ANSWER KEY (MAINS-2011)

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	3	2	1	4	2	3	3	4	3	2	3	4	4	1	1	4	1	2	2
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	3	2	2	2	3	3	1	3	1	2	4	3	4	4	4	2	1	4	3
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	1	3	2	4	4	2	4	4	1	2	3	3	2	2	2	1	1	4	1	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	2	1	3	4	3	4	1	1	2	3	3	2	3	1	4	1	1	4	3	2
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	2	2	3	4	3	4	3	2	1	3	4	4	1	2	4	4	3	2	2	4
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	3	1	3	2	1	2	4	2	2	2	2	1	4	3	3	4	2	2	2	4

HINTS & SOLUTIONS

1 **[3]**

Sol. $M = d.V \Rightarrow d = \dfrac{M}{L^3}$

$\Rightarrow d = \dfrac{4\,gm}{cm^3} = \dfrac{4(1/100)}{10^{-3}} = 40\dfrac{gm}{cm^3}$

2 **[3]**

Sol. Average velocity $= \dfrac{2v_1v_2}{v_1+v_2}$

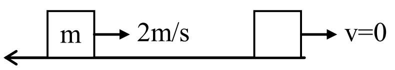
3 **[2]**

Sol. From the law of conservation of linear momentum

$mv\hat{i} + (3m)(2v)\hat{j} = 4\,mv'$

$v' = \dfrac{v}{4}\hat{i} + \dfrac{3}{2}v\hat{j}$

4. **[1]**



Sol. F=μmg

retardation of the block on the belt

$a = \dfrac{F}{m} = \mu g$

From $v^2 = u^2 + 2as$

$0 = 2^2 - 2(\mu g)\,s$

$s = \dfrac{4}{2\times 0.5\times 10} = 0.4$ m

5. **[4]**

Sol. From the law of conservation of angular momentum

$mvr = mv'\dfrac{r}{2}$

$v' = 2v$

so $\dfrac{KE}{KE_1} = \dfrac{\frac{1}{2}mv^2}{\frac{1}{2}mv'^2} = \dfrac{1}{4}$

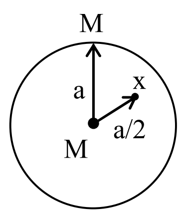
6. **[2]**

Sol. $v_{escape} = \sqrt{\dfrac{2GM}{R}}$

Escape velocity from earth surface.

7. **[3]**

Sol.

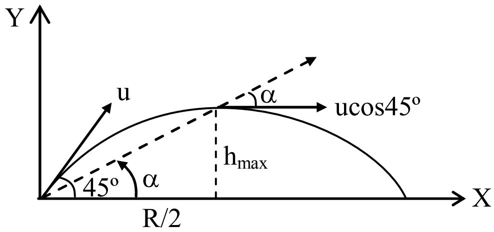


gravitational potential at x point

$V_x = \dfrac{GM}{a/2} + \dfrac{GM}{a} = \dfrac{3GM}{a}$

8. **[3]**

Sol.



$$\tan\alpha = \frac{h_{max}}{R/2} = \frac{\dfrac{u^2\sin^2 45^o}{2g}}{\dfrac{u^2\sin 90^o}{2g}}$$

$$\tan\alpha = \frac{1}{4}$$

$\alpha = \tan^{-1}(1/4)$

9 **[4]**

Sol. $P \propto T^{\gamma/\gamma-1}$

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^{\gamma/\gamma-1}$$

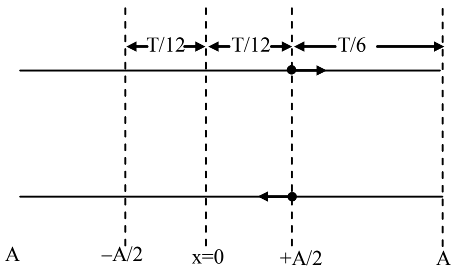
$$P_2 = P_1\left(\frac{T_2}{T_1}\right)^{\gamma/\gamma-1}$$

$$P_2 = 2\left(\frac{1200}{300}\right)^{\frac{1.4}{1.4-1}}$$

$P_2 = 256$ atm

10 **[3]**

Sol.



$$\text{Time interval} = \frac{T}{6} + \frac{T}{6} = \frac{2T}{6}$$

$$\text{Phase difference} \Rightarrow \frac{2T}{6} \equiv \frac{2\pi}{3}$$

11. **[2]**

Sol. $n \propto \sqrt{T}$

$$\frac{\Delta n}{n} = \frac{1}{2}\frac{\Delta T}{T}$$

$$\frac{\Delta T}{T} = 2\times\frac{\Delta n}{n} = 2\times\frac{6}{600} = 0.02$$

12. **[3]**

Sol. For without deviation

$$\frac{A}{A'} = -\frac{\mu'-1}{\mu-1}$$

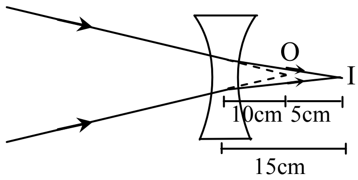
$$\frac{15^o}{A'} = -\frac{1.75-1}{1.50-1}$$

$$\frac{15^o}{A'} = -\frac{0.75}{0.50}$$

$A' = -10^o$

13. **[4]**

sol.



$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{15} - \frac{1}{10} = \frac{1}{f}$$

$f = -30$ cm

14. **[4]**

Sol. $W_{D\to E} = Q[V_E - V_D]$

$\because V_E = V_D \Rightarrow W_{D\to E} = 0$

15. **[1]**

Sol. $\vec{E} = -\left[\hat{i}\frac{\partial V}{\partial x} + \hat{j}\frac{\partial V}{\partial y} + \hat{k}\frac{\partial V}{\partial z}\right]$

$\vec{E} = -[\hat{i}(8x)]$

$\vec{E}_{(1,0,2)} = -8\hat{i}$

So electric field is 8 along negative x-axis.

16. **[1]**

Sol. By KVL along path ACDB

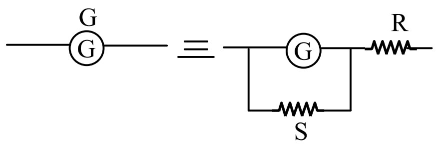
$V_A + 1 + (1)(2) - 2 = V_B$

$0 + 1 = V_B$

$\Rightarrow V_B = 1$ volt

17. **[4]**

Sol.



Current will be unchanged if resistance remains same so

$$G = \frac{GS}{G+S} + R$$

$$\Rightarrow R = G - \frac{GS}{G+S}$$

$$= \frac{G^2}{G+S}$$

18. **[1]**

Sol. For minimum deflection of 1 division
required current = 1 μA
$\Rightarrow$ Voltage required = IR = (1μA) (10) = 10 μV
$\therefore$ 40 μV ≡ 1ºC
$\Rightarrow 10\ \mu V \equiv \frac{1}{4}\ ºC = 0.25ºC$

19. **[2]**

Sol. $B = \frac{\mu_0 I}{2R} = \frac{\mu_0 qf}{2R}$

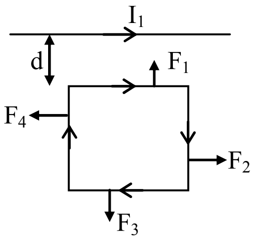
$I = \frac{q}{T} = qf$

20. **[2]**

Sol. $U = -MB\cos\theta$
$U = -MB\cos 0 = -0.4 \times 0.16 = -0.064$

21. **[1]**

Sol.



$\vec{F}_2 = -\vec{F}_4$

$\vec{F}_1 = \frac{\mu_0 I_1 I_2 \ell}{2\pi d}$

$\vec{F}_3 = \frac{\mu_0 I_1 I_2 \ell}{2\pi(d+\ell)}$

$\vec{F}_1 > F_3$

So wire attract loop.

22. **[3]**

Sol. $V_{rms} = \left[\frac{1}{T}\int_0^{T/2} V_0^2\, dt\right]^{1/2} = \left[\frac{V_0^2}{T}[t]_0^{T/2}\right]^{1/2}$

$= \left[\frac{V_0^2}{T}(T/2)\right]^{1/2}$ or $V_{rms} = \left[\frac{V_0^2}{2}\right]^{1/2} = \frac{V_0}{\sqrt{2}}$

13 **[2]**

Sol. $X_L = 2\pi fL$
$X_L \propto f$
$\frac{X_{L_2}}{X_{L_1}} = \frac{f_2}{f_1} \Rightarrow X_{L_2} = 40\ \Omega$
$R = 30\ \Omega$
$Z = \sqrt{(30)^2 + (40)^2} = 50\ \Omega$
$I = \frac{V}{Z} = \frac{200}{50} = 4A$

24. **[2]**

Sol. $V_0 = \frac{E_{Ph} - W}{e} = \frac{h(\nu - \nu_0)}{e}$

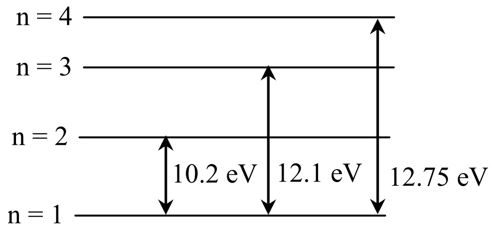
$= \frac{6.62\times10^{-34}(8.2\times10^{14} - 3.3\times10^{14})}{1.6\times10^{-19}}$

$= \frac{6.62\times10^{-34}}{1.6}\times 4.9\times10^{14+19}$

$= \frac{6.62\times4.9}{1.6}\times10^{-1} = 2$ volt

25 **[2]**

Sol. $E_{Ph} = K.E_{max} + W$
$= eV_0 + W = 10 + 2.75 = 12.75$ eV



Differenced of 4 and 1 energy level is 12.75 eV
So higher energy level is 4 to ground and Excited state is n = 3.

26. **[3]**

Sol.

	P	Q
	$4N_0$	N_0
$T_{1/2}$	1 min	2 min

$N_P = N_Q$
$\frac{4N_0}{2^{t/1}} = \frac{N_0}{2^{t/2}}$
$4 = 2^{t/2}$
$2^2 = 2^{t/2}$
$\frac{t}{2} = 2 \Rightarrow t = 4$ min

Disactive nucleus or Nuclei of R

$= \left(4N_0 - \frac{4N_0}{2^4}\right) + \left(N_0 - \frac{N_0}{2^2}\right)$

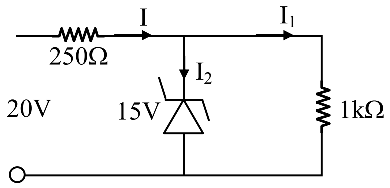
$= 4N_0 - \frac{N_0}{4} + N_0 - \frac{N_0}{4} = 5N_0 - \frac{N_0}{2}$

$= \frac{9}{2}N_0$

27. **[3]**
Sol. 11.1 eV is not possible

28. **[1]**

Sol.



$I_1 = \frac{15}{1k\Omega} = 15\text{ mA}$

$I = \frac{20-15}{250} = 20\text{ mA}$

$I_2 = I - I_1 = 20\text{ mA} - 15\text{ mA} = 5\text{mA}$

29. **[3]**
Sol. (a), (c) are forward bias.

30. **[1]**
Sol. $n_e\, n_h = n_i^2$

$n_e\, N_A = n_i^2$

$n_e = \frac{n_i^2}{N_A} = \frac{(1.5\times10^{16})^2}{4.5\times10^{22}} = 5 \times 10^9/m^3$

31. **[2]**
Sol. Unit of k = $mol^{1-n}\ \ell^{n-1}\ s^{-1}$

For zero order reaction

n = 0

unit of k = $mol\ \ell^{-1}\ s^{-1}$

32. **[4]**
Sol. $1.28 \longrightarrow 0.64 \longrightarrow 0.32 \longrightarrow 0.16 \longrightarrow 0.08 \longrightarrow 0.04$

No. of half lifes (n) = 5

$5 = \frac{\text{Total time}}{138}$

time required = 5 × 138

= 690 s

33. **[3]**
Sol. 2(i) – (iii) + (ii)

$\Delta H = 2(150) - 350 - 125$

$= -175$ kJ/mol

34. **[4]**
Sol. $O_2^+ = KK\sigma 2s^2\ \sigma^*2s^2\ \sigma 2p_z^2\ (\pi 2p_x^2 = \pi 2p_y^2)\ (\pi^*2p_x^1)$

$O_2 = KK\sigma 2s^2\ \sigma^*2s^2\ \sigma 2p_z^2\ (\pi 2p_x^2 = \pi 2p_y^2)\ (\pi^*2p_x^1 = \pi^*2p_y^1)$

O_2 and O_2^+ contain unpaired electron in π* ABMO so paramagnetic.

35. **[4]**
Sol. $E = \frac{hC}{\lambda} = hC\,R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

36. **[4]**
Sol. $[Ag^+]\ [Cl^-] = 1.8 \times 10^{-10}$

$[Ag^+] = \frac{1.8\times10^{-10}}{0.1} = 1.8\times10^{-9}\text{ M}$

$[Pb^{+2}]\ [Cl^-]^2 = 1.7 \times 10^{-5}$

$[Pb^{+2}] = \frac{1.7\times10^{-5}}{0.1\times0.1} = 1.7\times10^{-3}\text{ M}$

37. **[2]**
Sol.

$P_1 = 1.5$ bar	$P_2 = 1$
$T_1 = 288$ K	$T_2 = 298$ K
$V_1 = V$	$V_2 = ?$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_2 = 1.55\ V$

38. **[1]**
Sol. $i = 1 - \alpha + n\alpha$

$i = 1 - 0.3 + 2(0.3)$

$i = 1.3$

$\Delta T_f = iK_f\, m$

$= 1.3 \times 1.86 \times 0.1$

$\Delta T_f = +\ 0.24$ºC

Freezing point of solution = – 0.24ºC

39. **[4]**
Sol. $2Fe^{+3} + 2I^- \longrightarrow I_2 + 2Fe^{+2}$

40. **[3]**
Sol. $\text{Rate} = -\frac{1}{2}\frac{d[N_2O_5]}{dt} = +\frac{1}{4}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt}$

$\frac{1}{2}K[N_2O_5] = \frac{1}{4}K'[N_2O_5]$

$K' = 2K$ and $K'' = \frac{K}{2}$

41. **[1]**

Sol. $\pi v = \frac{w}{m} RT$

$2.57 \times 10^{-3} \times \frac{200}{1000} = \frac{1.26}{m} \times 0.083 \times 300$

$m = 61038 \text{ gm mol}^{-1}$

42. **[3]**

Sol. Plaster of paris = $CaSO_4.1/2\ H_2O$

Epsomite = $MgSO_4.7H_2O$

Kieserite = $MgSO_4.H_2O$

Gypsum = $CaSO_4.2H_2O$

43. **[2]**

Sol. SnO_2 react with acid as well base

So amphoteric

$SnO_2 + 4HCl \longrightarrow SnCl_4 + 2H_2O$

$SnO_2 + 2NaOH \longrightarrow Na_2\ SnO_3 + H_2O$

44. **[4]**

Sol. $SiO_2 \quad + \quad CaO \longrightarrow CaSiO_3$

Acidic Basic Slag

impunity flux

45. **[4]**

Sol. Aluminium dissolve in excess NaOH to liberating hydrogen and forming metaaluminate

$2\ Al + 2NaOH + 6H_2O \longrightarrow 2Na\ [Al(OH)_4]$

or $(2NaAlO_2.2H_2O) + 3H_2$

46. **[2]**

Sol. $M \xrightarrow{M^+} M^+ + e^-$ $\qquad IE_1 = 5.1$ eV

$M^+ + e^- \longrightarrow M$ $\qquad \Delta H_{eg} = -5.1$ eV

47. **[4]**

Sol. Maximum number of molecules = $\frac{8}{2} N_A$

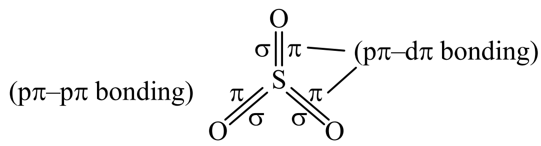
$= 4N_A$

48. **[4]**

Sol. $\frac{r_c}{r_a} = 0.414 \Rightarrow r_a = \frac{100}{0.414} = 241.5$ pm

49. **[1]**

Sol. Most preferred structure of SO_3 with lowest energy is as it contain maximum number of covalent bond.



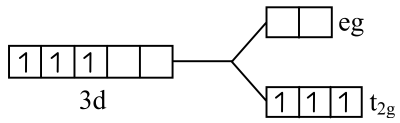
50. **[2]**

Sol. Due to positive oxidation state of Mn back donation in π* ABMO of CO is minimum therefore C–O bond is strongest.

51. **[3]**

Sol. $[Cr(NH_3)_6]^{+3}$ $[Ar]\ 3d^3\ 4s^0$

three unpaired electron are present in t_{2g} orbited



52. **[3]**

Sol. Localized l.p. is more basic than delocalized l.p.

53. **[2]**

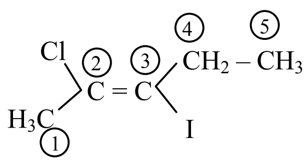
Sol. It is a fact

54. **[2]**

Sol. Intermediate carbanion is involve which is most stable with –M group.

55. **[2]**

Sol.

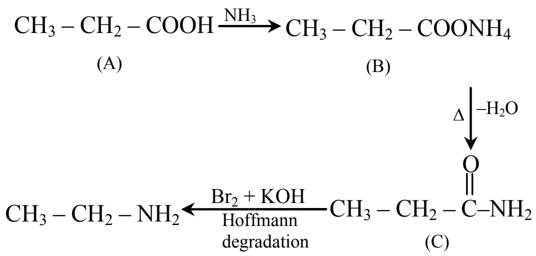


Configuration is (trans) OR (E)

Name ⇒ 2- chloro-3-iodo- 2-pentene

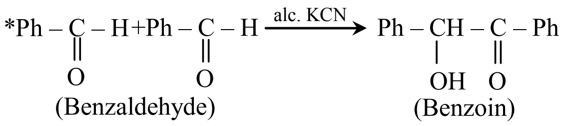
56. **[1]**

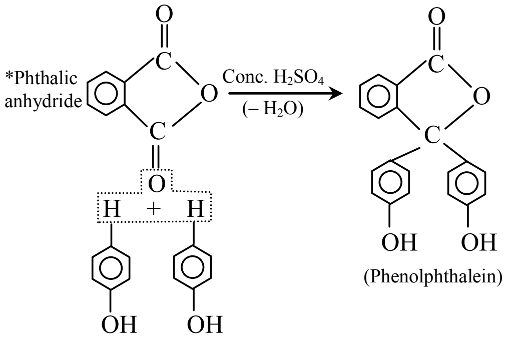
Sol.



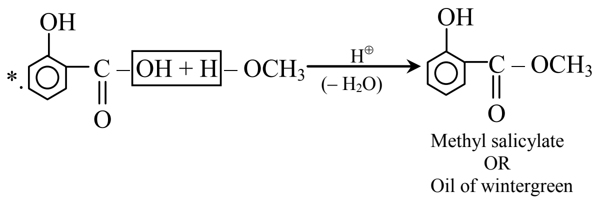
57. **[1]**

Sol.





* Methyl benzoate is involve in fries rearrangement.



58. **[4]**

Sol. Primary structure is unaffected by denaturation.

59. **[1]**

Sol. N.A. R $\propto$ $\oplus$ Charge on Sp^2

carbon $\propto \dfrac{-M}{+M} \propto \dfrac{-I}{+I}$

60. **[4]**

Sol. 1° halide generally shows SN^2 reaction.

(No rearrangement)