SRIGAYATRI EDUCATIONAL INSTITUTIONS
INDIA

Sec: SR MPC	**GT-1**	**Date: 08-09-20**
Time: 09:00 AM to 12:00 NOON	**2012_P1**	**Max.Marks:210**

KEY SHEET

PHYSICS

1	**C**	2	**B**	3	**C**	4	**A**	5	**B**
6	**B**	7	**A**	8	**A**	9	**A**	10	**D**
11	**BCD**	12	**ABC**	13	**BC**	14	**ABC**	15	**AC**
16	**4**	17	**5**	18	**1**	19	**4**	20	**7**

CHEMISTRY

21	**A**	22	**B**	23	**C**	24	**A**	25	**A**
26	**B**	27	**A**	28	**B**	29	**A**	30	**D**
31	**ABCD**	32	**ABC**	33	**ABD**	34	**BCD**	35	**BC**
36	**3**	37	**3**	38	**8**	39	**1**	40	**3**

MATHS

41	**A**	42	**C**	43	**B**	44	**B**	45	**A**
46	**A**	47	**A**	48	**C**	49	**B**	50	**D**
51	**AC**	52	**BCD**	53	**ACD**	54	**ACD**	55	**AB**
56	**6**	57	**6**	58	**3**	59	**0**	60	**7**

SOLUTIONS

PHYSICS

1. Horizontal momentum of system is conserved parallel to the walls. KE of tube is maximum when the ball and tube get common velocity.

$$mu = (3m)V_c \Rightarrow V_c = \frac{u}{3}$$

$KE_{\max}$ of the tube $= \frac{1}{2}(2m)V_c^2 = \frac{mu^2}{9}$

2. Let f_S is the focal length of equivalent mirror.

$$-\frac{1}{f_S} = \frac{2}{f_L} - \frac{1}{f_M} = \frac{2}{10} - \frac{1}{-5} = \frac{1}{2.5} \Rightarrow f_S = -2.5cm$$

$$V_I - V_M = -\left[\frac{f}{f-u}\right]^2 (V_0 - V_M)$$

$$V_I - 1 = -\left[\frac{-2.5}{-2.5+20}\right]^2 (-1-1)$$

$$V_I = 1 + 2\left[\frac{1}{7}\right]^2 = 1 + \frac{2}{49} = \frac{51}{49} = \frac{43+8}{49} m/s$$

3. $$v_t = \frac{2}{9}\frac{r^2\left(\rho - \rho/2\right)g}{\eta} = \frac{\frac{2}{9}\times 9\times 10^{-6}[1260]\times 10}{1.26} = 2\times 10^{-2} m/s$$

4. Let v_i is initial immersed volume of small container. $500(2)g = \mathrm{v}_i(1)g \Rightarrow \mathrm{v}_i = 1000\,cm^3$. This is initial volume of liquid displaced. Final volume of liquid displaced will be V = 500 cm^3 only.

Decrease in liquid level $h = \frac{\mathrm{v}_i - \mathrm{V}}{A} = \frac{100-500}{1000} = \frac{1}{2}cm$

5. $$mg - \frac{mv_0^2}{R} = \frac{mg}{2} \Rightarrow v_0 = \sqrt{\frac{gR}{2}} \text{ but } v_e = \sqrt{2gR}$$

$$\frac{v_e}{v_0} = \frac{\sqrt{2gR}}{\sqrt{gR/2}} \Rightarrow v_e = 2v_0$$

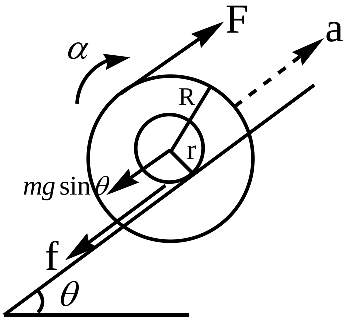
6. $$f_{\max} = 2(\Delta p_0)A = 4\times 10^3 \times 5\times 10^{-4} = 2N$$

7. $$L = \frac{\mu N^2 A}{\ell} \Rightarrow L \alpha \mu N^2$$

$$V = L\frac{dI}{dt} \Rightarrow V \alpha L \Rightarrow V \alpha \mu N^2$$

$$\frac{V_{air}}{V_{Al}} = \frac{\mu_0}{\mu_0 \mu_r}\left[\frac{600}{200}\right]^2 = 3$$

8.



$F - f - Mg\sin\theta = Ma$ ………(1)

About center,

$FR + fr = \frac{MR^2}{2}\alpha$ ……….(2)

Constraint equation is $a = r\alpha$ ……(3)

On solving (1), (2) and (3) and substituting $r = \frac{R}{3}$,

We get $a = \frac{2}{11M}\left[4F - Mg\sin\theta\right]$

9. Maximum height $H = \frac{u^2\sin^2\alpha}{2g} = 20$

$\Rightarrow u\sin\alpha = 20 \to (1)$

Vertically , the particle has a displacement of 25m downwards.

If t is the total time taken, then

$-25 = (u\sin\alpha)t - \frac{1}{2}gt^2 \quad \Rightarrow 5t^2 - 20t - 25 = 0$

Or $t^2 - 4t - 5 = 0$

Or $t = 5S,$ rejecting the negative root

In $t = 5S,$ horizontal displacement = 75 m. Therefore, $(u\cos\alpha)\times 5 = 75$

$(u\cos\alpha) = 15 \to (2)$

Eq (1) and (2) yield

$\tan\alpha = \frac{20}{15} = \frac{4}{3} \Rightarrow \alpha = \tan^{-1}\left(\frac{4}{3}\right)$

10. If x,y and 2 are the no.of α,β and $\beta^+ +$ partides euitted then

238-4x = 206 ------- (1)

92 – 2x+y-z = 82 ------(2)

Y – z = 6 hence if z = 1 then y = 7

11. Assume a clockwise cyclic process by considering one adiabatic process and one isochoric process drawn from upper to lower curve, along with AB. Q_{net} must be +ve and $Q_{isochoric}$ is –Ve. Hence Q_{AB} will be +ve always.

12 $Z_{Al} > Z_{Na} \Rightarrow$ Energy of K_α for Al > energy of K_α for Na

Also energy of K_β fore some metal > energy of K_α

13. Heat $= \int i^2 R dt$

$= \int_0^1 (t)^2 R dt + \int_1^2 1^2 R dt + \int_2^3 (3-t)^2 R dt = \frac{1}{3}R + R + \frac{R}{3} = \frac{5R}{3}$

$I^2 R \times 3 = \frac{5R}{3}, \quad I^2 = \frac{5}{9}, \quad I_1 = \frac{\sqrt{5}}{3} A$

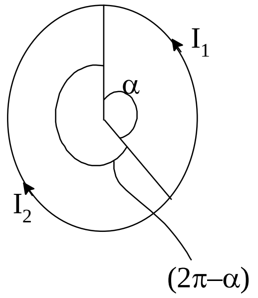
$I^2 R \times 15 = \frac{5R}{3}, \quad I_2 = \frac{1}{3} A$

14. Consider two sectors one of α and other of $(2\pi - \alpha)$

B at O will be zero if $I_1 \alpha = I_2 (2\pi - \alpha)$

$I_1 = \frac{E}{R_1}$, $I_2 = \frac{E}{R_2}$

So $\frac{\alpha}{R_1} = \left(\frac{2\pi - \alpha}{R_2}\right)$



$R_1 = \int \frac{\rho_0 \sin^2\theta}{A} R d\theta$ similarly we can get R_2

On solving we get $\alpha = \frac{\pi}{2}, \pi, \frac{3\pi}{2}$

15. Conceptual

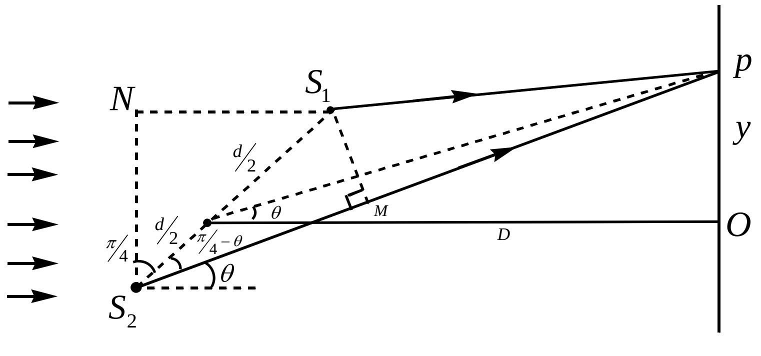
16. If P be the rate of loss of heat from the tube, C be the specific heat of liquid

$P + \Delta m C(30 - 25) = 25$

$P + \Delta m' C(30 - 25) = 30$

On solving P = 20 W

17.



After S_1, S_2, the path difference at 'p' is

$x_1 = S_2 M = (d)\cos\left[\pi/4 - \theta\right] = \frac{d}{\sqrt{2}}[\cos\theta + \sin\theta]$

If 'θ' is very small, $\cos\theta \approx 1, \sin\theta \approx \theta$

$\therefore x_1 = \frac{d}{\sqrt{2}}[1+\theta]$ ………..(1)

Before S_1, S_2, the path difference is

$x_2 = d\sin\frac{\pi}{4} = \frac{d}{\sqrt{2}}$ ………(2)

At P, the net path difference is $x = x_1 - x_2 = \left(\frac{d}{\sqrt{2}}\right)\theta$

$= \left(\frac{d}{\sqrt{2}}\right)\frac{y}{D}$

Change in path difference $\Delta x = \left(\frac{d}{\sqrt{2}}\right)\frac{\Delta y}{D}$

If $\Delta x = \lambda$ then $\Delta y = \beta$

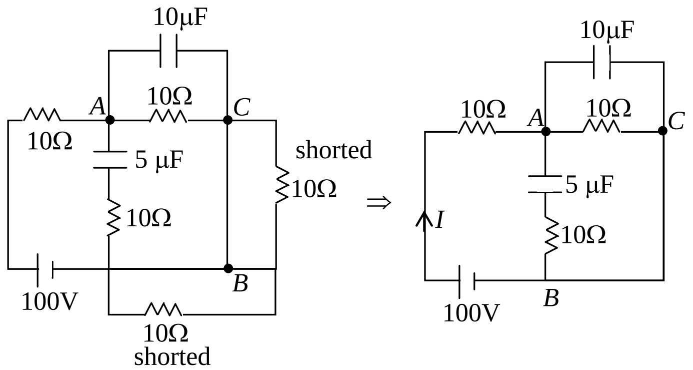
$\therefore \beta = \frac{\sqrt{2}\lambda D}{d} = \frac{\sqrt{2}\times 5\times 10^{-7}\times 10}{\sqrt{2}\times 10^{-3}} = 5\times 10^{-3} m$

18. Current through AC is

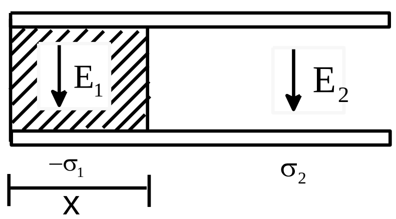
$I = \frac{100}{20} = 5A$

$V_{AC} = 5 \times 10 = 50$ V.

$\therefore$ $n = 1$.



19.



$E_1 = E_2$, since the potential difference between the plates is same.

$\Rightarrow \frac{\sigma_1}{\epsilon_e \epsilon_0} = \frac{\sigma_2}{\epsilon_0} \Rightarrow \sigma_1 = 4\sigma_2$

Also $4\sigma_2 \ell x + \sigma_2 \ell(\ell - x) = Q$

$\Rightarrow \quad \sigma_2 = \frac{Q}{\ell^2 + 3\ell x} \qquad \sigma_1 = \frac{4\theta}{\ell^2 + 3\ell x}$

$\Rightarrow \quad \sigma_1 = \frac{4Q}{\ell^2 + 3\ell \times \frac{\ell}{3}} = \frac{2Q}{\ell^2}$

Required change $Q_1 = \sigma_1 \ell x = \frac{\sigma_1 \ell^2}{3}$

$Q_1 = \frac{2Q}{3} = 4\mu C$

20. $T_3 = \mu mg$

$T_2 = \mu mg + 2T_3 = 3\mu mg$

$F = \mu mg + 2T_2 = 7\mu mg$

CHEMISTRY

21. If all acid from weighing paper is not transferred into titration vessel, the determined mole will be less than the expected. Hence, molar mass calculated from this mole value will be much higher; $M = \frac{m}{n}$.
22. $mps = \sqrt{\frac{2RT}{M}} \Rightarrow$ Increasing temperature will increases mps but distribution will be broaden.
23. At r = 0, ψ is minimum.
24. Fission reaction must be exothermic, i.e., there must be mass loss.
25. Combination of tin stone and wolframite is magnetic.
26. Concentrated H_2SO_4 cannot be used in this test instead of dil. H_2SO_4 because it produces intense brown fumes with NO_2^- and under these conditions no ring can be observed.
27. The presence of alkyl group pointed towards surface.
28. It cannot give Cl_2.
29. Conceptual.
30. Conceptual.
31. Intrinsic semiconductors are the pure substance. In absence of doping, electrical conductivity is so small that it has no practical use. Tellurium is from G-16, gives n-type while Be is from G-2, gives p-type semiconductors.
Also in case of semiconductors, increasing temperature increase kinetic energy of electrons more than band gap, hence electrical conductivity is increased.
32. Sublimation is an endothermic process.
$\Rightarrow \Delta H, \Delta E$ and q are all positive.
33.

$$H - O - O - HO = O$$

$$\downarrow \qquad \qquad \downarrow$$

$$BO = 1 \qquad BO = 2$$

O_2^{2-} is diamagnetic $\pi * 2p^4$ while O_2 is paramagnetic.

34. Conceptual.
35. Conceptual.
36. (i) $H_2 > He$: Boiling point order
    (iv) Diamond > graphite : Thermal conductivity order
    (v) HF > HI > HBr > HCl : Boiling point order
37. Jahn Teller theorem.
38. $K_{sp} = 4S^3 = 5\times10^{-19}$

    $\Rightarrow S = 5\times10^{-7}$ and $\left[OH^-\right] = 25 = 10^{-6}$

    $\Rightarrow pOH = 6$ and $pH = 8$.
39. Conceptual.
40. Conceptual.

MATHS

41. shifting (1, 1, 1) to (0, 0, 0) (2, 3, 4) goes to (1, 2, 3)

    $\lambda_{\min} = \text{dist}$. from (1, 2, 3) to x + y + z = 0 which is $\frac{6}{\sqrt{3}}$ and this result is true for all parallel planes

42. $2f(x) = \int_0^x \left(x^2 - 2xt + t^2\right) g(t)\,dt$

    $\Rightarrow 2f'(x) = x^2 g(x) + \int_0^x g(t)\,dt.2x$

    $-2\left[x^2 g(x) + \left(\int_0^x t g(t)\,dt\right)\right] + x^2 g(x)$

    $\Rightarrow f''(x) = 2g(x) + \int_0^x g(t)\,dt - xg(x)$

    $\Rightarrow f''(x) = \int_0^x g(t)\,dt$

    $\Rightarrow f'''(x) = g(x)$

43. $\frac{z^2 - z + 1}{z^2 + z + 1} = |z|$

    $\Rightarrow \frac{z^2+1}{-2z^2} = \frac{|z|+1}{|z|-1}\left[\because |z| \neq 1\right]$

    $\Rightarrow z + \frac{1}{z}$ must be purely real

    $\Rightarrow \text{In}\left(re^{i\theta} + \frac{e^{-i\theta}}{r}\right) = 0$

$\Rightarrow r\sin\theta - \dfrac{\sin\theta}{r} = 0 \Rightarrow \theta = 0$ as $r \neq 1$

$\Rightarrow \dfrac{x^2 - x + 1}{x^2 + x + 1} = |x| \Rightarrow$ for $x > 0$ 1 solution

for x < 0 no solution

44. $g(x) = \begin{cases} \cos x;\ 0 \le x \le \pi \\ \sin x - 1;\ x > \pi \end{cases}$

45. $4 \times 3 = 12$ letters

(3 letters to say boy 1 must go to 3 of the 4 boxes and the rest has no restriction)

46. a =b ; a = 2C; $\dfrac{a^3}{6d^3}$ must be non-zero finite for sample space whereas a = b; a = 2C,

$\dfrac{a^3}{6d^3}$ = 36 for limit to be 36

$\Rightarrow \dfrac{1}{3\times 6} = \dfrac{1}{8}$ [$\because$ a must be an even no. & d can be any no. for denominator]

47. $(\sin\alpha)^3 + (3\cos\beta)^3 + 4^3 = 3(\sin\alpha)(3\cos\beta)(4)$.

$\Rightarrow \sin\alpha = 3\cos\beta = 4$ (not possible)

or $\sin\alpha = 3\cos\beta + 4 = 0 \Rightarrow \sin\alpha = -1\cos\beta \Rightarrow \left(\dfrac{3\pi}{2}, \pi\right)$

48. $P'(x) = \alpha(x)(x-3)$

$P(x) = \alpha(x)\left(\dfrac{x^2}{3} - \dfrac{3x^2}{2}\right) + C$

$\Rightarrow \alpha = 6,\ C = 1$

$P(x) = 2x^3 - 9x^2 + 1$

$\Rightarrow \sum_{r=0}^{10} P(r) - (-1)^r\ {}^{10}C_r = 0$

$\Rightarrow \sum_{r=0}^{10} P(r)(-1)^r\ {}^{10}C_r + P(0) = 0$

$\Rightarrow \sum_{r=0}^{10} P(r)(-1)^r\ {}^{10}C_r = -1$

49. At r = 1 value $= \begin{vmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{vmatrix} = 1$

and at r = 2 = $= \begin{vmatrix} 2 & 3 & 4 \\ 1 & 3 & 6 \\ 0 & 1 & 4 \end{vmatrix} = 4$

from r = 3 $\begin{vmatrix} {}^{r}C_1 & {}^{r+1}C_1 & {}^{r+2}C_1 \\ {}^{r}C_2 & {}^{r+1}C_2 & {}^{r+2}C_2 \\ {}^{r}C_3 & {}^{r+1}C_3 & {}^{r+2}C_3 \end{vmatrix}$

$= (r)(r+1)(r+2)$

$$\Rightarrow \sum_{r=3}^{10}\begin{vmatrix} {}^{r}C_1 & {}^{r+1}C_1 & {}^{r+2}C_1 \\ {}^{r}C_2 & {}^{r+1}C_2 & {}^{r+2}C_2 \\ {}^{r}C_3 & {}^{r+1}C_3 & {}^{r+2}C_3 \end{vmatrix} = \sum_{r=3}^{10}\left[v(r+1)-V(r)\right]$$

$$\Rightarrow 1+4+\frac{(10\times 11\times 12\times 13)-(2x3\times 4\times 5)}{24} \text{ where}$$

$$V(r)= \frac{(r-1)(r)(r+1)(r+2)}{24}$$

50. $\begin{vmatrix} 1 & -1 & 1 \\ 2 & 2 & \lambda_1 \\ 3 & (\lambda_1+4) & 1 \end{vmatrix} = 0 \Rightarrow \lambda_1 = 1$ or - 6 (No solution)

$\Rightarrow \lambda_1 = 1, \lambda_2 = 2, \lambda_3 = 4$

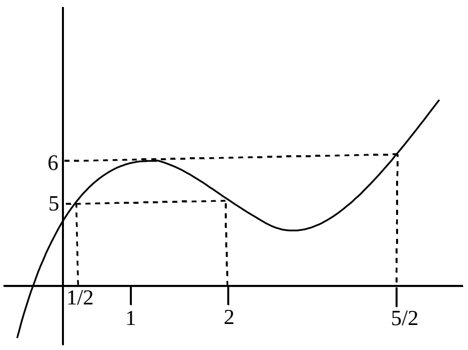
51. $\frac{d(y_1-y_2)}{dx} + P(x)(y_1-y_2) = 0$

$\Rightarrow y = y_1 + C(y_1 - y_2)$ is also a solution

& $\frac{dy}{dx} + \frac{y}{x} = x \Rightarrow d(dx) = x^2 dx \Rightarrow xy = \frac{x^3}{3} + C$

52. $P\left(\frac{D_1}{D_2}\right) = \frac{\left(\frac{1}{4}\right)\left(\frac{1}{3}\right)}{\left(\frac{1}{4}\right)\left(\frac{1}{3}\right)+\left(\frac{1}{4}\right)\left(\frac{1}{3}\right)+\left(\frac{1}{4}\right)\left(\frac{1}{3}\right)} = \frac{1}{3}$

53. Draw Graph



Option B is wrong as it need not be an onto function (a can be close to $\frac{5}{2}$ to 0)

54. $f(x) = e^x \sin x$

$\Rightarrow f'(x) \,\&\, f''(x) > 0 \ \forall x \in \left(0, \frac{\pi}{2}\right)$

$\Rightarrow$ Area A_1 is lesser than half of the area formed by coordinate axes, $x = \frac{\pi}{2}$ & $y = f\left(\frac{\pi}{2}\right)$

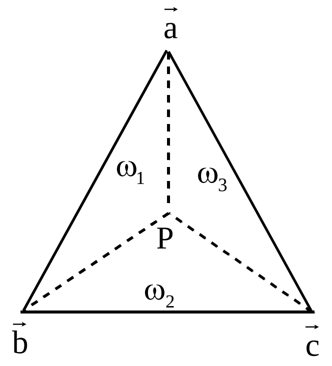
55. $\left(\sqrt{2}x - y - \sqrt{3} - 1\right)\ \left(\sqrt{2}x - y - 1 + \sqrt{3}\right) = 0$

$\Rightarrow 2x^2 + y^2 - 2\sqrt{2}xy - 2\sqrt{2}x + 2y - 2 - = 0$

56. $r = \frac{\Delta}{S} = \frac{\frac{1}{2}\times 2\times 2\times\sqrt{2}}{\sqrt{2}+\sqrt{6}} = \sqrt{3}-1$

$\Rightarrow (r+1)^2 = 3$

57.



$P:\left(\dfrac{\omega_1\vec{c}+\omega_2\vec{a}+\omega_3\vec{b}}{\omega_1+\omega_2+\omega_3}\right)$

58. $\dfrac{dy}{dt}=12t^2-6t-18$ & $\dfrac{dx}{dt}=5\left(t^2-4\right)(t+1)\neq 0$

$\forall t\in(-2,\ 2)$ $\dfrac{d^2y}{dt^2}=24t-6\Rightarrow \psi''-1<0$ & $\psi''\left(\dfrac{3}{2}\right)>0$

$\Rightarrow$ minimum value = -17.25 at $t=\dfrac{3}{2}$

maximum value = 14 at t = - 1

59. $1\le\log_{\{x\}}[x]\le 2$ but $\log_{\{x\}}[x]$ is ≤ 0 similarly $\log_{[x]}\{x\}\neq 1,\ 2\ \Rightarrow\lambda_1,\ \lambda_2=0$

60. $\left|\vec{a}-\vec{b}\right|^2+\left|\vec{b}-\vec{c}\right|^2+\left|\vec{c}-\vec{a}\right|^2$

$=2(1+4+9)-2\left(\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\ \vec{a}\right)$

$\le 3(1+4+9)\left[\text{from }\ \vec{a}+\vec{b}+\vec{c}=\vec{0}\right]$

≤ 42

$\Rightarrow 42=2\times3\times7\Rightarrow\lambda_2=8$

& $44=4\times11=2(2\times11)\Rightarrow\lambda_3=4$

$\left[\dfrac{84}{12}\right]=7$