# SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

| SR MPC | GT-4 | Date: 14-09-20 |
|---|---|---|
| Time: 09:00 AM to 12:00 NOON | 2014_P1 MODEL | Max.Marks:180 |

## KEY SHEET

## PHYSICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **BC** | 2 | **AC** | 3 | **AC** | 4 | **ABC** | 5 | **CD** |
| 6 | **AC** | 7 | **BD** | 8 | **A** | 9 | **AD** | 10 | **BD** |
| 11 | **3** | 12 | **7** | 13 | **6** | 14 | **5** | 15 | **5** |
| 16 | **2** | 17 | **1** | 18 | **5** | 19 | **5** | 20 | **5** |

## CHEMISTRY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 21 | **AC** | 22 | **ABC** | 23 | **ABD** | 24 | **CD** | 25 | **D** |
| 26 | **ABC** | 27 | **ABD** | 28 | **AB** | 29 | **B** | 30 | **ABCD** |
| 31 | **6** | 32 | **6** | 33 | **9** | 34 | **4** | 35 | **4** |
| 36 | **6** | 37 | **7** | 38 | **8** | 39 | **5** | 40 | **1** |

## MATHS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41 | **ABCD** | 42 | **BD** | 43 | **ACD** | 44 | **C** | 45 | **BD** |
| 46 | **ABC** | 47 | **ABC** | 48 | **BC** | 49 | **B** | 50 | **BCD** |
| 51 | **1** | 52 | **0** | 53 | **1** | 54 | **8** | 55 | **6** |
| 56 | **3** | 57 | **5** | 58 | **8** | 59 | **9** | 60 | **5** |

# SOLUTIONS
## PHYSICS

1. The flow of heat will always be in the direction of the temperature gradient from higher to lower temperature. Hence $Q_1$ in rod AB, $Q_2$ in rod BC will both be in clockwise sense while $Q_3$ in CA will be in anti – clockwise sense. Also, we have if L is the length of each rod and A its area of cross –section,

$$Q_1 = \frac{\alpha_1 A(100-50)}{L} = (50\alpha_1)\frac{A}{L}$$

$$Q_2 = \frac{\alpha_2 A(50-0)}{L} = (50\alpha_2)\frac{A}{L}$$

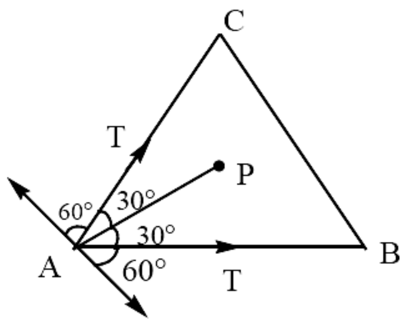
$$Q_3 = \frac{\alpha_3 A(100-0)}{L} = (100\alpha_3)\frac{A}{L}$$

Hence $Q_1 : Q_2 : Q_3 :: \alpha_1 : \alpha_2 : 2\alpha_3$

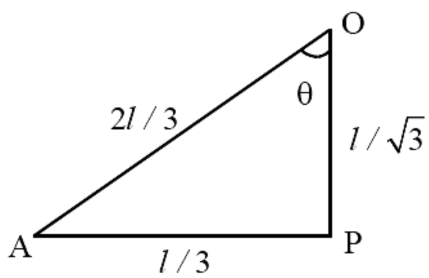
Also, $\frac{Q_1}{\alpha_1} + \frac{Q_2}{\alpha_2} = \left(50\frac{A}{L}\right) + \left(50\frac{A}{L}\right) = \left(100\frac{A}{L}\right) = \frac{Q_3}{\alpha_3}$

2. Draw free body diagrams and use Newton's second law.

3. Let P be the centroid of ABC.




$$AP = \frac{2}{3}(AC)\cos 30 = \frac{AC}{\sqrt{3}} = \frac{l}{3}$$




Due to symmetry normal force on any rod due to ground is mg.

Torque on any rod about 'O' can be equated to zero as

$$2T\cos 30\left(\frac{l}{\sqrt{3}}\right) + mg\frac{l}{2}\sin\theta = Nl\sin\theta$$

$$Tl + mg\frac{l}{2}\frac{1}{2} = mgl\frac{1}{2}$$

$$T = \frac{mg}{4}$$

4. $$\frac{1}{2}mv^2 + q\left(\frac{p\cos\theta}{4\pi\varepsilon_0 r^2}\right) = 0$$

Or $$v = \sqrt{\frac{-2Qp\cos\theta}{4\pi\varepsilon_0 m r^2}}$$

Circular motion of bead required a centripetal force

$$E_r = -\frac{\partial V}{\partial r} = \frac{2p\cos\theta}{4\pi\varepsilon_0 r^3}$$

Note that $QE_r = \dfrac{mv^2}{r}$

Thus wire frame does not exert any force on the bead to sustain circular motion. Bead will reach the point opposite its path executing a periodic motion.

5. To measure the current both $k_1$ and $k_2$ should be closed.

$$I = \frac{10}{18 + 2 + \frac{48\times 2}{48+2}} = \frac{50\times 10}{50\times 20 + 96} = \frac{500}{1096}$$

To measure the voltage both $K_1$ and $K_2$ should be opened. $V = I_g\left(R + R_g\right)$;

$$I_g = \frac{18}{18 + 952 + 48}I_0;\ I_0 = \frac{10}{2 + \frac{18\times 1000}{1000+18}} = \frac{10\times 1018}{2036 + 18000}$$

$$V = \frac{18(1000)}{1018}\times\frac{10\times 1018}{20036}$$

6. $$l_1 + e = \frac{l}{4}$$

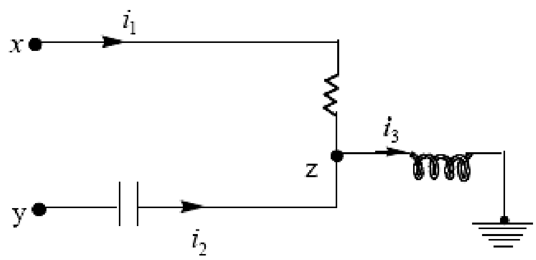
$$l_2 + e = \frac{3l}{4}$$

$$e = \frac{l_2 - 3l_1}{2}$$

$$l_3 + e = \frac{5l}{4}$$

$$l_3 = 2l_2 - l_1$$

7.




Current $i_3 = i_1 + i_2 = 5\sqrt{2}\sin(100\pi t)$

Potential of junction at z is $V_z = 5\sqrt{2}\sin\left(100\pi t + \frac{\pi}{2}\right)$

$$V_z = 25\sqrt{2}\sin\left(100\pi t + \frac{\pi}{2}\right)$$

Potential at $x$; $V_x = i_1R + V_z = 50\sin\left(100\pi t + \frac{\pi}{4}\right) + 25\sqrt{2}\sin\left(100\pi t + \frac{\pi}{2}\right)$

Potential at $y$; $V_y = i_2X_C + V_z = 50\sin\left(100\pi t - \frac{3\pi}{4}\right) + 20\sqrt{2}\sin\left(100\pi t + \frac{\pi}{2}\right)$

$$V_{xy} = 100\sin\left(100\pi t + \frac{\pi}{4}\right)$$

Net heat is getting released across resistor $\equiv (i_{rms})^2.R = 125W$

8. Conceptual

9. Conceptual

10. $V_L = \frac{2}{9}\frac{gr^2(\sigma - \rho)}{\eta}$ and torque by viscous forces will not be produced.

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11. $K \rightarrow \frac{F}{x^n} \rightarrow M^1L^{1-n}T^{-2}$

$$M^1L^{1-n}T^{-2} \rightarrow E \rightarrow (M)^a(L)^b\left(M^1L^{1-n}T^{-2}\right)^c$$

Amplitude

Given b = 4 -2 = -2c

C = 1

2 = b + (1–n)c

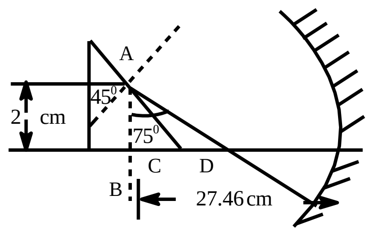
2 = 4 + 1 – n

n = 3

12. $z^2 = x^2 + y^2 \Rightarrow z\frac{dz}{dt} = x\frac{dx}{dy} - y\frac{dy}{dt}$

$x\frac{dx}{dt} = \frac{zdt}{dt} + y\frac{dy}{dt}$

13.




$\underline{|BAD} = 75^0$

$\tan 75^0 = \frac{BD}{AB} \Rightarrow BD = 2\left(2+\sqrt{3}\right) = 7.46\,cm$

Hence DP = 20 cm i.e., the ray emerging from the prism passes through the centre of curvature of the mirror.

14. Conceptual

15. Weight of sphere + chain = $(m + \lambda h)g$

Buoyant force = $\left(3m + \frac{\lambda h}{7}\right)g$

For equilibrium, weight = Buoyant force or, $m + \lambda h = 3m + \frac{\lambda h}{7}$ or $h = \frac{7m}{3\lambda}$

16. Let the piston be displaced by x.

$$PA + \frac{q^2}{2\varepsilon_0 A} = P_0 A$$

$$PA + \frac{1}{2\varepsilon_0 A}\frac{\varepsilon_0^2 A^2}{(L - x)^2}e^2 = P_0 A$$

$$P = P_0 - \frac{\varepsilon_0 e^2}{2(L - x)^2} = P_0 - \frac{2\varepsilon_0 e^2}{L^2} = P_0 - \frac{n\varepsilon_0 e^2}{L^2}$$

17. Ratio of area of $\Delta OCD$ to $\Delta OAB$ is the ratio of emf in reach CD and AB.

18. $\eta = \dfrac{\text{Total work done}}{\text{Total heat supplied}}$

$$W_{AB} = 5000\,J$$

$$W_{BC} = 1200\,R\ln 2$$

$$Q_{AB} = nC_P\Delta T = 2 \times \frac{5}{2}R \times 300 = 1500R$$

$$Q_{BC} = W_{BC} = 1200\,R\ln 2$$

$$\eta = \frac{600R(2\ln 2 - 1)}{1800R + 1200R\ln 2}$$

$$= 1 - \frac{21}{15 + 12\ln 2}$$

$$x = 7$$

19. Conceptual

20. $AB = \dfrac{v_0^2 \sin 2\theta}{g} = \dfrac{10 \times 10}{10 \times 2} = 5$

## CHEMISTRY

21. $2Al + 3MnO \rightarrow Al_2O_3 + 3Am = \overset{\boxed{Al}}{2Mole}$ ------------ $\overset{\boxed{MnO}}{3Mole}$ = 54 g

22. Conceptual

23. Conceptual

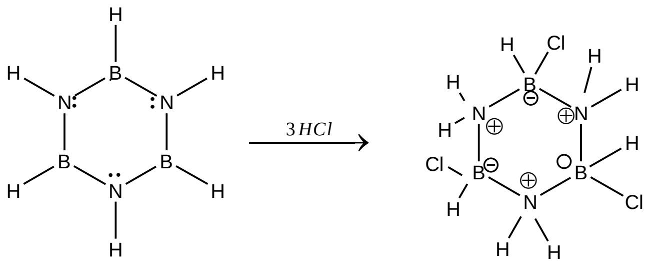
24. Conceptual

25. Correct order is $BeF_2 > BaF_2 > SrF_2 > CaF_2 > MgF_2$

26. for cyclic process: $\Delta U = 0$

$$\Delta U = q + w \;\; \theta = q + w \;\; q = -w \;\; w = \pi r^2 \;\; w = \pi\left(\frac{P_2 - P_1}{2}\right)\left(\frac{V_2 - V_1}{2}\right)$$

27.



28. Option 'C' has pos Option 'D' has pos

29. Hoffmann bromamide reaction

30. Conceptual

31. $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2 \overset{(+6)}{Mn}O_4 + 2H_2O$

32. It exist as ccp lattice

33. $E \propto \frac{1}{\lambda} \propto -\frac{2\pi^2 m e^4}{n^2 h^3 c} \propto \frac{-R_H}{n^2}$

For H-like particles all orbitals having same energy in given orbit.

34. $2^n = 2^2 = 4$

35. Stchyose is tetrasaccharide

36. $\Delta T_f = i\, m\, K_f$ $\Delta T_b = i\, m\, K_b$

37. $HCO_3^- \rightarrow CO_2 + OH^-$

$H^nCO_3^- = \frac{6.1}{61} \times \frac{20.8}{100} = {}^nCO_2$

$\underset{CO_2}{1\,Mole}\begin{pmatrix} at & 1\ atm \\ & 25^oC \end{pmatrix}$ …… 24.4 L

0.0286 …….?

= 0.7L $\Rightarrow 10 \times 0.7 = \boxed{7L}$

38. $\left[Ag(CN)_2\right]^{\pm n}, \left[Au(CN)_2\right]^{\pm n}, \left(Zn(CN)_4\right)^{\pm m}$

x= 2

y = 2

z = 4

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8

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39. Conceptual

40. Conceptual

## MATHS

41. f(-x) also satisfies the given equation and for $x \geq 0$, $h(x)=(f(x))^2+(f'(x))^2$ is a decreasing function.

42. $\frac{f(2x)}{e^{2x}-1}=\frac{f(x)}{e^x-1}$......... and so on taking limit $f(x)=f'(0)(e^x-1)$

43. $f(\alpha)=\lim_{x\to\alpha} e^{\frac{\tan 3(x-\alpha)(x-\beta)}{x-\alpha}}=e^{3(\alpha-\beta)}$ $f(\beta)=e^{3(\beta-\alpha)}$

44. distinct of S from directrices has AM as 10 $\Rightarrow CS=10$ and $e=\sqrt{5}$

45. Largest circle has its circumference, nearest to the radical axis

46. Let $B_1(\vec{r}_1)$, $B_2(\vec{r}_2)$.......$B_4(\vec{r}_4) \in A$ or $A_0$

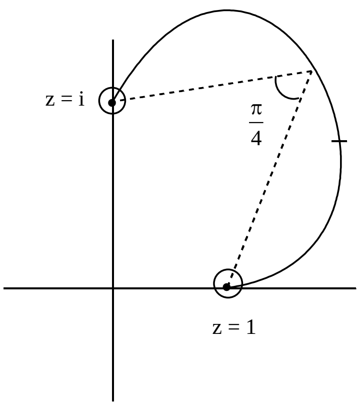
$A_1$= set of all points $k_1\vec{r}_1+k_2\vec{r}_3$ such that $k_1, k_2>0$ and $k_1+k_2=1$ (internal division), since any point inside tetrahedron can be written as $k_1\vec{r}_1+k_2\vec{r}_2+k_3\vec{r}_3+k_4\vec{r}_4$ (same way)

$$\equiv(k_1+k_2)\left(\frac{k_1\vec{r}_1+k_2\vec{r}_2}{k_1+k_2}\right)+(k_3+k_4)\left(\frac{k_3\vec{r}_3+k_4\vec{r}_4}{k_3+k_4}\right)$$

47. $a_k+b_k=n-1 \sum b_k^2=\sum\left((n-1)^2-2(n-1)a_k+a_k^2\right)$

$$=n(n-1)^2-2(n-1).\frac{n(n-1)}{2}+\sum a_k^2=\sum a_k^2$$

50.




51. $e^{x+y}=\tan(x+y) \Rightarrow x+y+=C \Rightarrow \frac{dy}{dx}=-1$

54. $2(2-d)+2(2+d)+4-d^2=b$

so $d=\sqrt{12-c}$

$b=12-d^2$, $c=8-2d^2$

for minimum d = 1

55. One example of Q is set of subsets containing 1. also for any subset B and A, Q can not have both B, A-B

56. Applying ab = 4 (a+b+c)

$$4d\left(2m^2+2mn\right)=2d^2mn\left(m^2-n^2\right)$$

$$\Rightarrow 4=dn\left(m-n\right)\Rightarrow n=1,2 \text{ or } 4$$

57. $$\frac{\frac{1}{6}.\frac{1}{6}1+\frac{1}{6}.\frac{2}{6}.\frac{1}{5}+\frac{1}{6}.\frac{3}{6}.0+0+.....}{\frac{1}{6}.\frac{1}{6}1+\frac{1}{6}.\frac{2}{6}.\frac{1}{6}+\frac{3}{6}+.....\frac{1}{6}\frac{6}{6}}$$

$$=\frac{1+\frac{2}{5}}{1+2+3+4+5+6}=\frac{\frac{7}{5}}{21}=\frac{7}{105}=\frac{1}{15}$$

58. $\text{Area}=\pi ab\times\frac{e^2}{4}=\pi.3.5\frac{16}{25.4}=\frac{12}{5}.\pi=7.56$ nearest integer is 8

59. Let $B=\begin{bmatrix} x & y \\ a & b \end{bmatrix}$ using AB = BA we get b = x, a = 0 also $2^n=6\Rightarrow x=3\Rightarrow |B|=9$

60. $x\in(0,4),\ y\in(0,4)\ \frac{4(x+iy)}{x^2+y^2}=\frac{4}{\bar{z}}$ so $\frac{4x}{x^2+y^2}<1,\ \frac{4y}{x^2+y^2}<1$