WEEKLY TEST MEDICAL PLUS - 01 TEST - 22 R & B SOLUTION Date 20-10-2019

[PHYSICS]

1. It is the speed of light in free space. Hence, dimension is that of speed, *i.e.*, LT^{-1}.

2. Boltzmann's constant = energy/temperature

$$= \frac{[ML^2T^{-2}]}{[\theta]} = [ML^2T^{-2}\theta^{-1}]$$

3. The only scalar quantity in the given set is pressure.

4. Distance travelled in *n*th second,

$$s_n = u + a\left(n - \frac{1}{2}\right)$$

Distance travelled in 2nd second,

$$s_2 = 0 + a\left(2 - \frac{1}{2}\right) \quad \ldots(i)$$

Distance travelled in 5th second,

$$s_5 = 0 + a\left(5 - \frac{1}{2}\right) \quad \ldots(ii)$$

Dividing eqn. (ii) by eqn. (i), $s_5 = 24$ m

5. When the body returns to origin, displacement is zero.

$$s = ut + \frac{1}{2}at^2$$

$$0 = 60t - \frac{1}{2} \times 10 \times t^2$$

Solving, $t = 12$ s

6. $$v \propto \lambda^x \rho^y g^z$$

Putting dimensions,

$$LT^{-1} = L^x(ML^{-3})^y(LT^{-2})^x$$

Solving, we get $v \propto \sqrt{g\lambda}$.

7. Squaring the given equation,

$$A^2 + B^2 + 2\vec{A}\cdot\vec{B} = C^2$$

Moreover, $A^2 + B^2 = C^2$ $\quad (\because A = 6, B = 8, C = 10)$

$\therefore \quad \vec{A}\cdot\vec{B} = 0,\ i.e.,\ \vec{A}$ is $\perp$ to $\vec{B}$

8. Using equation of motion,

height reached by first body, $h_1 = \frac{u^2}{2g}$

height reached by second body, $h_2 = \frac{u^2 \sin^2 30°}{2g} = \frac{1}{4} \times \frac{u^2}{2g}$

$\therefore \quad h_1 : h_2 = 4 : 1$

As $\quad$ PE $\propto$ height

$\therefore \quad (PE)_1 : (PE)_2 = 4 : 1$

9. KE of first body at the highest point = 0 ($\because v = 0$) but for 2nd body

$= \frac{1}{2} mu^2 \cos^2 30°$

$\therefore \quad K_1 : K_2 = 0$

10. The given figure (T-2.1) shows the speed-time graph of a body projected vertically up. Speed decreases initially, then reaches zero at the highest point and then increases.

11. Putting equations for T and R, we get

$$g\left(\frac{2u \sin \alpha}{g}\right)^2 = 2 \times \frac{u^2 \sin 2\alpha}{g}$$

or $\quad \tan \alpha = 1 \quad$ or $\quad \alpha = 45°$

12. We know that $T \propto \sqrt{R}$. When R is doubled, T becomes $\sqrt{2}$ times.

13. Let t be the duration of uniform acceleration. Then, $(9 - t)$ is the retardation. As the velocity at the end of uniform acceleration and at the beginning of retardation is same, we have

$$0 + at = 0 - 2a \times (9 - t)$$

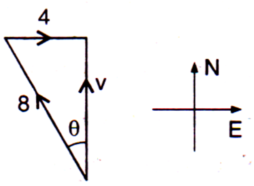
Solving, $\quad t = 6$ s

14. The train is moving with horizontal velocity in a straight line, hence vertical ranges will be same.

For a person inside the train, the horizontal range will be zero, because train is an inertial frame. The coin falls back to his hand. For a person outside the train such as C, the coin has a horizontal velocity and vertical acceleration g. Hence, it appears to follow a parabolic path. Hence, he observes a horizontal range.

15. In order to arrive at the opposite bank, the boat should start at an angle θ with north such that $\sin \theta = \frac{4}{8}$ or $\theta = 30°$. The real velocity of boat will be,

$$v = \sqrt{8^2 - 4^2} = \sqrt{48}, \quad \theta = 30° \text{ W of N}$$



16.
$$R = \frac{u^2 \sin 2\alpha}{g}$$

i.e., $R \propto \sin 2\alpha$ (for a given u)

$$\frac{R_1}{R_2} = \frac{\sin 30°}{\sin 90°} = \frac{1}{2}$$

$\therefore$ $R_2 = 2R_1 = 4$ km.

17. For a given braking force, the stopping distance $s \propto u^2$ ($\because v^2 - u^2 = 2as$). So, when velocity increases to 4 times, the stopping distance would increase to $16s$.

18. By Newton's law of gravitation,

$$F = \frac{Gm_1 m_2}{r^2}$$

Now, m_1 and m_2 are proportional to volume and hence r^3.

So, $F \propto \frac{r^3 \times r^3}{r^2} \propto r^4$

19. The acceleration down the plane $= \frac{g \sin\theta}{1 + (k^2/r^2)}$

This value is maximum when k is minimum, which happens for a solid sphere $\left(k^2 = \frac{2}{5} r^2\right)$.

20. Comparing with the equation of trajectory for projectile motion,

$$y = x \tan\theta - \frac{gx^2}{2u^2 \cos^2\theta}$$

We find, $\tan\theta = 16$

It is also given, $u \cos\theta = 2$

So, $\frac{u \sin\theta}{u \cos\theta} = 16$, $\therefore$ $u \sin\theta = 32$

Now $R = \frac{2u^2}{g} \sin\theta \cos\theta = \frac{2}{g}(u \sin\theta \times u \cos\theta)$

$= \frac{2}{10} \times 32 \times 2 = 12.8$ m

21. Work done = force × displacement = $100 \times \sin 50° \times 1$.

20% of this work is used to overcome friction. Hence, energy gained = 80% of this work = 80 sin 50° Joule.

22. The ball moves towards the left due to inertia to a force towards right. This means the bus is taking a right hand turn. The centripetal force is towards the right. Inertial force on the ball (in this case called centrifugal force) acts towards the left.

23. Coefficient of restitution $e = \sqrt{\frac{\text{height of rebound}}{\text{height of fall}}}$

24. Potential energy of a satellite $= -\frac{GMm}{R}$

Kinetic energy of a satellite $= \frac{GMm}{2R}$

$\therefore$ Required ratio = 2 : 1

25. The velocity is increasing, so KE should also be increasing. But since velocity is increasing uniformly, acceleration should be constant.

26. According to Kepler's 3rd law, $T^2 \propto R^3$.

Now, $T_1^{\,2} \propto R^3$ (for a satellite close to the earth)

For a geo-synchronous satellite, its distance from the surface of the earth is $6R$, and from centre $7R$.

So, $T_2^{\,2} \propto (7R)^3$

$\therefore$ $T_2 = 7^{3/2}.T_1 = T_1 7\sqrt{7}$ or $\frac{T_2}{T_1} = 7\sqrt{7}$

27. Earth's angular velocity about its axis is,

$$\omega = 1.2 \times 10^{-3} \text{ rad/s}$$

$\therefore$ $v = r\omega = 6000 \times 1.2 \times 10^{-3} \times 1000 = 7200$ m/s

28. Before the man hits the ground, he is in a state of free fall (ignoring air resistance). A body in a free fall state experiences weightlessness.

29. Here, the disc has only KE of rotation

$$= \frac{1}{2} I\omega^2 = \frac{1}{2} \times \frac{Mr^2}{2} \frac{v^2}{r^2} = \frac{1}{4} Mv^2$$

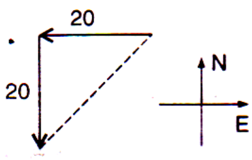
30. $(I)_{\text{solid}} = \frac{2}{5} mr^2$

$(I)_{\text{hollow}} = \frac{2}{3} mr^2$

Since, mass is same, for I to be same

$$\frac{2}{5} r_1^2 = \frac{2}{3} r_2^2 \quad \text{or} \quad \frac{r_2}{r_1} = \sqrt{\frac{3}{5}}$$

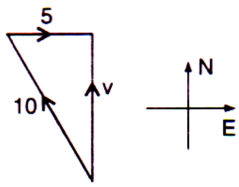
31. Change in velocity = final velocity – initial velocity. It is clear from figure, that change in velocity $= \sqrt{20^2 + 20^2} = 20\sqrt{2}$ m/s along south-west.



32. The man should leave at a slightly inclined direction so that his velocity and the velocity of river current will carry him in $\perp$ direction with the velocity.

$$v = \sqrt{(10)^2 - (5)^2} = 5\sqrt{3}$$

at an angle such that $\sin\theta = \frac{5}{10} = \frac{1}{2}$ or $\theta = 30°$. He should swim at an angle 30° W of N.



33. KE of a satellite $= \frac{1}{2}|\text{PE}|$

$$\text{KE} = \frac{GMm}{2R} \quad \text{and} \quad \text{PE} = -\frac{GMm}{R}$$

$$\text{TE} = \text{KE} + \text{PE} = -\frac{GMm}{2R} = -\text{KE} = -2 \times 10^6 \text{ J}$$

34. Force by axle will be directed inward (centripetal) and equal to $\frac{1}{2} m\omega^2 L$.

35. At the highest point, the projectile has only the horizontal component $= u \cos \alpha = \frac{u}{2}$ $(\because \alpha = 60°)$

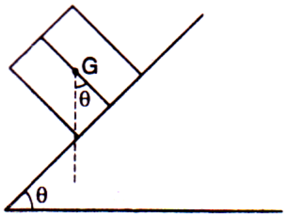
$$\text{Range} = \frac{u^2}{g} \sin 2\alpha = \frac{2u^2 \sin \alpha \cos \alpha}{g} = \frac{\sqrt{3}u^2}{2g}$$

36. Power $= \frac{1}{2} \frac{mv^2}{t}$ = constant

$$v^2 \propto t \text{ or } v \propto t^{1/2}$$

37. The cylinder begins to slide when the line through centre of gravity G passes beyond base of cylinder that is when

$$\tan \theta \geq \frac{r}{h/2} = \frac{2r}{h}$$



Hence, $h = 2r$ $(\because \theta = 45°)$

$$r = \frac{h}{2} = 5 \text{ cm}$$

38.
$$mgh = \frac{1}{2} mv^2 + \frac{1}{2} I\omega^2 = \frac{1}{2} mv^2 + \frac{1}{2} I \frac{v^2}{r^2}$$

If moment of inertia is more, v is less. Hence, speed would be less for a body having greater moment of inertia. The moment of inertia of a solid cylinder about its neutral axis is $\frac{1}{2} mr^2$ and of a hollow cylinder is mr^2. So speed will be less for hollow cylinder.

39. During elastic collision of equal masses, the velocities are exchanged. So, the moving mass comes to rest, and the mass initially at rest starts moving with the same velocity, *i.e.*, the moving mass transfers whole of its energy to the mass at rest.

40. Centripetal acc. $= \frac{v^2}{r} = \frac{4}{r^2}$

$\therefore$ $v = 2/\sqrt{r}$ and momentum will be $2m/\sqrt{r}$.

41. Let l be the length of the plane; then

$$l = \frac{1}{2} g \sin \theta = \frac{\frac{1}{2} g t_2^2}{\frac{1}{2} (g \sin \theta) t_1^2}$$

i.e., $\frac{t_2^2}{t_1^2} = \sin^2 \theta$

or $\sin \theta = \frac{t_2}{t_1} = \frac{5}{10} = \frac{1}{2}$

i.e., $\theta = 30°$

42. (a) Work done = Area enclosed by triangle $ABC = \frac{1}{2}AC \times BC = \frac{1}{2} \times (3V - V) \times (3P - P) = 2PV$

43. (c) Area enclosed between a and f is maximum. So work done in closed cycles follows a and f is maximum.

44. (a) Initial and final states are same in all the process.
Hence $\Delta U = 0$; in each case.
By FLOT; $\Delta Q = \Delta W$ = Area enclosed by curve with volume axis.
$\because$ $(\text{Area})_1 < (\text{Area})_2 < (\text{Area})_1 \Rightarrow Q_1 < Q_2 < Q_3$.

45. (a) For an isothermal process PV = constant

$$\Rightarrow PdV + VdP = 0 \Rightarrow -\frac{1}{V}\left(\frac{dV}{dP}\right) = \frac{1}{P}$$

So, $\beta = \frac{1}{P}$ $\therefore$ graph will be rectangular hyperbola.

[CHEMISTRY]

49. (c) For a reaction E_a for forward reaction $= E_a$ for backward reaction $+ \Delta H$.

62. **(a)** E_a

$$= \frac{2.303RT_1T_2}{T_2 - T_1} \log\frac{k_2}{k_1}$$

$$= \frac{2.303 \times 8.314 \times 293 \times 308}{15} \log 2$$

$$= \mathbf{34.67\ kJ\ mol^{-1}}.$$

63. **(c)**

$$t_{1/4} = \frac{2.303}{k}\log\frac{[A]_0}{3[A]_0/4}$$

$$= \frac{2.303}{k}[\log 4 - \log 3]$$

$$= \frac{2.303}{k}[0.6021 - 0.4771]$$

$$= \frac{2.303 \times 0.125}{k}$$

$$= \frac{0.2878}{k} \approx \frac{\mathbf{0.29}}{\mathbf{k}}$$

64. **(b)** $r = k[A]^x,\ \ 2r = k[4A]^x$

$$\frac{2r}{r} = \frac{k[4A]^x}{k[A]^x} \Rightarrow 4^x = 2$$

$$\Rightarrow \quad 2^{2x} = 2^1 \Rightarrow x = \frac{1}{2}$$

$$\frac{r'}{r} = \frac{k[9A]^{\frac{1}{2}}}{k[A]^{\frac{1}{2}}} \Rightarrow \frac{r'}{r} = (9)^{\frac{1}{2}}$$

$$\Rightarrow \quad r' = 3r$$

65. **(d)** No. of equivalent of hydrogen = No. of equivalent of Al = $\frac{4.5}{9} = 0.5$

2 gram H_2 = 22.4 L at STP

0.5 equivalent hydrogen, *i.e.*, 1 g = $\frac{0.5 \times 22.4}{2}$ = **5.6 L**

66. **(d)** Higher the reduction potential, easier is the gain of electrons.

67. **(c)** On adding equations (i) and (ii)

$Cu^{2+} + e^- \longrightarrow Cu^+$ or $Cu^{2+} \xrightarrow{e^-_{(i)}} Cu^+ \xrightarrow{e^-_{(ii)}} Cu$; $Cu^{2+} \xrightarrow{2e^-(iii)} Cu$

$Cu^+ + e^- \longrightarrow Cu$

$Cu^{2+} + 2e^- \longrightarrow Cu$

$$(-nFE)_{iii} = (-nFE)_i + (-nFE)_{ii}$$

$$2 \times E^0_{iii} = 1 \times 0.15 + 1 \times 0.50$$

$$E^0_{iii} = \frac{0.65}{2} = \mathbf{0.325\ V}$$

71. (c) $\ln K = \ln -\frac{E_a}{RT}$ is Arrhenius equation. Thus plots of ln K vs 1/T will give slope $= -E_a / RT$ or $-E_a / 2.303R$.

80. [c] $2\ KClO_3 \rightarrow 2\ KCl + 3O_2$

2 mol　　3 mol

= 2 × 122.5g　　= 3 × 22.4 L at STP

$\because$ 2 × 122.5 5g $kclO_3$ liberates 3 × 22.4 L of 02 gas at STP

$\therefore$ 4.90 g $kclo_3$ liberates = $\frac{3 \times 12.4}{2 \times 122.5} \times 4.90$ = 1.3 44 L

81. [c] suppose the formula of hydrocarbon is C_xH_y .

$$C_xH_y + \left(x \frac{y}{4}\right) o_2 \rightarrow xco_2 + \frac{y}{2} H_2O$$

1 vol　x + y/4 vol.　x vol　0 vol

20 ml　20 $(x + \frac{y}{4})$ ml　20 ml　0

From question vol . of co_2 formed = 60 ml

20 x = 60 $\therefore$ x = 3

vol of o_2 used = 100 ml

$20 (x + \frac{y}{4}) = 100 \therefore y = 8$

Hence hydrocarbon is C_3H_8

82. 10% (w/w) solution means 100 g = $\frac{100}{1.1}$ ml

solution contains 10 g solute, NaOH

Molarity = $\frac{w \times 1000}{m^1 \times v} = \frac{10 \times 1000}{40 \times \left(\frac{100}{1.1}\right)} = 2.75M$

83. [c] neq . of $KMNO_4$ = neq of $H_2C_2O_4$

$\frac{v \times 0.1 \times 5}{1000} = \frac{40 \times 0.2 \times 2}{1000}$

v = 32 ml

84. $\frac{(r_2)Li^{+}}{(r_3)He^{+}} = \frac{0.529 \times 2^2 / 3}{0.529 \times 3^2 / 2} = \frac{8}{27}$

85. .[a] It is case of back titration

carbonate $\xrightarrow[\text{excess}]{\text{HCl}}$ left acid

left acid $\downarrow$ reacted with NaOH

$\therefore$ equivalent of left acid = NaOH used for neutralisation

= 5 × 1

$\therefore$ left acid 5 ml so consumed acid 25-5 = 20 ml

$\therefore$ Equivalent of carbonate = Equivalent of acid used

$\frac{1}{E_q.wt} \times 1000 = 20$ $\therefore E_q$.wt (metal carbonate) = 50

86. [c] - Fact

87. [c] $m\,\Delta v.\,\Delta V \geq \frac{h}{4\pi}$

$\therefore \Delta V = \frac{1}{2m}\sqrt{\frac{h}{4\pi}}$

88. [a] before dilution = after dilution

$n_1v_1 = n_2v_2$

$y_1\,x_1 = y_2.v$

v = vol. after dilution v = $\frac{111.6}{2}$

change in volume $\Delta V = V - x_1$

$= y_1x_1/y_2 - x_1$

$= x_1\left(\frac{y_1}{y_2} - 1\right)$

89.[d] $Fe_2o_3 + 3\ co \rightarrow 2\ Fe + 3\ co_2$

160 gm 3 mol

$\therefore$ by 4 gm 0.075 mol

$$c + \frac{1}{2}\ O_2 \rightarrow co$$

1 mol of co fromed by 11200 ml of o_2

$\therefore$ 0,075 = 11200 × 0.075

= 840 ml

90.[b] Lines belongs to lyman series has in ultra violet reagion

$n_1 = 1\ n_2 = 6$

$\therefore$ no. of lines = 6 – 1 = 5