100010)_2 = 2^5 \times 1 + 2^4 \times 0 + 2^3 \times 0 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 0$

$= 32 + 0 + 0 + 0 + 2 + 0 = (34)_{10}$

and $(11011)_2 = 2^4 \times 1 + 2^3 \times 1 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 1$

$= 16 + 8 + 0 + 2 + 1 = (27)_{10}$

$\therefore$ Sum, $(100010)_2 + (11011)_2 = (34)_{10} + (27)_{10} = (61)_{10}$

2	61	Remainder
2	30	1 LSD
2	15	0
2	7	1
2	3	1
2	1	1
	0	1 MSD

$\therefore$ Required sum (in binary system)

$(100010)_2 + (11011)_2 = (111101)_2$

05) Ans: **B)** 5 seconds

Sol: Force $(F) = 6\,N$;

Initial velocity $(u) = 0$;

Mass $(m) = 1\,kg$ and final velocity $(v) = 30\,m/s$.

Therefore acceleration $(a) = \frac{F}{m} = \frac{6}{1} = 6\,m/s^2$ and

final velocity $(v) = 30 = u + at = 0 + 6 \times t$ or $t = 5$ seconds.

06) Ans: **C)** $0.50\,\Omega$

Sol: Here, $r = \left(\frac{l_1 - l_2}{l_1}\right)R = 0.5\,\Omega$.

07) Ans: **D)** both (2) and (3).

08) Ans: **C)** 1.5

Sol: For dark fringe at P,

$S_1P - S_2P = \Delta = (2n-1)\lambda/2$

Now, here n =3 and λ = 6000

$\therefore \Delta = \frac{5\lambda}{2} = 5 \times \frac{6000}{2} \Rightarrow \Delta = 15000\ Å = 1.5$ micron

09) Ans: **D)** Proportionality between restoring force and displacement from equilibrium position

Sol: As we know, $F = -kx$.

10) Ans: **C)** $T_1 > T_3 > T_2$

Sol: From the Wien's law, $\lambda_m \propto \frac{1}{T}$ and from the figure $(\lambda_m)_1 < (\lambda_m)_3 < (\lambda_m)_2$. Thus, $T_1 > T_3 > T_2$.

11) Ans: **D)** Zero

12) Ans: **B)** 3 : 2

Sol: Suppose two cells have emfs ε_1 and ε_2 (also $\varepsilon_1 > \varepsilon_2$). Potential difference per unit length of the potentiometer wire = k (say)

When ε_1 and ε_2 are in series and support each other then

$\varepsilon_1 + \varepsilon_2 = 50 \times k$

...(i)

When ε_1 and ε_2 are in opposite direction

$\varepsilon_1 - \varepsilon_2 = 10 \times k$

...(ii)

On adding equation (i) and equation (ii)

$2\varepsilon_1 = 60k \Rightarrow \varepsilon_1 = 30k$ and $\varepsilon_2 = 50k - 30k = 20k$

$\therefore \frac{\varepsilon_1}{\varepsilon_2} = \frac{30k}{20k} = \frac{3}{2}$

13) Ans: **C)** the angular speed of the earth will increase.

Sol: If radius of earth decreases then its moment of inertia also decreases.

As $L = I\omega \therefore \omega \propto \frac{1}{I}$ (L is constant.)

It means angular velocity of the earth will increase.

14) Ans: **D)** 5.0 ± 11%

Sol: Given, Weight in air = (5.00 ± 0.05) Newton and Weight in water = (4.00 ± 0.05) Newton

Loss of weight in water = (1.00 ± 0.1) Newton

Relative density $= \frac{\text{weight in air}}{\text{weight loss in water}}$

Relative density $= \dfrac{5.00 \pm 0.05}{1.00 \pm 0.1}$

Thus, relative density with max. permissible error

$= \dfrac{5.00}{1.00} \pm \left(\dfrac{0.05}{5.00} + \dfrac{0.1}{1.00}\right) \times 100$

Max. permissible error $= 5.0 \pm (1 + 10)\% = 5.0 \pm 11\%$

15) Ans: **B)** μA

Sol: As the ray emerges normally, thus $e = 0$.
According to relation $A + \delta = i + e$, we get $i = A + \delta$
$\therefore$ By $\delta = (\mu - 1)A$, we get $i = \mu A$.

16) Ans: **A)** $3\ \mu F$

Sol: We know, $C = \dfrac{\varepsilon_0 A}{d}$. As A $\rightarrow \dfrac{1}{2}$ times

and $d \rightarrow 2$ times,

$\therefore C \rightarrow \dfrac{1}{4}$ times $\Rightarrow C' = \dfrac{1}{4}C = \dfrac{12}{4} = 3\ \mu F$

17) Ans: **D)** 324 Hz

Sol: From given problem, n_A =?, n_B = Known frequency = 320 Hz
x = 4 bps, which remains same after filling.
Unknown fork A is filed, thus $n_A \uparrow$.
$\therefore n_A \uparrow - n_B = x \rightarrow$ Wrong
$n_B - n_A \uparrow = x \rightarrow$ Correct
$\Rightarrow n_A = n_B - x = 320 - 4 = 316$ Hz.
This is the frequency before filling. But in question frequency after filing is asked which must be greater than 316 Hz, such that it produces 4 beats per second. therefore it is 324 Hz

18) Ans: **C)** 1 : 1

Sol: As work done does not depend on time.

19) Ans: **D)** 22, 18

Sol: From given,
Number of protons = 2 + 2 + 6 + 2 + 6 = 18 and
Number of neutrons = 40 - 18 = 22.

20) Ans: **D)** 1 ohm

Sol: Current,

$i = \dfrac{V}{R} \Rightarrow 2 = \dfrac{6}{\dfrac{6 \times 3}{6+3} + R} = \dfrac{6}{2 + R} \Rightarrow R = 1\,\Omega$

21) Ans: **D)** 16 times

Sol: As we know,
Work = Force × Displacement (length)
Therefore from the above relation, if unit of force and length be increased by four times then the unit of energy will increase by 16 times.

22) Ans: **C)** 27

Sol: In the given reaction, x + 1 = 24 + 4
$\Rightarrow$ x = 27

23) Ans: **D)** 12 : 1

Sol: The angular velocity of the minute hand,

$\omega_{min} = \dfrac{2\pi}{60} \dfrac{Rad}{min}$

and the angular velocity of the hour hand,

$\omega_{hr} = \dfrac{2\pi}{12 \times 60} \dfrac{Rad}{min} \quad \therefore \quad \dfrac{\omega_{min}}{\omega_{hr}} = \dfrac{2\pi / 60}{(2\pi / 12) \times 60}$

24) Ans: **D)** $\dfrac{800}{9}$ V

Sol: Initially potential difference across each capacitor is $V_1 = \dfrac{20}{(10+20)} \times 200 = \dfrac{400}{3}$ V

and $V_2 = \dfrac{10}{(10+20)} \times 200 = \dfrac{200}{3}$ V

and finally common potential is $V = \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$\Rightarrow V = \dfrac{10 \times \dfrac{400}{3} + 20 \times \dfrac{200}{3}}{(10+20)} = \dfrac{800}{9}$ V

25) Ans: **A)** minimum potential energy.

26) Ans: **C)** $p \neq 0, E \neq 0$

Sol: EM waves carry momentum and thus can exert pressure on surfaces. They also transfer energy to the surface, therefore $p \neq 0$ and $E \neq 0$.

27) Ans: **A)** decrease.

28) Ans: **C)** $\sqrt{\dfrac{4\pi M}{i}}$

Sol: Magnetic moment of circular loop carrying current is given by $M = IA = I(\pi R^2)$

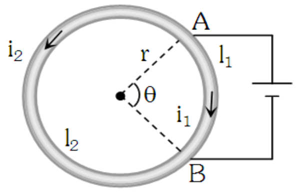
$\Rightarrow M = I\pi\left(\dfrac{L}{2\pi}\right)^2 = \dfrac{IL^2}{4\pi} \Rightarrow L = \sqrt{\dfrac{4\pi M}{I}}$

29) Ans: **D)** Zero

Sol: Directions of currents in two parts are different, so directions of magnetic fields due to these currents are opposite. Also applying Ohm's law across AB

$i_1R_1 = i_2R_2 \Rightarrow i_1l_2 = i_2l_2 \quad \left(\text{As, } R = \rho\dfrac{l}{A}\right)$

Also, $B_1 = \dfrac{\mu_o}{4\pi} \times \dfrac{i_1l_1}{r^2}$ and $B_2 = \dfrac{\mu_o}{4\pi} \times \dfrac{i_2l_2}{r^2}$ $(\because l = r\theta)$

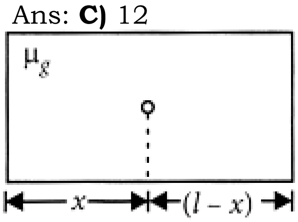


$\Rightarrow \dfrac{B_2}{B_1} = \dfrac{i_1l_1}{i_2l_2} = 1$

Therefore, two field inductions are equal but of opposite direction. So, resultant magnetic induction at the centre is zero and is independent of θ.

30) Ans: **C)** 12

Sol:



Here $\mu = 1.5$

$l =$ length of the slab

$x =$ position of air bubble from one side

As per question, total apparent length of slab $= 5+3$

or $\frac{x}{\mu} + \frac{(l-x)}{\mu} = 8$ or $\frac{l}{\mu} = 8$

$\therefore l = 8\mu = 8\times 1.5 = 12\,\text{cm}$

31) Ans: **B)** 150 K

Sol: Here, we have,

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} \Rightarrow \frac{T_2}{T_1} = \left(\frac{1}{8}\right)^{\frac{1.5-1}{1.5}} = \left(\frac{1}{8}\right)^{\frac{1}{3}} = \frac{1}{2}$

$\Rightarrow T_2 = \frac{T_1}{2} = \frac{300}{2} = 150\,\text{K}$

32) Ans: **A)** 100°C

Sol: 100°C

33) Ans: **D)** $\frac{1}{2\pi f(2\pi f L + R)}$

Sol: $\tan\phi = \frac{X_C - X_L}{R}$ or $\tan\left(\frac{\pi}{4}\right) = \frac{\frac{1}{\omega C} - \omega L}{R}$

$R = \frac{1}{\omega C} - \omega L$ or $(R + 2\pi f L) = \frac{1}{2\pi f C}$ or

$C = \frac{1}{2\pi f (R + 2\pi f L)}$

34) Ans: **D)** $32P_1$

Sol: For an adiabatic process

$PV^{\gamma} = \text{constant}$ or $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

For monatomic gas $\gamma = \frac{5}{3}$

$\therefore P_1V_1^{5/3} = P_2\left(\frac{V_1}{8}\right)^{5/3} \Rightarrow P_2 = P_1 \times (2)^5 = 32P_1$

35) Ans: **B)** $V_2 > V_1$

Sol: From the graph,

$\theta_2 > \theta_1 \Rightarrow \tan\theta_2 > \tan\theta_1 \Rightarrow \left(\frac{T}{P}\right)_2 > \left(\frac{T}{P}\right)_1$

Also from $PV = \mu RT$, $\frac{T}{P} \propto V \Rightarrow V_2 > V_1$.

36) Ans: **B)** 16×10^{-11}

Sol: By using, $eE = mg$

$\Rightarrow e = \frac{mg}{E} = \frac{16\times 10^{-6}\times 10}{10^6} = 16\times 10^{-11}$ C.

37) Ans: **B)** 75 joule

Sol: Work done, $W = \frac{1}{2}Fl = \frac{1}{2}\times Mg \times l$

$\Rightarrow = \frac{1}{2}\times 5\times 10\times 3 = 75\,\text{J}$

38) Ans: **C)** both (1) and (2).

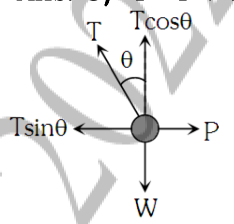
39) Ans: **D)** 12.5×10^{-2} m

Sol: From the given problem,

$6\times 10^{-2} \times \text{Circumference} = \text{Force}$

$\therefore$ $\text{Circumference} = \frac{75\times 10^{-4}}{6\times 10^{-2}} = 12.5\times 10^{-2}$ m

40) Ans: **C)** $T = P + W$



Sol:

As the metal sphere is in equilibrium under the effect of three forces therefore, $\vec{T} + \vec{P} + \vec{W} = 0$

From the figure, $T\cos\theta = W$ ...(i)

$T\sin\theta = l$ ...(ii)

By solving the equations (i) and (ii), we get, $P = W\tan\theta$ and $T^2 = P^2 + W^2$

41) Ans: **C)** $2\times 10^4\,\text{cm}^2$

Sol: Here, $P_1 = P_2 \Rightarrow \frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\Rightarrow \frac{10^7}{10^2} = \frac{2000\times 10^3\times 10^3}{A_2}$

$\therefore$ $A_2 = 2\times 10^4\,\text{cm}^2$ $(g = 980 \approx 10^3\,\text{cm/s}^2)$

42) Ans: **D)** $-(6\hat{i} + 5\hat{j} + 2\hat{k})$

Sol: The electric field $\vec{E}$ and potential V in a region are related as $\vec{E} = -\left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right]$

Here, $V(x,y,z) = 6xy - y + 2yz$

$$\therefore \vec{E} = -\left[\frac{\partial}{\partial x}(6xy - y + 2yz)\hat{i} + \frac{\partial}{\partial y}(6xy - y + 2yz)\hat{j} + \frac{\partial}{\partial z}(6xy - y + 2yz)\hat{k}\right]$$

$= -\left[(6y)\hat{i} + (6x - 1 + 2z)\hat{j} + (2y)\hat{k}\right]$

at point (1, 1, 0),

$\vec{E} = -\left[(6(1))\hat{i} + (6(1) - 1 + 2(0))\hat{j} + (2(1))\hat{k}\right]$

$= -(6\hat{i} + 5\hat{j} + 2\hat{k})$

43) Ans: **B)** 1.76×10^{11} coulomb / kg
Sol: In this case,
$$\frac{e}{m}=\frac{1.6\times10^{-19}}{9.1\times10^{-31}}\Rightarrow\frac{e}{m}=1.76\times10^{11}\,C/kg$$

44) Ans: **C)** Statement 1 is true but statement 2 is false.
Sol: The manner in which the two coils are oriented, determines the coefficient of coupling between them. i.e. $M=K^2.L_1L_2$
The coefficient of coupling is maximum, when the two coils are wound on each other, and thus mutual inductance between the coil is maximum.

45) Ans: **D)** All molecules have same speed
Sol: Molecules of an ideal gas move randomly with different speeds.

46) Ans: **A)** 5.2×10^3 N
Sol: Given, $u=250\,m/s$, $v=0$, $s=0.12$ metre
and $F=ma=m\left(\frac{u^2-v^2}{2s}\right)=\frac{20\times10^{-3}\times(250)^2}{2\times0.12}$
$\therefore\ F=5.2\times10^3$ N

47) Ans: **A)** 6562 Å, 4863 Å
Sol: We have $\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$.
For first wavelength, $n_1=2$, $n_2=3\Rightarrow\lambda_1=6562$ Å
For second wavelength, $n_1=2$, $n_2=4$
$\Rightarrow\lambda_2=4863$ Å

48) Ans: **B)** 1.5%
Sol: From the problem orbital radius is increased by 1% is given and time period of satellite $T\propto r^{3/2}$.
$\therefore$ Percentage change in time period = $\frac{3}{2}$(% change in orbital radius) = $\frac{3}{2}(1\%)=1.5\%$

49) Ans: **D)** 40 J
Sol: From given problem, $\Delta Q=\Delta U+\Delta W$
$\Rightarrow\Delta U=\Delta Q-\Delta W=150-110=40$ J

50) Ans: **A)** 8T
Sol: Here, $\frac{T_1}{T_2}=\left(\frac{R_1}{R_2}\right)^{3/2}$
Thus, from given $\Rightarrow\frac{T_1}{T_2}=\left(\frac{R}{4R}\right)^{3/2}\Rightarrow T_2=8T_1$