LEADER & ACHIEVER COURSE

PHASE : MLM,N,R,S,MAZI,L,T,U,M2AP1A, M2AP1B, M4AA2A

TARGET : PRE-MEDICAL 2020

Test Type : **MAJOR** Test Pattern : NEET(UG)

TEST DATE : 20 - 02 - 2020

TEST SYLLABUS : 01

HINT – SHEET

1. $x^{1/3} = \dfrac{-(1)\pm\sqrt{1^2-4(1)(-2)}}{2} = \dfrac{-1\pm 3}{2} = -2, +1$

$\Rightarrow$ x = –8, 1

2. Angular momentum = mvr

$= [MLT^{-1}][L] = [ML^2T^{-1}]$

3. Let height of every storey is h so,

$$\frac{1}{2}\times g\times 5^2 = 25h$$

h = 5m

In one sec distance travelled by the ball is

$$S = \frac{1}{2}g(1)^2 = 5m$$

So, No. of storey = (1)

4. $t = \dfrac{2u\sin\theta}{g} = \dfrac{2\times 20\times\sin 30^\circ}{10} = 2s$

Now, we shall calculate the total time taken by the ball to hit the ground.

Using, $s = ut + \dfrac{1}{2}gt^2$, we get

$$40 = -10t' + \frac{1}{2}\times 10\times\left(t'^2\right)$$

[$\because$ u = –20 sin30° = –10 m/s]

$\therefore\quad 5\left(t'^2\right) - 10t' - 40 = 0$

Solving, we have, t' = 4s

$\therefore\quad \dfrac{t'}{t} = \dfrac{4s}{2s} = \dfrac{2}{1}$

5. $\because$ system remains at rest

$\therefore$ F_{net} on each block is zero

$\therefore$ contact force between A & B = between wall & B = 30 N

6. $\sqrt{(5)^2 + (2\sqrt{6})^2}$

$\sqrt{25+24}$ = 7

7. $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

$\Rightarrow \dfrac{dR}{R^2} = \dfrac{dR_1}{R_1^2} + \dfrac{dR_2}{R_2^2}$

$\Rightarrow \dfrac{dR}{R} = \left(\dfrac{dR_1}{R_1^2} + \dfrac{dR_2}{R_2^2}\right)R$

$\Rightarrow \dfrac{dR}{R}\times 100 = \left(\dfrac{dR_1}{R_1^2} + \dfrac{dR_2}{R_2^2}\right)R\times 100$ = 3.875

8. V = u–gt

at t = $\dfrac{T}{2} = \dfrac{u}{2g}$

V = u/2

9. At t = t_1 position of both cars is same and after this $x_A > x_B$. So A overtake B at t = t_1.

10. $a = \dfrac{100}{10+10+5} = 4m/s^2$

force on B = 5 × a = 5 × 4 = 20 N

11. $t = \alpha x^2 + \beta x$

$$\frac{dt}{dx} = 2\alpha x + b$$

$$v = \frac{1}{2\alpha x + \beta}$$

$$a = v\frac{dv}{dx} = \frac{1}{(2\alpha x+\beta)}\frac{d}{dx}[2\alpha x+\beta]^{-1}$$

$$= \frac{-2\alpha}{(2\alpha x+\beta)^3}$$

$a = -2\alpha v^3$

Retardation $= 2\alpha v^3$

12. $\frac{96.54}{2.40} = 40.225$ but final answer must contain as many significant figures as in number with least upto number of significant figures so answer = 40.2 (after rounding off)

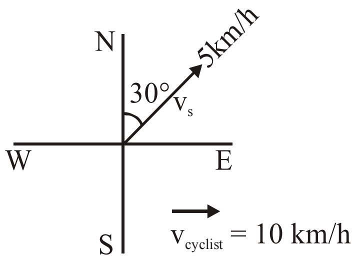
13. $h = 0 + \frac{1}{2}gt_1^2$

r $\quad t_1 = \sqrt{\frac{2h}{g}}$

$$\frac{h}{2} = 0 + \frac{1}{2}gt_2^2 \Rightarrow t_2^2 = \frac{2}{g}\times\frac{h}{2}$$

$$\Rightarrow t_2 = \sqrt{\frac{2}{g}\times\frac{h}{2}} = \frac{1}{\sqrt{2}}\times\sqrt{\frac{2h}{g}} = \frac{t_1}{\sqrt{2}}$$

14.

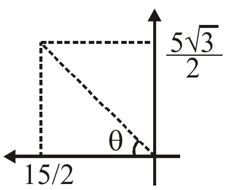


$$v_{S/C} = v_S - v_C$$

$$= 5\cos 30\hat{j} + 5\sin 30\hat{i} - 10\hat{i}$$

$$= \frac{5\sqrt{3}}{2}\hat{j} + \frac{5}{2}\hat{i} - 10\hat{i}$$

$$= \frac{5\sqrt{3}}{2}\hat{j} - \frac{15}{2}\hat{i}$$



$$\tan\theta = \frac{\frac{5\sqrt{3}}{2}}{\frac{15}{2}} = \frac{1}{\sqrt{3}}$$

$\theta = 30°$

$\Rightarrow$ 30° N of W

15. $a = \frac{2g - 3g\sin 30°}{3+2} = \frac{20-15}{5} = 1\,m/s^2$

$T = 2(g-a) = 2(10-1) = 18N$

16. $x = 2t \Rightarrow t = x/2$

$$y = 4t^2 = \frac{4x^2}{4}$$

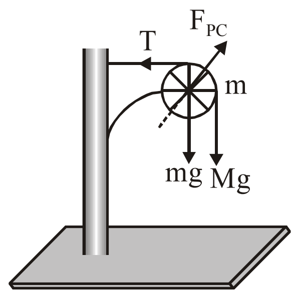
$y = x^2$

$$\int x^2 dx = \frac{x^3}{3} + C$$

17. Thickness is the most accurate because its least count is smallest.

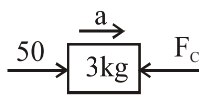
18. Speed cannot be negative, time can not return.

19. Force on the pulley by the clamp



$$F_{pc} = \sqrt{T^2 + [(M+m)g]^2}$$

20. $a = \frac{50-18}{3+5} = \frac{32}{8} = 4\,m/s^2$



$50 - F_C = 3a$

$F_C = 50 - 3 \times 4$

$F_C = 38N$

21. $\vec{A} - \vec{B} = \hat{j}$

$\vec{B} = \vec{A} - \hat{j}$

$\vec{B} = (3\hat{i} + 2\hat{j} + \hat{k}) - \hat{j}$

$\vec{B} = 3\hat{i} + \hat{j} + \hat{k}$

22. Diameter $= 5 \times 0.5$ mm $+ 20\left(\frac{0.5m}{50}\right)$

$= 2.7$ mm

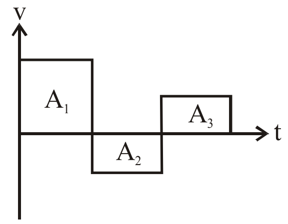
$$m = \frac{4}{3}\pi\frac{d^3}{\delta}\cdot\rho$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{3\Delta d}{d}$$

$$\%\Delta\rho = 2 + 3 \times \frac{0.01}{2.7} \times 100$$

$$\%\,\Delta\rho = 2 + \frac{10}{9} = 3.1\,\%$$

23. Distance = $A_1 + A_2 + A_3$ displacement = $A_1 - A_2 + A_3$



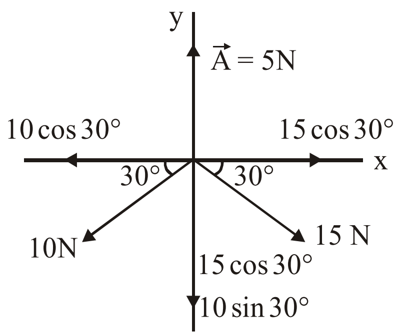
24. Impulse = change in momentum
= 2mu = 2 × 0.15 × 10 = 3.0 Ns

$$F_{pc} = \sqrt{(Mg)^2 + [(M+m)g]^2}$$

$$F_{pc} = \sqrt{M^2 + (M+m)^2 g}$$

25. Reading = mg_{eff} = m [g + a] > mg.

26.



27. $K = \dfrac{J}{kelvin} = ML^2T^{-2}\theta^{-1}$

$$\frac{\alpha Z}{K\theta} = M^0L^0T^0$$

$[\alpha] = MLT^{-2}\theta^0$

$$[P] = \frac{[\alpha]}{[\beta]} \Rightarrow [\beta] = \frac{[\alpha]}{[P]} = \frac{MLT^{-2}}{ML^{-1}T^{-2}} = L^2$$

28. $H = \dfrac{u^2\sin^2\theta}{2g}$ and $R = \dfrac{u^2\sin 2\theta}{g}$

Since, H = R

$$\frac{u^2\sin^2\theta}{2g} = \frac{u^2 \times 2\sin\theta\cos\theta}{g}$$

or $\tan\theta = 4$ or $\theta = \tan^{-1}(4)$.

29. $a = \dfrac{u\,dM/dt}{M_0 - t\,dM/dt} = 50\ \text{m s}^{-2}$

30. The weight of the body should be balanced by the vertical force exerted by the inclined plane on the block.

31. $\vec{A}\ \ 2\hat{i}\ \ 2\hat{j}-\hat{k}$ and $\vec{B} = 6\hat{i} - 3\hat{j}\ \ 2\hat{k}$

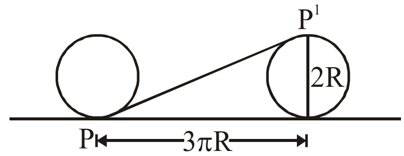
$\vec{C} = \vec{A}\times\vec{B}\ \ (2\hat{i}\ \ 2\hat{j}-\hat{k})\times(6\hat{i}-3\hat{j}\ \ 2\hat{k})$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 2 & -1 \\ 6 & -3 & 2 \end{vmatrix} = \hat{i} - 10\hat{j} - 18\hat{k}$$

Unit vector perpendicular to both $\vec{A}$ and $\vec{B}$

$$\frac{\hat{i}-10\hat{j}-18\hat{k}}{\sqrt{1^2\ \ 10^2\ \ 18^2}}\quad \frac{\hat{i}-10\hat{j}-18\hat{k}}{5\sqrt{17}}$$

32.



(R = 1m)

$$PP^1 = \sqrt{(3\pi R)^2 + (2R)^2} = \sqrt{9\pi^2 + 4}$$

33. When the height attained by the projectile is largest, the angle θ with the horizontal is 90°. In that case, time of flight (=2usinθ/g) is the largest.

35. Limiting force of friction
= μR = μMg = 0.4 × 2 × 10 = 8N
As external applied force = 2.8 N. Because it is less than the limiting friction, the actual force of friction is equal to external force of 2.8 N but in opposite direction.

37. $x = t^3 + 4t^2 - 2t + 5$

$v = 3t^2 + 8t - 2$

$a = 6t + 8$

at t = 4, $v = 3(4)^2 + 8(4) - 2$
= 78 m/s

$a = 6(4) + 8 = 32\ m/s^2$

$t_1 = 0,\quad x_1 = 5m$

$t_2 = 4s,\quad x_2 = (4)^3 + 4(4)^2 - 2(4) + 5 = 125$ m

t = 0 to t = 4s

$$\vec{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{125-5}{4-0} = 30\ m/s$$

$t_1 = 0,\quad v_1 = -2m/s$

$t_2 = 4s,\quad v_2 = 3(4)^2 + 8(4) - 2 = 78$ m/s

t = 0 to t = 4s

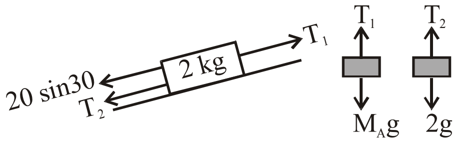
$$\vec{a} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{78-(-2)}{4-0} = 20\ m/s^2$$

38. Range is same for angles of projection θ and 90° – θ.

$$\therefore \quad R = \frac{u^2 \sin 2\theta}{g}; \quad h_1 = \frac{u^2 \sin^2\theta}{2g}$$

and $h_2 = \dfrac{u^2 \cos^2\theta}{2g}$

Hence, $\sqrt{h_1 h_2} = \dfrac{u^2 \sin\theta\cos\theta}{2g}$

39. 

$T_1 = M_A g$ ...(1)

$T_2 = 20$ N ...(2)

$T_1 = T_2 + 20 \sin 30$ ...(3)

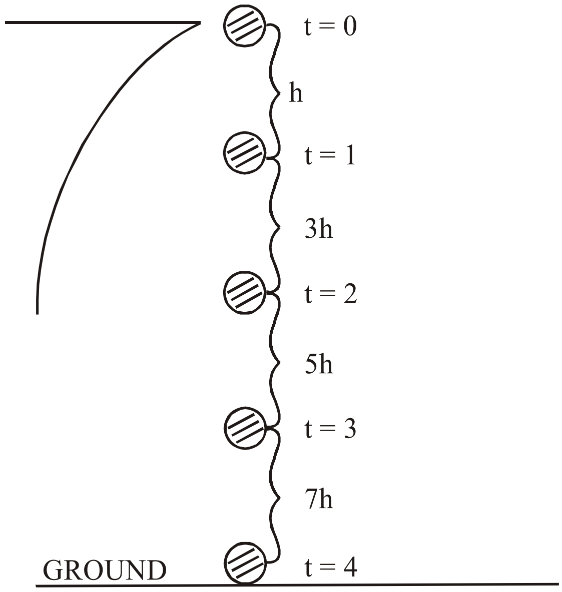
Solving

$M_A = 3$ kg

40. In a conservative field, $F = -\dfrac{dU}{dr}$

$$\therefore \quad F = -\frac{d}{dx}(ax^2 - bx) = b - 2ax$$

41. Watt= Joule/second = Ampere × volt = Ampere^2 × Ohm

43. 

time to reach the ground t = 4 sec

$$= \frac{1}{4}\left[\frac{u^2 \sin 2\theta}{g}\right] = \frac{R}{4}$$

45. $a_A = a_B = \dfrac{F}{M + m}$

because body A will not side on body B till $F < F_{limiting.}$

46. Time period = 5×10^{-3} sec.

Frequency $= \dfrac{1}{T} = \dfrac{1}{5 \times 10^{-3}} = 200\,\text{sec}^{-1}$

47. $\psi_{321} \Rightarrow n = 3,\ \ell = 2,\ m = 1$

angular momentum $= \dfrac{h}{2\pi}\sqrt{\ell(\ell+1)} = \dfrac{\sqrt{6}h}{2\pi}$

spherical node = $n - \ell - 1$

= 3 – 2 – 1 = 0

Angular node = ℓ = 2

sum $\Rightarrow \dfrac{\sqrt{6}h}{2\pi} + 0 + 2$

$\Rightarrow \dfrac{\sqrt{6}h + 4\pi}{2\pi}$

48. Isothermal (T = constant, ΔE = 0, ΔH = 0) x⇒p

Adiabatic (q = 0, ΔE = w) y ⇒ q

Isochoric (V = const, w = 0, q = ΔE) z ⇒ s

Isobaric (P = const, q = ΔH) w ⇒ r

49. HCl & NaH

1 : 35.5 23 : 1

Na : Cl

23 : 35.5

50. $B^{\oplus} + H_2O \rightleftharpoons BOH + H^{\oplus}$; $K_h = \dfrac{K_w}{K_b}$

$$h = \sqrt{\frac{k_h}{C}} = \sqrt{\frac{k_w}{k_b C}}$$

51. $r = 0.529 \times \dfrac{n^2}{z}$ Å

$r = 0.529 \times \dfrac{1^2}{2}$ Å

r = 0.2645 Å

52. 1. $SO_2Cl_2 \rightarrow \underline{S}O_2^{+2} + 2Cl^-$

$x - 4 = +2$

$x = +6$

2. $Fe(CN)_6^{-4}$

$x + 6\times(-1) = -4,\ x = +2$

3. $H\underline{N}O_2$

$1 + x - 4 = 0$

$x = +3$

4. $Ni(CO)_4$

$x + 4 \times 0 = 0$

$x = 0$

54. Molecular formula of urea is NH_2CONH_2

$$\% \text{ of N} = \frac{14\times2}{60}\times 100 = 46.6\%$$

55. HNO_3 HNO_2 & HI solutions has pH < 7 while pH of NaCl solution is 7.

56. mass of cathode rays < mass of anode rays.

$$\left(\frac{e}{m}\right)_{cathode} > \left(\frac{e}{m}\right)_{Anode}$$

$s_1 > s_2$

57.

$$\underbrace{\overbrace{Cr_2O_7^{-2} + Fe^{+2} \longrightarrow 2Cr^{+3} + Fe^{+3}}^{+2\rightarrow+3\ (1\uparrow)\times 6}}_{+12\rightarrow+6\ \downarrow 6}$$

$$Cr_2O_7^{-2} + 6Fe^{+2} \longrightarrow 2Cr^{+3} + 6Fe^{+3} + 7H_2O + 14H^+$$

$n = 6$

58. $\Delta S = 2.303\ nC_V \log\frac{T_2}{T_1}$ (Isochoric porcess)

$$= 2.303 \times 1 \times (20 - 8.3) \times \log\frac{300}{150}$$

$= 0.693 \times 11.7$ J

59. ${}_8O^{2-} = 1s^2\ 2s^2\ 2p^6$

Number of $e^- = 10$

Number of valence $e^- = 8$

Moles of $O^{2-} = \frac{4.8}{16} = 0.3$ mol

Number of valence e^- in 4.8 g of O^{2-}

$= 0.3 \times 8 \times N_A$

$= 2.4\ N_A$

60. $HA \rightleftharpoons H^+ + A^-$

C

C–Cα Cα Cα

$[H^+] = C\alpha$

$$= 0.1 \times \frac{2}{100} = 2\times10^{-3}\ M$$

$[H^+][OH^-] = K_w$

$$[OH^-] = \frac{K_w}{[H^+]} = \frac{10^{-14}}{2\times10^{-3}} = 5\times10^{-12}\ M$$

61. Limiting line of paschen's series : $\infty \rightarrow 3$

$$\frac{1}{\lambda} = R\times Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda} = R\times 1\left(\frac{1}{9} - \frac{1}{\infty}\right) \Rightarrow \lambda = 9 \times \frac{1}{R}$$

$\lambda = 9 \times 912$

$= 8208$ Å

62.

$$\underset{x=+5}{ClO_{3\,(aq)}^{\ominus}} + \underset{x=-1}{5Cl_{(aq)}^{\ominus}} + 6H_{(aq)}^{\oplus} \longrightarrow \underset{x=0}{3Cl_{2(g)}} + 3H_2O_{(\ell)}$$

Oxidation

Reduction

63. (1) $\Delta S < 0, \Delta H < 0$ Spontaneous at low T

(2) $\Delta S > 0, \Delta H > 0$ Spontaneous at high T

(3) $\Delta S < 0, \Delta H < 0$ Spontaneous at low T

(4) $\Delta S < 0, \Delta H > 0$ Never Spontaneous

64. Molar mass of $(NO)_x = 2 \times$ V.D.

$x(14 + 16) = 2 \times 60$

$x(30) = 2 \times 60$

$x = 4$

65. $[H^+][OH^-] = K_w$

$K_w = (10^{-6})^2$

$K_w = 10^{-12}$

66. $\Delta V_A = 0.05$ m/s
$\Delta V_B = 0.02$ m/s
$m_B = 5m_A$

$m_A v_A . \Delta x_A \geq \frac{\lambda}{4\pi}$ ..(1)

$m_B v_B . \Delta x_B \geq \frac{\lambda}{4\pi}$ ..(2)

eq. $\frac{(1)}{(2)} = \frac{\Delta x_A}{\Delta x_B} = \frac{m_B v_B}{m_A v_A}$

$= \frac{5m_A \times 0.02}{m_A \times 0.05}$

$\frac{\Delta x_A}{\Delta x_B} = 2$

67. $P_B = \frac{n_B}{n_A + n_B + n_C} P_T$

$= \frac{2}{1+2+3} P$

$= \frac{P}{3}$

68. $MgSO_{4(s)} + aq \longrightarrow MgSO_{4(aq)}$ $\Delta H = a$
$MgSO_4 \cdot 7H_2O(s) + aq \longrightarrow MgSO_{4(aq)}$ $\Delta H = b$
$MgSO_4(s) + 7H_2O \longrightarrow MgSO_4 \cdot 7H_2O(s)$ $\Delta H = a - b$

70. Equilibrium constant remains constant at constant temperature.

71. $\lambda = \frac{h}{mv}$

If velocity of particles are same then $\lambda \propto \frac{1}{m}$
mass : sodium > Lithium > hydrogen > electron
λ : electron > hydrogen > lithium > sodium

72. $\frac{r_A}{r_B} = \sqrt{\frac{d_B}{d_A}}$

$r_A = r_B \left(\frac{d_B}{d_A}\right)^{1/2}$

75. $K_C = \frac{[C]^3 [B]}{[A]^2}$

$16 = \frac{\frac{2^3}{v^3} \cdot \frac{2}{v}}{\frac{2^2}{v^2}} \Rightarrow 16 = \frac{4}{v^2} \Rightarrow v^2 = \frac{1}{4}$

$\Rightarrow \boxed{v = \frac{1}{2} L}$

76. Energy $= \frac{hc}{\lambda} = \frac{-RhC}{4}$

$\frac{1}{\lambda} = R \times 2^2 \left(\frac{1}{n^2} - \frac{1}{\infty^2}\right)$

$\frac{4R}{n^2} = \frac{R}{4}$

$n^2 = 16$

$\boxed{n = 4}$

No. of orbitabl = n^2 = 16

77. $P_1V_1 > P_2V_2 > P_3V_3$
$T_1 > T_2 > T_3$ (PV = nRT)

79. Basic buffer : WB + WBSA(salt)

80. Ice $\rightleftharpoons$ water
Equilibrium shifts in right direction if pressure is increased because density of $H_2O_{(\ell)}$ is greater than $H_2O_{(S)}$.

81. $He^{\oplus}$ is single electron species so its energy depends on 'n'. only there will be higher energy for higher value of 'n'.

82. Quality of fuel is measure by its calorific value

83. Number of molecules = Moles × N_A

$= \frac{\text{Vol. at STP (in L)}}{22.4 L} \times N_A$

$= \frac{1 \times 10^{-3}}{22.4} \times N_A$

$= \frac{N_A}{22400}$

85. $SnO_{2(s)} + 2H_{2(g)} \rightleftharpoons 2H_2O_{(g)} + Sn_{(\ell)}$
volume fraction of gas = mole fraction of gas

$X_{H_2} = 0.45$

$X_{H_2O} = 0.55$

$K_p = \frac{(P_{H_2O})^2}{(P_{H_2})^2}$

$K_p = \frac{(P_T \times 0.55)^2}{(P_T \times 0.41)^2}$

$K_p = \left(\frac{55}{45}\right)^2$

$K_p = \frac{121}{81} \approx 1.5$

86. d_{Z^2} has conical node while d_{xz}, $d_{x^2-y^2}$ has two nodal planes each.

87. Heat of Ionisation of
HA = 13.6 – 12.8 = 0.8
HB = 13.6 – 12.9 = 0.7
HC = 13.6 – 11.9 = 1.7
HD = 13.6 – 11.3 = 2.3

88. Initial moles of $CO_2 = \frac{220 \times 10^{-3}}{44} = 5 \times 10^{-3}$ mol

Removed moles of $CO_2 = \frac{6 \times 10^{20}}{6 \times 10^{23}} = 1 \times 10^{-3}$ mol

Remaining moles of $CO_2 = 4 \times 10^{-3}$ mol

89. $K_2SO_3 \Rightarrow$ SB + WA (Highest pH) ; pH > 7

$MgSO_4 \Rightarrow$ WB + SA pH < 7

$NaCl \Rightarrow$ SB + SA (pH = 7) at 25°C

$KNO_3 \Rightarrow$ SB + SA pH = 7)

90. If $\Delta n_g < 0 \Rightarrow K_p < K_c$

136. *Rhodospirillum Nostoc, Nitrosomonas, Chara, Porphyra, Lycopodium, Chlorobium*

167. Module Pg.# 177 last para, last line