Hints & Solutions

PART A - PHYSICS

1. **c)** $\frac{8}{3}$ **J**

Work done by the force
= force displacement
or W = F × s ...(i)
But from Newton's 2nd law, we have
Force = mass × acceleration
ie, F = ma ...(ii)
Hence, from Equation (i) and (ii), we get

$$W = mas = m\left(\frac{d^2s}{dt^2}\right)s \quad ...(iii)$$

$$\left(\because a = \frac{d^2s}{dt^2}\right)$$

Now, we have, $s = \frac{1}{3}t^2$

$$\therefore \frac{d^2s}{dt^2} = \frac{d}{dt}\left[\frac{d}{dt}\left(\frac{1}{3}t^2\right)\right]$$

$$= \frac{d}{dt} \times \left(\frac{2}{3}t\right) = \frac{2}{3}\frac{dt}{dt} = \frac{2}{3}$$

Hence, equation (iii) becomes

$$W = \frac{2}{3}ms = \frac{2}{3}m \times \frac{1}{3}t^2 = \frac{2}{9}mt^2$$

We have given
m = 3kg, t = 2s

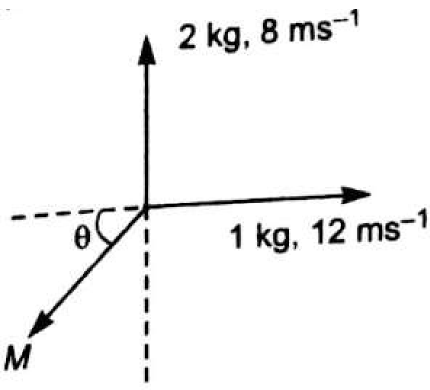
$$W = \frac{2}{9} \times 3 \times (2)^2 = \frac{8}{3}J$$

2. **b)** **100 J**

Net work done in sliding a body up to a height h on inclined plane
= Work done against gravitational force
+ Work done against frictional force
⇒ $W = W_g + W_f$ ...(i)
but W = 300 J
Work Energy and power
$W_g = mgh$
= 2 × 10 × 10 = 200 J
Putting in equation (i), we get
$300 = 200 + W_f$
⇒ $W_f = 300 - 200 = 100$ J

3. **a)** **5 kg**

Momentum of first part = 1 × 12 = 12kg ms^{-1}
Momentum of the second part
= 2 × 8 = 16 kg ms^{-1}
∴ Resultant momentum
$= \sqrt{(12)^2 + (16)^2}$ = 20kg ms–1
The third part should also have the same momentum.
Let the mass of the third part be M, then
4 × M = 20
M = 5 kg
Alternative :



$Mv \cos \theta = 12$
$Mv \sin \theta = 16$

$$\tan \theta = \frac{16}{12} = \frac{4}{3}$$

$$M = \frac{12 \times 5}{4 \times 3} = \frac{60}{12} = 5 \text{ kg}$$

4. **b)** **2 Mg/k**

Let x be the extension in the spring.
Applying conservation of energy
$mgx - kx^2 = 0 - 0$

$\Rightarrow \quad x = \frac{2mg}{k}$

$E = \frac{1}{2}k\left(\frac{T}{k}\right)2 = \frac{1}{2}\frac{T^2}{k}$

5. **c)** **less than that of bullet**

For recoil of riffle, momentum will be conserved
MV = mv

$\frac{\text{K.E of riffle}}{\text{K.E of bullet}} = \frac{\frac{1}{2}MV^2}{\frac{1}{2}Mv^2}$

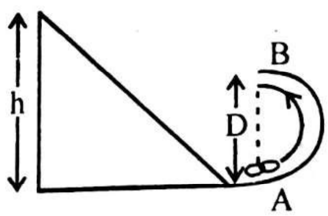
$= \frac{M}{m} \times \left(\frac{m}{M}\right)^2 = \frac{m}{M}$

As m < M, kinetic energy of riffle < kinetic energy of bullet.

6. **a)** **momentum is conserved in all collisions but kinetic energy is conserved in elastic collisions**

Kinetic energy is not conserved in inelastic collision as some energy is stored as deformation at the point of collision in the form of potential energy. Since no deformation occurs in case of eleastic collision so, kinetic energy is conserved. But momentum is conserved in both elastic and inelastic collisions as in both the cases, no external force is applied on them so, no change in momentum.

7. **d)** $\mathbf{\frac{5}{4}D}$



For the body to reach point B, the body must have least velocity of $\sqrt{5gr}$ at A.
So for a body falling from height h.
Velocity = $\sqrt{2gh}$

$\sqrt{2gh} = \sqrt{5gr} = 2gh = 5g\frac{D}{2}$

$h = \frac{5D}{4}$

8. **c)** **6 m/s, 12 m/s**

Let their velocitied after the collision be v_1 and v_2. As we know for elastic collision. Relative velocity of approach = relative velocity of separation
$10 - 4 = v_2 - v_1 \Rightarrow 6 = v_2 - v_1$
$\Rightarrow \quad v_1 = v_2 - 6$
Applying conservation of momentum,
$10 \times 10 + 5 \times 4 = 10v_1 + 5v_2$
$120 = 10v_1 + 5v_2$
$120 = 10(v_2 - 6) + 5v_2 = 15v_2 - 60$
$5v_2 = 180$
$\Rightarrow \quad v_2 = 12$cm/sec,
$v_1 = 6$cm/sec

9. **a)** **4.4 J**

Change in momentum,
$\Delta p = F.t = 0.2 \times 10 = 2$

Initial value of velocity = $\frac{10}{5}$ = 2m/sec

Initial energy = $\frac{1}{2} \times 5 \times 2 \times 2 = 10J$

Total final momentum = 10 + 2
= 12 kg m/sec

Final velocity = $\frac{12}{5}$ m/sec

Final energy = $\frac{1}{2} \times 5 \times \frac{12}{5} \times \frac{12}{5}$

$= \frac{72}{5} = 14.4J$

10. **c)** **60 J**

Let v be the common velocity.
Applying conservation of momentum
$2 \times 10 + 3 \times 0 = (2 + 3)v$

$v = \frac{10 \times 2}{5} = 4 m/sec$

Initial Energy = $\frac{1}{2} \times 2 \times (10)^2 + 0 = 100J$

Final Energy = $\frac{1}{2} \times 5 \times 4 \times 4 = 40J$

Loss of energy = 100 – 40 = 60 joule

11. **b)** **25 J**

Work done = $\vec{F}.\vec{s}$

$\left(3\hat{i}+4\hat{j}\right).\left(3\hat{i}+4\hat{j}\right) = 9 + 16 = 25$ joule

12. **c)** **twice of the initial value**

The relation between kinetic energy and linear momentum is

$E = \frac{p^2}{2m}$ so $E \propto p^2$

If energy becomes four times then momentum will become twice as

$p \propto \sqrt{E}$

13. **a)** $\sqrt{3}\,\mathbf{v_0}$

$\frac{1}{2}mv_0^2 = mgh$ - (i)

$\frac{1}{2}mv^2 = mg \times 3h$ - (ii)

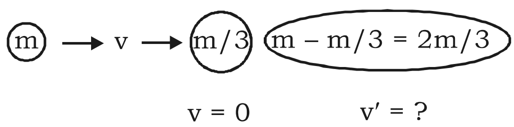
Dividing $\frac{v_2}{v_0} = 3$; $v^2 = 3{v_0}^2$

⇒ $v = \sqrt{3v_0}$

14. **d)** **the linear momentum is conserved**

In inelastic collision, linear momentum is conserved.

15. **c)** $\frac{\mathbf{3}}{\mathbf{2}}\mathbf{v}$



According to momentum conservation.

$mv = m/3 \times 0 + \frac{2m}{3}v'$

$mv = \frac{2m}{3}v'$

$v' = \frac{3}{2}v$

16. **b)** **2 J**

Workdone $= \int_0^2 F.dx = \int_0^2 kx\,dx = \frac{1}{2}kx^2\Big]_0^2$

$= \frac{1}{2}.1.(4-0) = 2 J$

17. **d)** **1.2 m**

According to conservation of momentum

$m_1v_1 + m_2v_2 = (m_1 + m_2)v$

where v is common velocity of the two bodies.

$m_1 = 0.1$ kg $m_2 = 0.4$ kg

$v_1 = 1$ m/s $v_2 = -0.1$ m/s

∴ $0.1 \times 1 + 0.4 \times (-0.1) = (0.1 + 0.4)v$

or $0.1 - 0.04 = 0.5 v$

$v = \frac{0.06}{0.5} = 0.12$ m/s

Hence, distance covered = 0.12 × 10 = 1.2 m

18. **a)** $\mathbf{-x\hat{i}+z\hat{k}}$

$F_x = \frac{-dU}{dx} = x\frac{-d}{dx}\left(\frac{x^2-z^2}{2}\right) = -x$

$F_z = \frac{-dU}{dt} = \frac{-d}{dz}\left(\frac{x^2-z^2}{2}\right) = z$

∴ $\vec{F} = -x\hat{i}+z\hat{k}$

19. **b)** $\mathbf{v_A = v_B}$

As the ball moves down from height 'h' to ground the P.E. at height 'h' is converted to K.E. at the ground (Applying law of conservation of Energy).

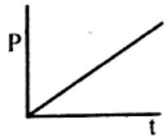
Hence, $\frac{1}{2}m_AV_A^2 = m_Agh_A$

or $v_A = \sqrt{2gh}$

Similarly, $V_B = \sqrt{2gh}$

or $V_A = V_B$

20. **d)**



$P = F \times v \Rightarrow P = F a t$

$\therefore$ $P \propto t$

21. **a)** $\mathbf{\frac{3g}{2l}}$

The moment of inertia of the uniform rod about an axis through one end and perpendicular to length is

$$I = \frac{ml^2}{3}$$

where m is mass of rod and l its length. Torque ($\tau = I\alpha$) acting on centre of gravity of rod is given by

$$\tau = mg\frac{l}{2}$$

or $$I\alpha = mg\frac{l}{2}$$

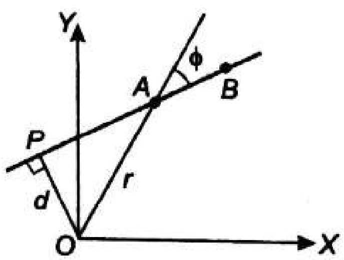
or $$\frac{ml^2}{3}\alpha = mg\frac{l}{2}$$

$$\therefore \quad \alpha = \frac{3g}{2l}$$

22. **b)** $\mathbf{L_A = L_B}$

From the definition of angular momentum

$$\vec{L} = \vec{r} \times \vec{p} = rmv \sin\phi\left(-\vec{k}\right)$$



Therefore, the magnitude of L is

$L = mvr \sin \phi = mvd$

where $d = r \sin \phi$ is the distance of closest approach of the particle to the origin. As d is same for both the particles, hence $L_A = L_B$.

23. **c)** $\mathbf{\sqrt{2} : 1}$

$$\frac{k_{ring}}{k_{disc}} = \sqrt{\frac{I_{ring}}{I_{disc}}} = \sqrt{\frac{MR^2}{\frac{1}{2}MR^2}}$$

24. **c)** $\mathbf{\vec{r} \cdot \vec{\tau} = 0}$ **and** $\mathbf{\vec{F} \cdot \vec{\tau} = 0}$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

Torque is perpendicular to both $\vec{r}$ and $\vec{F}$

$$\therefore \quad \vec{\tau} \cdot \vec{r} = 0$$

$$\vec{F} \cdot \vec{\tau} = 0$$

25. **b)** $\mathbf{\frac{\omega M}{M + 2m}}$

$I_1\omega_1 = I_2\omega_2$

In the given case

$I_1 = MR^2$

$I_2 = MR^2 + 2mR^2$

$\omega_1 = \omega$

then $\omega_2 = \frac{I_1}{I_2}\omega = \frac{M}{M + 2m}\omega$

26. **a)** $\mathbf{\frac{4}{3}Ml^2}$

Moment of inertia of rod about an axis through its centre of mass and perpendicular to rod + (mass or rod) × (perpendicular distance between two axes)

$$= \frac{Ml^2}{12} + M\left(\frac{1}{2}\right)^2 = \frac{Ml^2}{3}$$

Moment of inertia of the system

$$= \frac{Ml^2}{3} \times 4 = \frac{4}{3}Ml^2$$

27. **d)** **2.5 kg-m²**

Torque = $I\alpha$

[I is moment of inertia and a is angular acceleration]

$31.4 = 1 \times 4\pi$

$I = \frac{31.4}{4\pi} = 2.50 \text{ kg-m}^2$

28. **a)** $\geq \sqrt{\frac{10}{7} gh}$

Applying law of conservation of energy for rotating body,

$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$

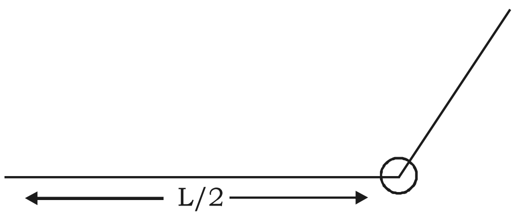
$\frac{1}{2}mv^2 + \frac{1}{2}\frac{2}{5}mr^2 \times \frac{v^2}{r^2} = mgh$

$\frac{v^2}{2} + \frac{2v^2}{10} = gh$

$\frac{5v^2 + 2v^2}{10} = gh$

$\Rightarrow v^2 = \frac{10}{7}gh$

29. **b)** $\frac{1}{12}ML^2$



We know that for a body, moment of inertia

M.I. = $\sum Mr^2$

Now, bending of rod does not alter the distribution of individual particle, the body is made of, so the value $\sum Mr^2$ will not change. Hence the changed moment of inertia of the body will be $\frac{1}{12}ML^2$.

30. **c)** $\frac{7}{10}$ **J**

When a body rolls over a smooth surface, it has linear K.E. and rotational K.E.

$\therefore \quad E = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

where $\omega = \frac{v}{r}$ and $I = \frac{2}{5}mr^2$ for solid sphere.

$\therefore \quad K.E. = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right) \cdot \frac{v^2}{r^2}$

$= \frac{1}{2}mv^2 + \frac{1}{5}mv^2 = \frac{7}{10}mv^2$

$= \frac{7}{10} \times 1 \times 1^2 = \frac{7}{10}J$

31. **a)** $\frac{ML^2}{6}$

Moment of inertia of system = M.I. of A + M.I. of B + M.I. of C

M.I. of A = M.

T through centre and perpendicular to length $= \frac{1}{12}ML^2$

M.I. of C = M.I. of A = $\frac{1}{12}ML^2$

M.I. of B = 0

(moment of mass about an axis passing through its own position is zero)

$\therefore$ Total M.I. $= \frac{1}{12}ML^2 + \frac{1}{12}ML^2$

$= \frac{1}{6}ML^2$

32. **d)** **the axis of rotation**

$\omega = \frac{2\pi}{T} = \frac{\theta}{t}$ in magnitude and direction is axis of rotation (direction in which θ changes with t)

33. **b)** **10**

Given : initial angular speed,

ω_0 = 2 rad/s, angular acceleration,

$\alpha = 3$ rad/s², time t = 2s

From the equation of the angular displacement,

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2 = 2 \times 2 + \frac{1}{2} \times 3 \times (2)^2$$

$$= 4 + 6 = 10 \text{ radians}$$

34. **a)** $\sqrt{\omega_2} : \sqrt{\omega_1}$

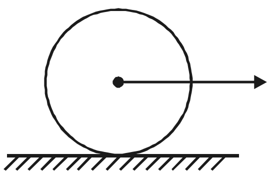
$I_1\omega_1 = I_2\omega_2$

$MK_1^2\omega_1 = MK_2^2\omega_2$

$$\left(\frac{K_1}{K_2}\right)^2 = \frac{\omega_2}{\omega_1}$$

$$\Rightarrow \frac{K_1}{K_2} = \sqrt{\omega_2} : \sqrt{\omega_1}$$

35. **a)** $\frac{2}{3}$



$$TKE = \frac{1}{2}mv^2$$

$$RKE = \frac{1}{2}I\omega^2$$

$\omega = v/R$

$$\Rightarrow \frac{TKE}{TKE + RKE} = \frac{2}{3}$$

36. **c)** $\left(\frac{1}{4\pi^2}\right)ml$

Length of the wire $= l$

Let it is bent in the form of a circular ring of radius r.

Thus, radius of the ring

$r = \frac{1}{2\pi}$

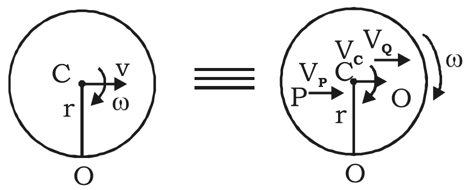
The moment of inertia of the ring about its axis.

$$I = mr^2 = m\left(\frac{l}{2\pi}\right)^2$$

$$= m \times \frac{l^2}{4\pi^2}$$

$$= \left(\frac{l}{4\pi^2}\right)ml^2$$

37. **a)** $V_Q > V_C > V_P$



From Fig. (I) we have OC = r (radius)

Therefore, $v = r\omega$

Since, ω = constant, therefore $v \propto r$

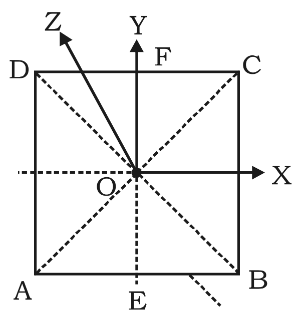
Now, form fig. (II) it is clear that its distance, $O_P < O_C < O_Q \Rightarrow V_P < V_C < V_Q \propto V_Q > V_C > V_P$.

38. **d)** $I_{AC} = I_{EF}$

By the theorem of perpendicular axes,

$I_Z = I_X + I_Y$ or $I_Z = 2I_Y$

($\because I_X = I_Y$ by symmetry of the figure)



$\therefore I_{EF} = \frac{I_z}{2}$

Again by the same theorem

$I_Z = I_{AC} + I_{BD} = 2I_{AC}$

($\therefore I_{AC} = I_{BD}$ by symmetry of the figure)

$\therefore I_{AC} = \frac{I_z}{2}$

From (i) and (ii) we get

$I_{EF} = I_{AC}$

39. **a)** $\frac{1}{2}\mathbf{mR^2}$

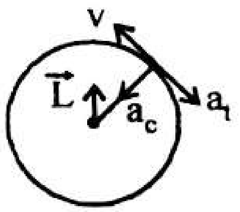
For complete disc with mass '4M'. M.I. about given axis = $(4M)(R^2/2) = 2\,MR^2$

Hence, by symmetry for the given quarter of the disc

M.I. = $2MR^2/4 = \frac{1}{2}MR^2$

40. **b)** **Only direction of angular momentum $\vec{L}$ is conserved**

Since v is changing (decreasing). L is not conserved in magnitude. Since it is given that a particle is confined to rotate in a circular path, it can not have spiral path. Since the particle has two acceleration a_c and a_t therefore the net acceleration is not towards the centre.



The direction of $\vec{L}$ remains the same even when the speed decreases.

41. **b)** **B**

We know that

$$I = \frac{m_1r_1^2 + m_1r_2^2 + m_3r_3^2 + ... + m_nr_n^2}{m_1 + m_2 + m_3 + ...}$$

where r_1, r_2, r_3 are distances of mass m_1, m_2, m_3, etc. from the axis. From the relation it is clear that I depends upon distribution of the masses and position of axis.

So, assertion is true.

We know that

angular momentum = $I\omega$

Torque = $I\alpha$

If we compare these equations with equations like linear momentum = mv, force = ma, we find that I represents mass in angular motion. As mass represents inertia in linear motion. I represents inertia in angular motion. But assertion and reason are mutually exclusive. So, (b) is the answer.

42. **d)** **D**

The angular momentum of earth-moon system will be conserved because no torque is acting on it.

So, $\tau = \frac{dL}{dt}$

If $\tau = 0$, $\frac{dL}{dt} = 0 \Rightarrow L$ is constant

or angular momentum is constant. So reason is wrong.

So, $I_1\omega_1 = I_2\omega_2$

where I_1 and I_2 are momentia of inertia of earth and moon and ω_1 and ω_2 are their angular velocities. If earth slows down ω, will be decreased. So, I_2 will be decreased if we take ω_2 to remain constant.

$I_2 = m_2r_2^2$ where m_2 is mass of moon and r_2 is radius of moon's orbit, r_2 will be reduced to reduce I_2. Hence moon will come near to the earth. Hence assertion is right.

43. **a)** **A**

Along with earth, particles of atmosphere also revolves around the axis of rotation. Now due to change in the constitution of atmosphere there is small change in the total moment of inertia of the whole system. Applying conservation of angular momentum.

$I\omega = I'\omega'$

If I' changes, there is corresponding change in the angular velocity of the system.

44. **a)** **A**
Under central force field, force acts along the line joining the bodies so it does not have rotatory effect i.e. torque is zero. Hence angular momentum is conservative.

45. **a)** **A**
When mass of the opponent is brought nearby his moment of inertia gets reduced which makes the operation of rotating him around the hip an easier exercise.

46. **b)** **B**
In sliding down, the entire potential energy is converted into kinetic energy. While in rolling down, some part of the potential energy is converted into kinetic energy of rotation. Therefore linear velocity acquired is less.

47. **c)** **C**
The position of centre of mass of a body depends on shape, size and distribution of mass of the body. The centre of mass does not lie necessarily at the centre of the body. Many objects have a point, a line or a plane of symmetry. The centre of mass of such an object then lies at that point, on that line or in that plane. Also the centre of mass of an object need not lie within the object, like no iron at the centre of mass of a horse shoe.

48. **d)** **D**
Both assertion and reason are true and reason is the correct explanation of assertion.
As the polar ice melts, it will flow towards the equator thereby increasing the moment of inertia of earth. Hence the angular velocity decreases. So the day length will become longer.

49. **d)** **D**

50. **d)** **D**
For a disc rolling without slipping on a horizontal rough surface with uniform angular velocity, the acceleration of lowest point of disc is directed vertically upwards and is not zero (due to translation part of rolling, acceleration of lowest point is zero. Due to rotational part of rollig, the tangential acceleration of lowest point is zero and centripetal acceleration is non-zero and upwards). Hence assertion is false.

51. **a)** **A**

52. **d)** **D**
In an elastic collision, no conversion of energy, so K.E. remains constant during the time of collision. There is no friction acting in this case. In case of friction too conservation of energy is followed provided we take into account all the transformations there.

53. **d)** **D**
Frictional force is non-conservative as work done against frictional force can not be stored as potential energy.

54. **a)** **A**
In a quick collision, time t is small.
As $F \times t$ = constant, therefore force involved is large. i.e. collision is more violent is comparison to slow collision.
Momentum, $p = mv$ or $p \propto v$
i.e. momentum is directly proportional to its velocity, so the momentum is greater in a quicker collision.

55. **a)** **A**

In elastic collision, kinetic energy remains conserved therefore the ball rebounds with the same velocity. According to Newton's second law

$F \times t =$ change in linear momentum

$\therefore$ $F \times 1 = m \times n (u + u) \Rightarrow F = 2mnu$

56. **c)** **C**

If there were only one propeller in the helicopter, the helicopter itself, would have turned in opposite direction of the direction of propeller due to conservation of angular momentum. Thus two propeller provides helicopter a steady movement.

57. **a)** **A**

58. **c)** **C**

59. **b)** **B**

60. **a)** **A**

PART B - CHEMISTRY

61. **a)** **Internal energy**

62. **b)** **The system gains heat and has work performed on it.**

$\Delta E = q + w$

q and w both are positive

$\Delta E > 0 \Rightarrow E_2 - E_1 > 0 \Rightarrow E_2 > E_1$

63. **b)** **10 kJ**

$\Delta E = q + w$

$= 10 + 0 = 10$ kJ

64. **d)** **$w > 0; q = 0; \Delta U > 0$**

65. **d)** **Energy of the universe remains constant**

66. **b)** **w = –11.488 kJ**

$$w = -2.303 \, nRT \log\left(\frac{V_2}{V_1}\right)$$

$v_2 = 40$ L

$v_1 = 4$ L

$n = 2$

$R = 8.314$

$w = -11.488$ K J

67. **d)** **Adiabtic expansion**

$q = 0, \quad w < 0$

$\Delta E = q + w < 0$

$\Delta E < 0 \Rightarrow E_2 < E_1$

$\Rightarrow T_2 < T_1$

68. **b)** **Between 1 and 2**

1st solution - $[H^+] = 10^{-1}$ M

2nd solution - $[H^+] = 10^{-5}$ M

$$[H^+] \text{ of mixture } = \frac{10^{-1} + 10^{-5}}{2}$$

$\approx 5 \times 10^{-2}$

$pH = 2 - \log 5 = 1.3$

69. **b)** $\Delta S = \dfrac{q_{rev}}{T}$

70. **a)** **84 J mol^{-1}K^{-1}**

$$\Delta S = \frac{q}{T} = \frac{8400}{100}$$

$= 84$ J/mol-K

71. **d)** **ΔH = +ve, $T\Delta S$ = +ve and $\Delta H > T\Delta S$**

$\Delta G < 0 \Rightarrow$ Reversible (feasible)

$\Delta G > 0 \Rightarrow$ Irreversible (Non-feasible)

$\Delta G = \Delta H - T\Delta S$

72. **c)** **$PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$**

$\Delta H = \Delta E + \Delta ngRT$

if $\Delta ng > 0 \Rightarrow \Delta H > \Delta E$

73. **a)** **–297.1 kJ**

$SO_{2(g)} + O_{2(g)} \rightleftharpoons SO_{3(g)}$ (–98.3 kJ)

(Formation of SO_3) = $S_{(s)} + \frac{3}{2} + O_{2(g)}$ (–395.4 kJ)

(Formation of SO_2) = $S_{(s)} + O_{2(g)} \rightleftharpoons SO_{2(g)}$ (?)

$\Delta H = (98.3 - 395.4)$ kJ

$= -297.1$ kJ

74. **d)** **–370 kJ**

ΔH^0 when 1 mol of $H_{2(g)}$ reacts with 1 mol of $Cl_{2(g)}$ is $-185 \times 2 = -370$ kJ

75. **a)** **HCl, KOH**

Strong acid with strong base

76. **d)** **45.0 kJ**

Enthalpy of ionization

= Energy absorbed during neutralization

= –12.1 – (–57.1)

= 45 kJ

77. **d)** **7.33**

$$K_c = \frac{K_f}{K_b} = \frac{1.1 \times 10^{-2}}{1.5 \times 10^{-3}}$$

$$= \frac{11 \times 10}{15} = 7.33$$

78. **c)** **reduced by 1000 times**

$(pH)_1 = 3 \Rightarrow [H^+]_1 = 10^{-3}$

$(pH)_2 = 6 \Rightarrow [H^+]_2 = 10^{-6}$

79. **d)** $\frac{[C]}{[A]^3[B]^2}$

$$K_c = \frac{[C]}{[A]^3 \cdot [B]^2}$$

80. **d)** $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$

$$\text{Unit of } K_c = \frac{(mol/L)^2}{(mol/L)} = mol/L$$

81. **d)** **None of these**

82. **d)** **both pH and pOH decrease with increase in temperature**

83. **b)** **50**

K_c for reaction

$$NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$$

$$= \left(\frac{1}{4\times10^{-4}}\right)^{\frac{1}{2}} = \frac{1}{2\times10^{-2}} = 50$$

84. **b)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$

$K_p = K_c (RT)^{\Delta ng}$

if $\Delta ng > 0 \Rightarrow K_p > K_c$

if $\Delta ng < 0 \Rightarrow K_p < K_c$

85. **b)** **8.5**

(t = 0)	5	5		0
	$2SO_{2(g)}$	$O_{2(g)}$	$\rightleftharpoons$	$2SO_{3(g)}$
(t = t)	(5 – 3)	$\left(5 - 3/2\right)$		3

total no.of mol at equilibrium

$= 5 - 3 + 5 - 3/2 + 3$

$= 8.5$

86. **c)** $[P_4] > [Cl_2]$

87. **a)** **K_p does not change significantly with pressure**

88. **a)** $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

89. **c)** **16**

90. **d)** **Mixture is heated**

91. **a)** **Low temperature, high pressure**

92. **d)** $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

93. **d)** C_2H_4

94. **a)** $HClO < HClO_2 < HClO_3 < HClO_4$

95. **a)** $H_2PO_4^-$

96. **d)** 10^{-9}

$$K_a = c\alpha^2 = 0.1 \times \left(\frac{0.01}{100}\right)^2 = 10^{-9}$$

97. **d)** $\sqrt{K_a c}$

t = 0	C			
	$HA_{(aq)}$	$\rightleftharpoons$	$H^+_{(aq)}$	$+ A^-_{(aq)}$
t = t	$C(1-\alpha)$		$C\alpha$	$C\alpha$

$K_a = c\alpha^2$ (if $\alpha < 0.05$)

$$[H^+] = c\alpha = c \cdot \sqrt{\frac{K_a}{c}} = \sqrt{K_a \cdot c}$$

98. **b)** 2.1×10^{-4}

$$K_a = c\alpha^2 = 0.2 \times \left(\frac{3.2}{100}\right)^2$$

$= 2.1 \times 10^{-4}$

99. **d)** **Temperature increases**

100. **c)** **11**

$[OH^-] = 10^{-3}$

$\Rightarrow [H^+] = 10^{-11}$

$pH = -\log[H^+]$

$= 11$

101. **a)** **A**

$[OH^-]$ from NaOH = 10^{-7}

$[OH^-]$ from water = 10^{-7}

$[OH^-]$ total = $10^{-7} + 10^{-7} = 2 \times 10^{-7}$

$pOH = 7 - \log 2 = 6.7$

$pH = 14 - 6.3 = 7.7$

102. **d)** **D**

$[H^+] = 2 \times 10^{-3}$

$pH = 3 - \log 2 = 27$

103. **c)** **C**

HCl is strong acid and CH_3COOH is weak acid ($\alpha < 1$)

104. **a)** **A**

105. **a)** **A**

106. **a)** **A**

107. **a)** **A**

108. **b)** **B**

109. **a)** **A**

110. **b)** **B**

111. **a)** **A**

112. **c)** **C**

113. **c)** **C**

114. **b)** **B**

115. **a)** **A**

116. **a)** **A**

117. **a)** **A**

118. **b)** **B**

119. **c)** **C**

120. **a)** **A**