JEE ADVANCED-2017
MODEL PAPER-II

Time:2:00 PM to 5:00 PM **IMPORTANT INSTRUCTIONS** **Max Marks: 246**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 8)	Questions with Multiple Correct Choice	4	-2	8	32
Sec – II(Q.N : 9 – 16)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	4	-2	8	32
Sec – III(Q.N : 17 – 22)	Integer Type Questions	3	-2	6	18
Total				**22**	**82**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 23 –30)	Questions with Multiple Correct Choice	4	-2	8	32
Sec – II(Q.N : 31 – 38)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	4	-2	8	32
Sec – III(Q.N : 39 – 44)	Integer Type Questions	3	-2	6	18
Total				**22**	**82**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 45 – 52)	Questions with Multiple Correct Choice	4	-2	8	32
Sec – II(Q.N : 53 – 60)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	4	-2	8	32
Sec – III(Q.N : 61 – 66)	Integer Type Questions	3	-2	6	18
Total				**22**	**82**

PHYSICS: **Max.Marks : 82**

SECTION – I
(MULTIPLE CORRECT CHOICE TYPE)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE is/ are correct**

Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

1. Nucleus A decays to B with decay constant 'λ_1' and B decays to C with a decay constant 'λ_2'. Initially at t=0 number of nuclei of A and B are $2N_0$ and N_0 respectively. At $t = t_0$, number of nuclei B stop changing. If at this instant number of nuclei of B are $\frac{3N_0}{2}$, then

   a) $t_0 = \frac{1}{\lambda_1} \ell n_e \left(\frac{4\lambda_1}{3\lambda_2} \right)$ b) $t_0 = \frac{1}{\lambda_2} \ell n_e \left(\frac{4\lambda_1}{3\lambda_2} \right)$

   c) $N_A = \frac{3N_0}{2} \left(\frac{\lambda_2}{\lambda_1} \right) at\ t = t_0$ d) $N_A = \frac{2N_0}{3} \left(\frac{\lambda_2}{\lambda_1} \right) at\ t = t_0$

2. A stationary person observes that rain is falling vertically down at 30 kmph. A cyclist is moving up an inclined plane making an angle 30^0 with horizontal at 10 kmph. In which direction should the cyclist hold his umbrella to prevent himself from the rain?

   a) At an angle $\tan^{-1}\left(\frac{3\sqrt{3}}{5} \right)$ with inclined plane

   b) At an angle $\tan^{-1}\left(\frac{3\sqrt{3}}{5} \right)$ with horizontal

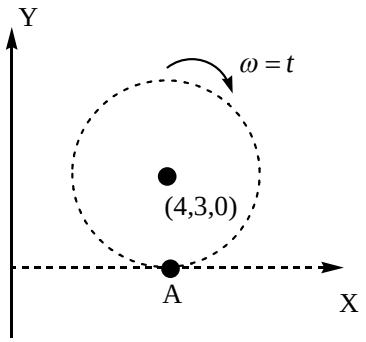
   c) At an angle $\tan^{-1}\left(\frac{\sqrt{3}}{7} \right)$ with inclined plane

   d) At an angle $\tan^{-1}\left(\frac{\sqrt{3}}{7} \right)$ with vertical

3. The potential energy 'U' in Joule, of a particle of mass 1kg, moving in x-y plane, obeys the law $U = 3x + 4y$, where (x, y) are the co-ordinates of the particle in metre. If the particle is at rest at (6, 4) at t=0, then
   a) The particle has constant acceleration
   b) The work done by the external forces, from the position of rest of the particle to the instant of crossing the x-axis is 25J
   c) The speed of the particle when it crosses the y-axis is $10ms^{-1}$
   d) The co-ordinates of the particle at time t = 4s are (-18, -28)

4. The radiation emitted when an electron jumps from n = 3 to n = 2 orbit in a fixed hydrogen atom, falls on a photo metal to produce photo electrons. The electrons from the metal surface with the maximum kinetic energy are made to move perpendicular to a magnetic field of $3 \times 10^{-4} T$ in a radius of 10 mm. Choose the correct statement(s)
   a) The maximum KE of the electrons is 0.8 eV
   b) The maximum KE of the electrons is 0.16 eV
   c) The work function of metal is 1 eV
   d) The work function of the metal is 2eV

5. A plane mirror is placed in the y-z plane, a point object 'A' is moving in a circular path of radius 3m and centre (4m, 3m, 0m) in x-y plane, with variable angular velocity given by $\omega = t\,(\text{rad/sec})$. At t = 0 the particle is at the position shown in fig.



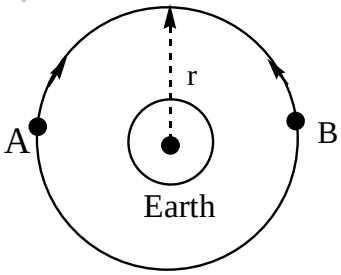
a) At time $\sqrt{5\pi}$, the relative velocity of the object with respect to the image will be zero for the third time

b) At time $\sqrt{\pi}$, the relative velocity of the object with respect to the image will be zero for the third time

c) The line joining object and image is always perpendicular to the mirror

d) The line joining object and image is perpendicular to the mirror at time '$n\sqrt{\pi}$' only. (where n is integer).

6. Two satellites A and B of equal mass m, moving in same circular orbit about earth, but in opposite sense as shown. The radius of orbit is 'r'. The satellites undergoes a collision which is perfectly in-elastic. For this situation, mark out the correct statement(s).
(Take mass of earth as 'M')



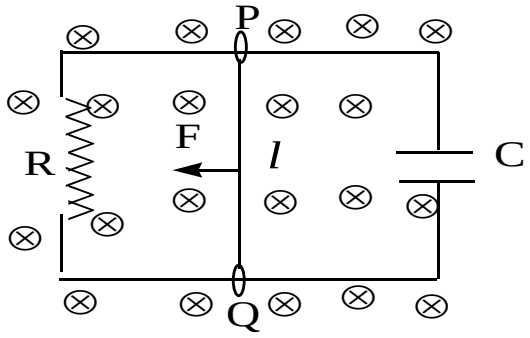
a) The total energy of the two satellites plus earth system just before collision is $\frac{-GMm}{r}$

b) The total energy of the two satellites plus earth system just after collision is $\frac{-2GMm}{r}$

c) The total energy of two satellites plus earth system just after collision is $\frac{-GMm}{2r}$

d) The combined mass (two satellites) will fall towards the earth just after the collision.

7. A conducting rod PQ of length 'l' is dragged with a constant force 'F' along two smooth parallel rails separated by a distance 'l' as shown. Then choose the correct statement(s)



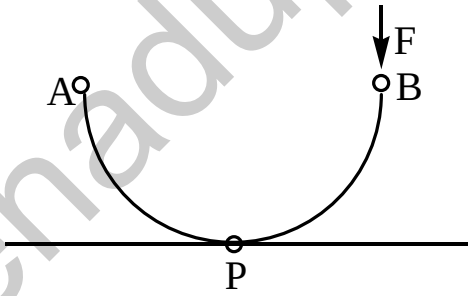
a) Terminal velocity of the rod, $v_t = \dfrac{2FR}{B^2l^2}$

b) Terminal velocity of the rod, $v_t = \dfrac{FR}{B^2l^2}$

c) Maximum charge on capacitor, $q_{\max} = \dfrac{FCR}{Bl}$

d) Maximum charge on capacitor, $q_{\max} = \dfrac{2FCR}{Bl}$

8. A half section of pipe of mass m and radius r rests on a rough horizontal surface. A vertical force F is applied as shown. Assuming that the section rolls without sliding. Then [Centre of mass of half ring is $\dfrac{2r}{\pi}$ below the centre]:



a) The moment of inertia about an axis passing through P and parallel to the axis of pipe is $\dfrac{2mr^2}{\pi}(\pi-2)$

b) For the instant shown, the angular acceleration is $\dfrac{F\pi}{2mr(\pi-2)}$

c) The moment of inertia about an axis passing through A and parallel to the axis of pipe is $2mr^2$

d) For rolling without slipping, the co-efficient of friction between the surfaces should be $\mu = \dfrac{F}{2(mg+F)}$

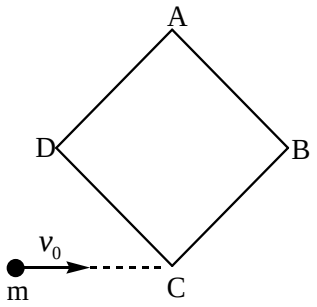
SECTION - II
(COMPREHENSION TYPE)

This section contains **4 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONE OR MORE** is/are **correct**.

Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

Passage-1

A square plate ABCD is hanging in vertical plane and free to rotate about a fixed horizontal axis passing through 'A' and perpendicular to the plane of square plate. Mass of square plate is 'm' and side 'a'. A particle of mass 'm' moving horizontally with velocity v_0 in the plane of plate collide at point 'C' and stick to the square plate as shown



9. Angular velocity of the plate just after the collision is

a) $\frac{3\sqrt{2}v_0}{4a}$ b) $\frac{\sqrt{2}v_0}{6a}$ c) $\frac{3v_0}{4\sqrt{2}a}$ d) $\frac{6\sqrt{2}v_0}{a}$

10. Angular impulse acting on the square plate about the axis during the collision is

a) $\frac{mv_0a}{2\sqrt{2}}$ b) $\frac{\sqrt{2}mv_0a}{12}$ c) $\frac{\sqrt{2}mv_0a}{6}$ d) $\frac{3mv_0a}{2\sqrt{2}}$

Passage-2

Two coherent point light sources of same frequency are placed at x = -d/2 and x = d/2. These source are surrounded by a spherical screen having equation $x^2 + y^2 + z^2 = R^2$ (where R>>d). The sources emit monochromatic light of wavelength (λ = d/3).

Waves from both the sources reach screen and superimpose. When waves reaching any point on the screen have a constant path difference of $n\lambda$ (where λ is wavelength of light and 'n' is some integer), the superposition of these waves is constructive in nature (i.e. maximum intensity) n may be called as order of maximum.

11. The number of maximas obtained on the screen is

A) 7 B) 12 C) 6 D) 8

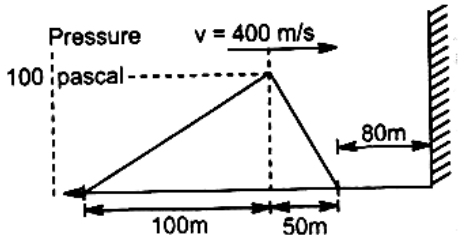
12. As screen is a bounded one therefore the length of maxima is finite which of the following data are correct about shape and length of second order maxima

A) hyperbola, $\frac{2\pi R\sqrt{5}}{3}$ B) circle, $\frac{2\pi R\sqrt{5}}{3}$

C) hyperbola, $\frac{2\pi R}{3}$ D) circle, $\frac{2\pi R}{3}$

Passage-3

A plane pressure pulse, triangular in shape, approaches a rigid wall along normal at a speed of 400m/s. At time t = 0, situation is shown in the figure. The peak pressure is 100Pa. The pulse gets reflected by the wall and pressure near the wall gets doubled. Height of the wall is 2 m and width is also 2m. A detector on the wall records a minimum excess pressure of 16 Pascal.

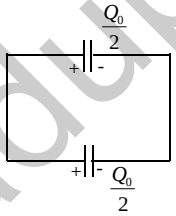


13. For the first time when will the detector start to record the pressure pulse?
(a) $22\times10^{-2}s$ (b) $21\times10^{-2}s$ (c) $31.5\times10^{-2}s$ (d) $20\times10^{-2}s$

14. For how much time the detector will record the pulse?
(a) $37.5\times10^{-2}s$ (b) $34.5\times10^{-2}s$ (c) $31.5\times10^{-2}s$ (d) $21\times10^{-2}s$

Passage-4

Two capacitors each having area 'A' and plate separation 'd' are connected as shown. Each capacitor carries charge $\frac{Q_0}{2}$. The plates of one capacitor are slowly pulled apart by an external agent till the separation between them becomes 2d. The other capacitor is not disturbed.



15. The work done by the external agent in this process will be:
a) $\frac{Q_0^2 d}{12A\in_0}$ b) $\frac{Q_0^2 d}{6A\in_0}$
c) $\frac{Q_0^2 d}{18A\in_0}$ d) $\frac{Q_0^2 d}{9A\in_0}$

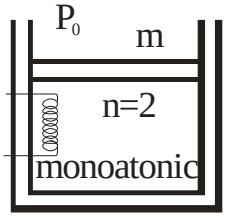
16. The force applied by the external agent when the separation between the plates is 'x' is given by:
a) $\frac{Q_0^2}{4\left(\frac{x}{d}+1\right)^2 A\in_0}$ b) $\frac{Q_0^2}{2\left(\frac{x}{d}+1\right)^2 A\in_0}$
c) $\frac{Q_0^2}{2A\in_0}$ d) $\frac{Q_0^2}{\left(\frac{x}{d}+1\right)^2 A\in_0}$

SECTION – III
(INTEGER TYPE)

This section contains **6** questions . The answer to each of the questions is a single digit integer, ranging from **0 to 9**. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.

Marking scheme +3 for correct answer , 0 if not attempted and -2 in all other cases.

17. Two moles of an ideal monatomic gas are contained in a vertical cylinder of cross-sectional area A as shown. The piston is frictionless and has mass m. At a certain instant a heater starts supplying heat to the gas at a rate of q J/s. All the boundaries are thermally insulated. Atmospheric pressure is P_o. If the velocity of piston under isobaric condition is $\frac{2}{x}\frac{q}{[p_o A + mg]}$. Then the value of 'x' will be

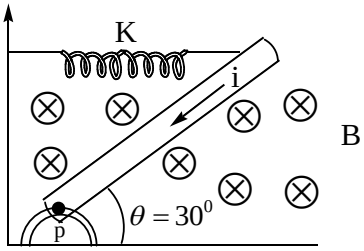


18. A small bar starts sliding down an inclined plane forming an angle 'α' with the horizontal. The friction co-efficient depends on the distance covered as $\mu = kx$, where k is constant. The distance covered by the bar till it stops is $x = \frac{p}{k}\tan\alpha$. Then P= _____

19. A long metal rod of length 'l' and relative density 'σ' is held vertically with its lower end touching the surface of water. If the speed of the rod when it just sinks in water is $V = \sqrt{\frac{6gl}{\alpha}\left(1-\frac{1}{2\sigma}\right)}$ then $\alpha = ?$

20. The curvature radii of concavo-convex glass lens are 60 cm and 20 cm. The convex surface of the lens is silvered with the lens horizontal, the concave surface is filled with water. The focal length of the effective mirror is $\frac{10x}{13}cm$ .Then $x =$ _____ $\left(\mu_w = \frac{4}{3}; \mu_g = \frac{3}{2}\right)$

21. A thin, uniform rod with negligible mass and length 'l' is attached to the floor by a frictionless hinge at a point P. A horizontal spring with force constant 'k' connects the other end of the rod to a vertical wall. The rod is in a uniform magnetic field 'B' directed into the plane of the figure. There is current 'i' in the rod, in the direction shown. When the rod is in equilibrium and makes an angle of 30^0 with the floor, the spring is stretched by $x = \frac{nBil}{k}$. The value of n is_____



22. A ball of mass 2kg, charge $1\mu C$ is dropped from top of a high tower. In space, electric field exist in horizontal direction away from tower which varies as $E = (5-2x)\times 10^6 Vm^{-1}$. The maximum horizontal distance that the ball can go from the tower is _____m

MATHS: **Max.Marks : 82**

SECTION – I

(MULTIPLE CORRECT CHOICE TYPE)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE is/ are correct**

Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

23. In ΔABC, $a^4+b^4+c^4=2c^2\left(a^2+b^2\right)$ if

a) $C=\frac{\pi}{4}$ b) $C=\frac{\pi}{3}$ c) $C=\frac{2\pi}{3}$ d) $C=\frac{3\pi}{4}$

24. Let $f(x)=\sin^{-1}x+\sin^{-1}(1-x)$ and $g(x)=\cos^{-1}x$ then

a) Domain of $g(x)$ is [-1,1] b) If $f(x)=g(x)$ then $x=0,\frac{1}{2}$

c) Domain of $f(x)$ *is* $[0,1]$ d) Domain of $f(x)$ *is* $[-1,1]$

25. If $f(x)=\underset{n\to\infty}{Lt}A_n$ where $A_n=\sum_{r=0}^{n}\frac{\left(\tan\frac{x}{2^{r+1}}+\tan^3\frac{x}{2^{r+1}}\right)}{1-\tan^2\frac{x}{2^{r+1}}}$ then

a) $A_n=\frac{\sin\frac{x}{2^{n+1}}}{\cos\frac{x}{2^{n+1}}\cos\frac{x}{2^n}}$ b) $A_n=\tan x-\tan\frac{x}{2^{n+1}}$

c) $\underset{x\to0}{Lt}\frac{f(x)-\sin x}{x^3}=\frac{2}{3}$ d) $\underset{x\to0}{Lt}\frac{f(x)-\sin x}{x^3}=\frac{1}{2}$

26. $f(x)=\frac{2\cos x-\sin 2x}{(\pi-2x)^2}, g(x)=\frac{e^{-\cos x}-1}{8x-4\pi}$ and $h(x)=\begin{cases}f(x), & x<\pi/2\\ g(x), & x>\pi/2\end{cases}$ then

a) $h(x)$ is continuous at $x=\pi/4$ b) $h(x)$ has removable discontinuity at $x=\pi/2$

c) $f\left(\frac{\pi^-}{2}\right)+g\left(\frac{\pi^+}{2}\right)=0$ d) $\underset{x\to0}{Lt}\,g(x)=0$

27. Let $P_1\left(t_1,t_1^3\right), P_2\left(t_2,t_2^3\right),\ldots\ldots, P_n\left(t_n,t_n^3\right)$ be points on $y=x^3$ such that tangent at P_i intersects the curve at P_{i+1} for $i=1,2,\ldots,(n-1)$ and $t_1=1$ then

a) $\underset{n\to\infty}{Lt}\sum_{k=1}^{n}\frac{1}{t_k}=2/3$ b) $\underset{n\to\infty}{Lt}\sum_{k=1}^{n}\left|\frac{1}{t_k}\right|=2$

c) $\frac{area\ of\ \Delta P_2P_3P_4}{area\ of\ \Delta P_1P_2P_3}=16$ d) Length of Normal at $P_1=\frac{\sqrt{10}}{3}$

28. In ΔABC, $\sum_{r=0}^{n}{}^nC_r.a^{n-r}.b^r.\cos\left(rA-(n-r)B\right)=$

a) $(a+b)^n$ b) $(a-b)^n$ c) c^n d) c^{2n}

29. Let $P(x,y)$ be a variable point such that $\left|\sqrt{(x-1)^2+(y-2)^2}-\sqrt{(x-5)^2+(y-5)^2}\right|=3$. Then locus of P is a hyperbola. Let e,e_1 be eccentricities of the hyperbola and its conjugate hyperbola. Then

a) $e=\frac{5}{3}$ b) $e_1=\frac{5}{4}$

c) radius of director circle of Hyperbola is $\frac{\sqrt{7}}{2}$

d) radius of director circle of conjugate hyperbola is $\frac{\sqrt{7}}{2}$

30. An ellipse is touching both coordinate axes and with foci at (1, 1), (3, 3). Then

a) Length of Major axis = $2\sqrt{5}$ b) radius of the director circle = $2\sqrt{2}$

c) $x-axis$ is tangent at $\left(\frac{5}{2},0\right)$ d) y-axis is tangent at $\left(0,\frac{5}{2}\right)$

SECTION - II
(COMPREHENSION TYPE)

This section contains **4 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONE OR MORE** is/are **correct**.

Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

Passage-1

Let 'S' be the set of all 4-digited numbers formed by using the digits 0, 1, 2, 3, 4, 5 when repetition of digits being allowed. For any subset 'E' of 'S', let P(E) denotes the probability of occurrence of the event 'E'.

31. If $E \subseteq S$ and E = {x/x has at least one non-zero digit repeated} then P(E) =

a) $\frac{143}{216}$ b) $\frac{71}{108}$ c) $\frac{2}{3}$ d) $\frac{35}{54}$

32. If $E_1 \subseteq S,\ E_2 \subseteq S$ such that E_1 = {x/sum of digits of 'x' is 6} and E_2 = {x/x is an arrangement of (2, 2, 1, 1) or (3, 1, 1, 1)} then $P\left(E_1 \cap \bar{E}_2\right)=$

a) $\frac{1}{24}$ b) $\frac{1}{18}$ c) $\frac{1}{36}$ d) $\frac{1}{90}$

Passage-2

Initially 50 pounds of salt is dissolved in a large tank having 300 gallons of water. A brine solution is pumped into the tank at a rate of 3 gal/min and well stirred solution is then pumped out at the same rate. Given the concentration of the solution entering is 2 lb/gal. Answer the following with this information.

33. Amount of salt at time 't' min is

a) $600-550e^{-t/100}$ b) $550-500e^{-t/100}$ c) $550e^{t/100}-500$ d) $600e^{-t/100}-550$

34. Amount of salt present at $t=50\min$ is

a) $600-550e^{-0.5}$ b) $550-500e^{-0.5}$ c) $550e^{0.5}-500$ d) $600e^{-0.5}-550$

Passage-3

If $f(x)$ is differentiable then $\int e^x\left(f(x)+f'(x)\right)dx = e^x f(x)+c$. Using this result answer the following

35. $\int e^x.\dfrac{\left(2-x^2\right)}{(1-x)\sqrt{1-x^2}}dx =$

a) $e^x.\sqrt{\dfrac{1-x}{1+x}}.\dfrac{1}{(1-x)^2}+k$ b) $e^x.\sqrt{\dfrac{1+x}{1-x}}+k$

c) $e^x.\sqrt{\dfrac{1-x}{1+x}}+k$ d) $-e^x.\sqrt{\dfrac{1-x}{1+x}}+k$

36. $\int \dfrac{e^{\tan^{-1}x}}{1+x^2}\left[\sec^{-1}\sqrt{1+x^2}+\cos^{-1}\left(\dfrac{1-x^2}{1+x^2}\right)\right]dx =$

a) $e^{\tan^{-1}x}.\left(\tan^{-1}x\right)^2+c$ b) $e^{\tan^{-1}x}.\left(\cot^{-1}x\right)^2+c$

c) $e^{\tan^{-1}x}.\left(\sin^{-1}x\right)^2+c$ d) $e^{\tan^{-1}x}.\left(\cos^{-1}x\right)^2+c$

Passage-4

Let 'p' be an odd prime number and $T_p=\left\{A=\begin{bmatrix}a & b\\ c & a\end{bmatrix} / \ a,b,c\in\{0,1,2,...,(p-1)\}\right\}$. Then answer the following

37. The number of A in T_p such that A is either symmetric or skew – symmetric or both and det A is divisible by 'p' is

a) $(p-1)^2$ b) $2(p-1)$ c) $(p-1)^2+1$ d) $2p-1$

38. The number of symmetric matrices A in T_p such that trace of A is not divisible by p but det A is divisible by p is

a) $(p-1)\left(p^2-p-1\right)$ b) $p^3-(p-1)^2$ c) $(p-1)^2$ d) $2(p-1)$

SECTION – III
(INTEGER TYPE)

This section contains **6** questions . The answer to each of the questions is a single digit integer, ranging from **0 to 9**. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.
Marking scheme +3 for correct answer , 0 if not attempted and -2 in all other cases.

39. If $6+\tan^4\theta+\tan^2\theta\le\sec^4\theta+\sec^2\theta$ then least value of $\sec^2\theta$ is

40. If $f(x)=\begin{cases}\left|1-4x^2\right|, & 0\le x<1\\ \left[x^2-2x\right], & 1\le x<2\end{cases}$ where [.] denotes the greatest integer function, then the number of points at which f(x) is not differentiable is

41. The number of ordered pairs of positive integers (x, y) such that $\dfrac{1}{x}+\dfrac{1}{y}=\dfrac{1}{2007}$ and $x<y$ is

42. Let $f(x,y,z)=2^x+3^y+5^z$ be a function in variables $x,y,z\in\{1,2,3,4,5\}$. The number of ordered triplets (x,y,z) such that $f(x,y,z)$ is a multiple of 4 is 'k' then $\dfrac{k}{14}=$

43. A ray of light is sent along the line $x-2y+5=0$, upon reaching the line $3x-2y+7=0$, the ray is reflected from it. If the equation of the reflected ray is $ax+by+c=0$ such that 'a' is a prime number and b,c are integers then integral part of $\dfrac{c}{a}$ is

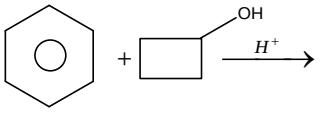
44. Minimum distance between the curves $y^2=x-1$ *and* $x^2=y-1$ is equal to d, then $2\sqrt{2}d=$

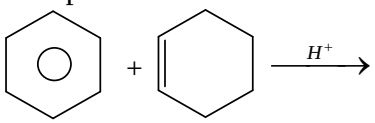
SECTION – I
(MULTIPLE CORRECT CHOICE TYPE)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE is/ are correct**

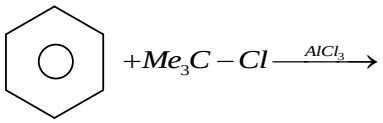
Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

45. Which of the following reactions give alkylation product?

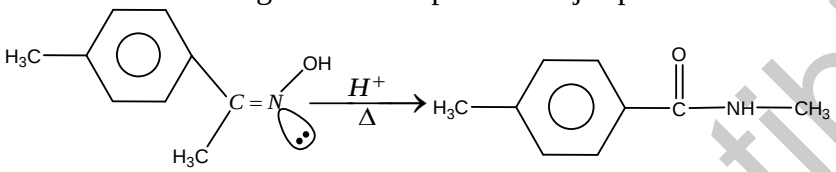
a) 

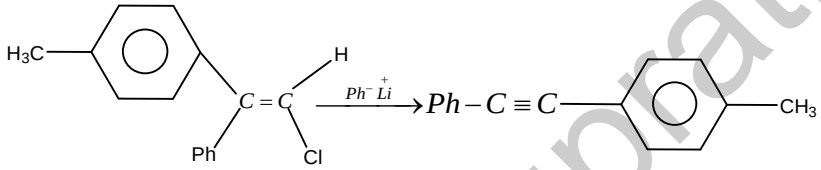
b) 

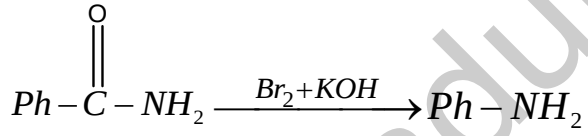
c) 

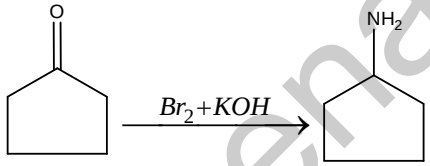
d) 

46. Which of the following reactions represent major products?

a) 

b) 

c) 

d) 

47. The oxidation of which of the following compounds with $KMnO_4, \bar{O}H / \Delta$ following by treatment of acid will give benzoic acid?

a) $C_6H_5CH_3$ b) $C_6H_5CH = CH - CH_3$

c) $C_6H_5C \equiv C - CH_3$ d) $C_6H_5 - \overset{O}{\overset{\|}{C}} - CH_2OH$

48. Select the incorrect statements(s)

a) Cs^+ is more hydrated than the other alkali metal ions

b) Among the alkali metals $Li, Na, K \text{ and } Rb$, Lithium has the highest melting point.

c) Ionic mobility of $Li^+_{(aq)}$ maximum among alkali metal cations

d) Ionization potential of Li is lower than of Na

49. What changes occur when acidified $Cr_2O_7^{2-}$ ion reacts with H_2O_2 solution in presence of ether solvent

a) Orange colour of solution turns blue

b) Oxidation state of Cr-atom decreases

c) Oxidation state of Cr-atom remains constant

d) Orange colour of solution turns green

50. 6 moles of ozone is partially converted into oxygen till the number of ozone and oxygen molecules become equal. Then

a) Masses of ozone & oxygen in the mixture are equal

b) The mixture contains 18 moles of oxygen atoms.

c) The mixture contains 3.6 moles of oxygen

d) Ozone and oxygen gasses are 3:2 mass ratio in the final mixture.

51. Peroxodisulphate salts (e.g. $Na_2S_2O_8$) are strong oxidizing agents used as bleaching agents for salts, fats, oils, etc.

Given $O_{2(g)} + 4H^+_{(q)} + 4e^- \rightarrow 2H_2O_{(l)}$; $E^0 = 1.23V$

$S_2O^{2-}_{8(aq)} + 2e^- \rightarrow 2SO^{2-}_{4(aq)}$; $E^0 = 2.01V$

Which of the following statements is (are) correct?

a) Oxygen gas can oxidize sulphate ion to peroxodisulphate ion $\left(S_2O_8^{2-}\right)$ in acidic solution

b) Oxygen gas is reduced to water

c) Water is oxidized to O_2

d) $S_2O_8^{2-}$ ion is reduced to SO_4^{2-} ions

52. Which of the following is/are not correct for I order reaction ?

a) $t_{1/2} \propto a$ b) $t_{1/2} \propto \frac{1}{a}$ c) $t_{1/2} \propto a^0$ d) $t_{1/2} \propto a^2$

SECTION - II
(COMPREHENSION TYPE)

This section contains **4 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONE OR MORE** is/are **correct**.

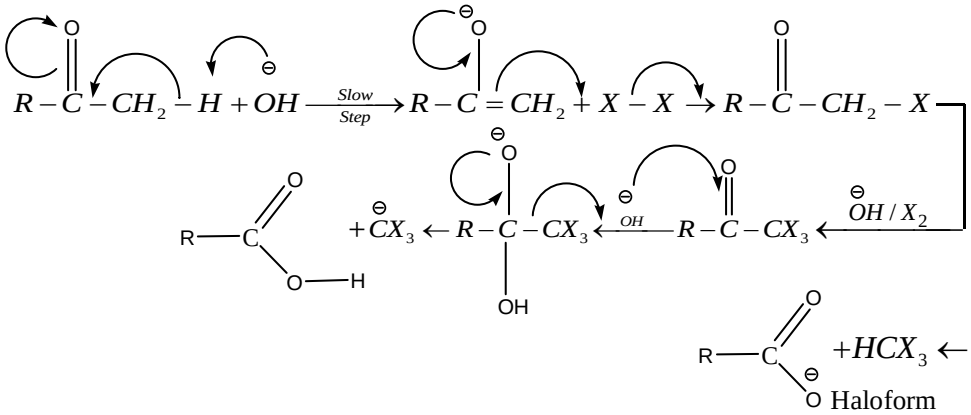
Marking scheme +4 for correct answer , 0 if not attempted and -2 in all other cases.

Passage-1

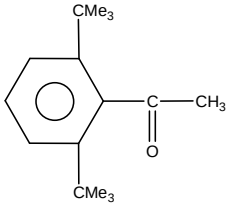
Compound having $-\overset{\overset{O}{\|}}{C}-CH_3$ group reacts rapidly with halogen in presence of a base to from haloform. The reaction is known as haloform.

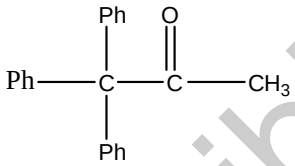
$$R-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{X_2+\overset{+}{O}H} R-\overset{\overset{O}{\|}}{C}-\overset{-}{O}+CHX_3$$

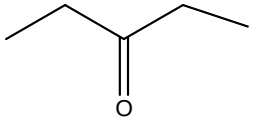
Mechanism:

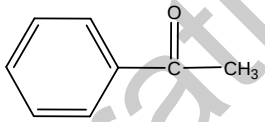


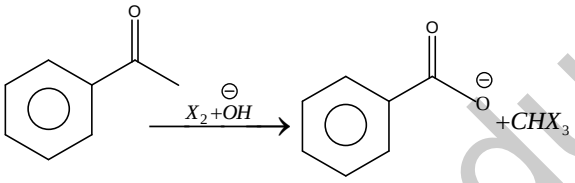
53. Which of the following will yield iodoform on reaction with $I_2 + NaOH$?

a) 

b) 

c) 

d) 

54. 

Which of the following is correct comparison of rate of haloform reaction with various halogens?

a) $r_{Cl_2} > r_{Br_2} > r_{I_2}$ b) $r_{I_2} > r_{Br_2} > r_{Cl_2}$ c) $r_{Cl_2} = r_{Br_2} = r_{I_2}$ d) $r_{Br_2} > r_{Cl_2} > r_{I_2}$

Passage-2

Molecular orbital's i.e bonding and anti bonding molecular orbitals are obtained by linear combination of atomic orbitals of the bonded orbitals. Filling of electrons occurs in MO in increasing order of energy and the electronic configuration thus helps in calculating the bond order.

$$B.O = \frac{1}{2}(N_b - N_a); B.O \propto Bond\ energy \propto \frac{1}{Bond\ length}$$

55. Which of the following statement is incorrect

a) Among O_2^+, O_2 *and* O_2^-. The correct order of bond length is $O_2^- > O_2 > O_2^+$

b) He_2 molecular doesnot exist as the bonding and anti-bonding orbital cancel each other.

c) O_2, O_2^- *and* B_2 molecules are paramagnetic

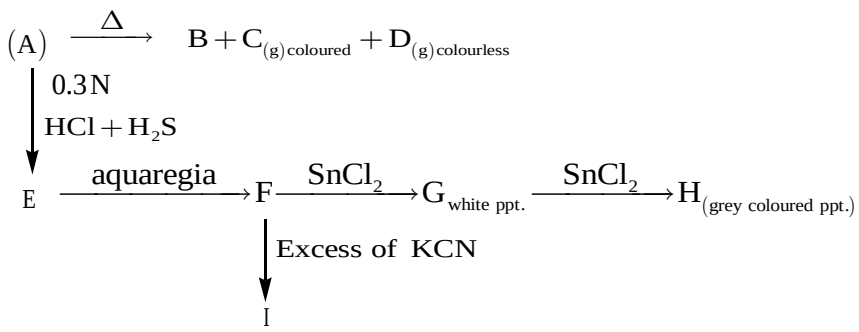
d) In F_2 molecule, the energy of $\sigma 2P_z$ is more than $\pi 2P_x$ *and* $\pi 2P_y$

56. Which of the following molecules have identical bond order and same magnetic properties

$(I) O_2^+$ $(II) NO$ $(III) N_2^-$

a) *I & II only* b) *I & III only* c) *I, II, III* d) *II & IV only*

Passage-3



57. The structure of 'I' is

a) Tetrahedral b) Sq. planar c) Octahedral d) Trigonal bipyramidal

58. Which of the following statement is incorrect

a) H is also known as quick silver b) G is also known as calomel

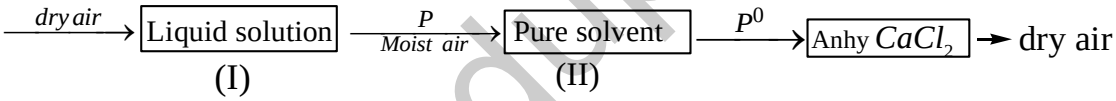
c) D is given by decomposition of $(NH_4)_2Cr_2O_7$

d) Gas 'C' gives two different oxy acids on reaction with water

Passage-4

Lowering of vapour pressure by Ostwald & Walker dynamic method. It is based on the principle when air is allowed to pass through a solvent or solution, it takes up solvent vapour with it to get itself saturated at that temperature

(I) & (II) are weighed separately before and after passing dry air. Loss in mass of each set gives the following of vapour pressure. The temperature of air, the solution and the solvent is kept constant.



59. Loss in mass of solvent (W_{II}) will be proportional to

a) $P^0 - P$ b) $P - P^0$ c) $\frac{P}{P^0}$ d) $P \times P^0$

60. Gain in mass of anhydrous $CaCl_2$ is proportional to

a) P b) P^0 c) $P - P^0$ d) $P^0 - P$

SECTION – III
(INTEGER TYPE)

This section contains **6** questions . The answer to each of the questions is a single digit integer, ranging from **0 to 9**. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.

Marking scheme +3 for correct answer , 0 if not attempted and -2 in all other cases.

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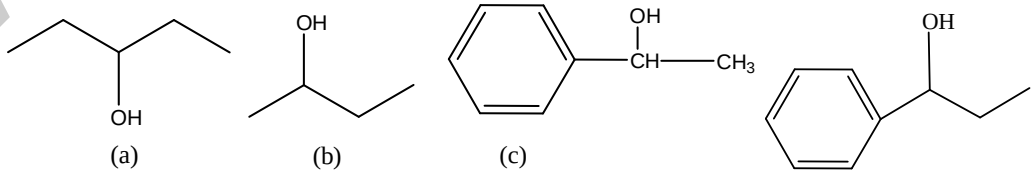
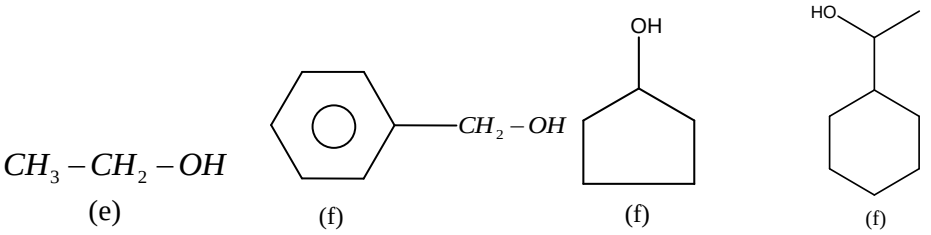
61. Find out number of alcohols that can give positive iodoform test.



(a) (b) (c)



(e) (f) (f) (f)

62. How many moles of HI reacts with glycerol to give 2-iodopropane

63. $2Cu^{2+} + K_4\left[Fe(CN)_6\right] \longrightarrow$ one mole of complex (A) and its coordination no. is 'x'.

$Pb^{2+} + \text{excess of } KI \longrightarrow$ one mole of complex (B) and its coordination no. is 'y'

$Au + NaCN + H_2O + O_2 \longrightarrow$ one mole of complex (C) and its coordination no. is 'z'.

Then $(x + y - z)$ is …….

64. A weak field complex of Ni^{+2} has magnetic moment of 2.82 BM. The number of electron in the t_{2g} level of Ni^{+2} will be……

65. If De-Broglie wavelength of electron revolving in 6th orbit of Li^{2+} ion is λ_1, that of electron revolving in 2nd orbit of He^{+} ion is λ_2, and that for electron revolving in 3rd orbit of 'H' atom is λ_3, then the value of $\frac{\lambda_3 - \lambda_2}{\lambda_1}$ is ----------

66. The equilibrium pressure of $NH_4CN_{(s)} \rightleftharpoons NH_{3(g)} + HCN_{(g)}$ is 0.298 atm. If NH_4CN is allowed to decompose in presence of NH_3 at 0.25 atm, calculate the partial pressure of HCN at equilibrium. It partial pressure of HCN at equilibrium is $y \times 10^{-2}$ atm, then what is y

KEY SHEET

Physics

1) **AC**	2) **AD**	3) **ABCD**	4) **AC**	5) **C**	6) **ABD**	7) **BC**	8) **ABCD**	9) **C**	10) **A**
11) **A**	12) **B**	13) **B**	14) **B**	15) **A**	16) **B**	17) **5**	18) **2**	19) **3**	20) **9**
21) **1**	22) **5**								

Mathematics

23) **AD**	24) **ABC**	25) **BD**	26) **A**	27) **ABCD**	28) **C**	29) **ABD**	30) **ABCD**	31) **A**	32) **A**
33) **A**	34) **A**	35) **B**	36) **A**	37) **D**	38) **D**	39) **3**	40) **2**	41) **7**	42) **5**
43) **1**	44) **3**								

Chemistry

45) **D**	46) **A**	47) **A**	48) **B**	49) **C**	50) **D**	51) **A**	52) **A**	53) **D**	54) **C**
55) **2**	56) **1**	57) **3**	58) **2**	59) **2**	60) **5**	61) **A**	62) **C**	63) **B**	64) **C**
65) **1**	66) **7**								

SRI CHAITANYA IIT ACADEMY.

EENADU PRATHIBHA NET

JEE ADVANCED-2017

MODEL PAPER-II : SOLUTIONS

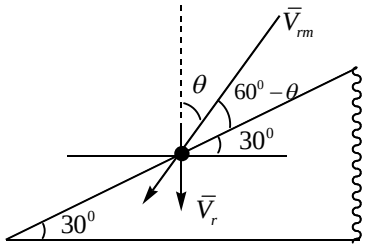
PHYSICS

1. Apply the law of disintegration.

2. $\bar{V}_r = -30\,\hat{j}; \bar{V}_m = \frac{10\sqrt{3}}{2}\hat{i} + \frac{10}{2}\hat{j} = 5\sqrt{3}\hat{i} + 5\hat{j}$

$\bar{V}_{rm} = \bar{V}_r - \bar{V}_m = -30\,\hat{j} - \left(5\sqrt{3}\hat{i} + 5\hat{j}\right) = -5\sqrt{3}\hat{i} - 35\,\hat{j}$

$\therefore \tan\theta = \frac{|V_x|}{|V_y|} = \frac{5\sqrt{3}}{35} = \frac{\sqrt{3}}{7}$ $\qquad \therefore \theta = \tan^{-1}\left(\frac{\sqrt{3}}{7}\right)$ with vertical.



Angle of V_{rm} with inclined plane is $60^0 - \theta = \beta$

$$tan\beta = \tan\left(60 - \theta\right) \Rightarrow \tan\beta = \frac{\tan 60^0 - \tan\theta}{1 + \tan 60^0 \tan\theta} = \frac{\sqrt{3} - \frac{\sqrt{3}}{7}}{1 + \sqrt{3}\left(\frac{\sqrt{3}}{7}\right)} = \frac{3\sqrt{3}}{5}$$

$\therefore \beta = \tan^{-1}\left(\frac{3\sqrt{3}}{5}\right)$ with the inclined plane

3. We know, $F_x = \frac{-dU_x}{dx}$ *and* $f_y = \frac{-dU_y}{dx}$

Hence, force on the particle is $\bar{F} = -\left(3\hat{i} + 4\,\hat{j}\right)N$

$|F| = 5N = \text{constant} \quad \Rightarrow \text{a} = \frac{|\text{F}|}{m} = 5m/s^2$

Hence, the acceleration of the particle is constant, so option (a) is constant

At t=0 , particle was at rest at (6,4)

From $x = 6 + \frac{1}{2}a_x t^2 = \left(6 - \frac{3}{2}t^2\right)m$ and $y = 4 + \frac{1}{2}a_y t^2 = \left(4 - 2t^2\right)m$

When the particle crosses the x-axis y=0 $\Rightarrow t_1 = \sqrt{2}s$

$\therefore$ Displacement during this time, $S = \frac{1}{2}at^2$

$S = \frac{1}{2} \times 5 \times \left(\sqrt{2}\right)^2 = 5m$

Hence, work done by the force, upto this instant is $W = FS = 5 \times 5 = 25J$

Hence, option (b) is correct

The particle crosses y-axis when x = 0

Hence, $6 - \frac{3}{2}t_2^2 = 0 \Rightarrow t_2 = 2\sec$

$\therefore$ speed of the particle at this instant will be

$V = at_2 = 5 \times 2 = 10\,m/s^2$

Hence, option (c) is correct

At t=4 sec, $x = 6 - \frac{3}{2}(4)^2 = -18m$

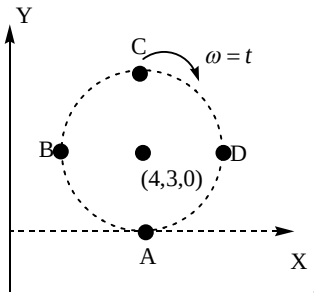
And $y = 4 - 2(4)^2 = -28m$

Hence, option (d) is correct

4. $h\nu = w + K.E_{max}$

$r = \frac{mv}{Bq}$

5. Relative velocity of object w.r.t image will be zero for the 3rd time when particle reaches B in 2nd rotation



$\Rightarrow \left(2\pi + \frac{\pi}{2}\right) = \frac{1}{2}(1)t^2$

$\therefore t = \sqrt{5\pi}\,\sec.$

6. Just before collision, the total energy of two satellites is $E = -\frac{Gmm}{2r} - \frac{Gmm}{2r} = -\frac{Gmm}{r}$

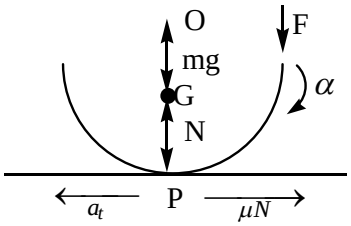
Let orbital velocity is V, then from momentum conservation $mv - mv = 2m \times v_1 \Rightarrow V_1 = 0$ i.e velocity of combined mass is zero. Hence, combined mass falls towards earth. At this instant, the total energy of the system only consists of the gravitational potential energy given by

$U = -\frac{GM(2m)}{2r}$

7. Conceptual

8. Torque due to applied force $\tau = Fr = I_p\alpha$

Where I_p is the moment of inertia about an axis passing through point of contact



$I_0 = I_G + m(OG)^2 = mr^2 \Rightarrow I_G = mr^2 - m(OG)^2$

$I_p = I_G + m(GP)^2 = mr^2 - m(OG)^2 + m(r - OG)^2$

$= 2mr^2 - \frac{4mr^2}{\pi}$ where $OG = \frac{2r}{\pi} = \frac{2mr^2}{\pi}(\pi - 2)$

Angular acceleration

$\alpha = \frac{Fr\pi}{2mr^2(\pi - 2)} = \frac{F\pi}{2mr^2(\pi - 2)}$ in the clockwise direction

At P, $mg + F = N$

Friction force $f = \mu N = \mu(mg + F)$

For pure rolling, $a = \frac{\mu(mg + F)}{m} = \alpha(PG)$

$\mu = \frac{m\alpha(PG)}{(mg + F)} = m\left[\frac{F\pi}{2mr(\pi - 2)}\right]\frac{r(\pi - 2)}{\pi(mg + F)} = \frac{F}{2(mg + F)}$.

9. Initial angular momentum, $L_i = L_{plate} + L_{particle} \Rightarrow L_i = mv_0 a\sqrt{2}$

Final angular momentum, $L_f = \left(\frac{ma^2}{6} + \frac{ma^2}{2} + 2ma^2\right)\omega$

According to law of conservation of angular momentum $L_i = L_f$

$mv_0 a\sqrt{2} = \left(\frac{16ma^2}{6}\right)\omega$

$\therefore \omega = \frac{3v_0}{4\sqrt{2}}$

10. Angular impulse = change in angular momentum $= I\omega = \left(\frac{ma^2}{6} + \frac{ma^2}{2}\right)\omega = \frac{mv_0 a}{2\sqrt{2}}$

11. Shape of the central, first and second fringes are circle

12. For length of second maxima find perimeter of the circle

13 & 14. Calculate pressure with time using slope

15. When the distance between plates of one of capacitors is x, $C_x = \frac{A\in_0}{x}$ *and* $C = \frac{\in_0 A}{d}$

Change on C_x is $q = Q_x = \frac{C_x}{C + C_x}Q_0$

$$F_x = \frac{Q_x^2}{2A\in_0} = \frac{C_x^2 Q_0^2}{\left(C + C_x\right)^2 \times 2A\in_0}$$

$$dw = F_x dx$$

$$W = \int dw = \int_d^{2d} f_x dx = \frac{Q_0^2 d}{12A\in_0}$$

16. $F_x = \dfrac{C_x^2 Q_0^2}{\left(C + C_x\right)^2 \times 2A\in_0}$ where $C_x = \dfrac{\in_0 A}{x}$

This is also equal to force by external agent (as a =0)

$$F_{ext} = F_x = \frac{\left(\frac{A\in_0}{x}\right)^2 Q_0^2}{\left(\frac{A\in_0}{d} + \frac{A\in_0}{x}\right)^2 2A\in_0} = \frac{Q_0^2}{2\left(\frac{x}{d}+1\right)^2 A\in_0}.$$

17. According to I law of thermodynamics

$dQ = du + dw$

where $du = nC_v dT = n\left(\dfrac{3R}{2}\right) dT$

and $dw = pdv = PAdx$

where $P = P_0 + \dfrac{Mg}{A}$

Also , $PV = \left(n\right) RT$

On differentiation, $PdV = RdT$

$$\therefore dQ = \frac{3}{2} pdv + pdv = \frac{5}{2} pdv = \frac{5}{2} PAdx$$

Further, $dQ = q.dt$

$$\therefore qdt = \frac{5}{2} PAdx \Rightarrow q = \frac{5}{2} PA\frac{dx}{dt} = \frac{5}{2}\left(P_0 + \frac{Mg}{A}\right) A.\upsilon \Rightarrow \upsilon = \frac{2}{5}\frac{q}{\left(P_0 A + Mg\right)}$$

18. Equation of motion down the incline is given by

$mg\sin\alpha - \left(kx\right) mg\cos\alpha = ma \Rightarrow a = g\sin\alpha - \left(kx\right) g\cos\alpha$

But, $a = \dfrac{dv}{dt} = \left(\dfrac{dv}{dx}\right)\left(\dfrac{dx}{dt}\right) = v\dfrac{dv}{dx}$

$$\therefore Vdv = \left(g\sin\alpha - kxg\cos\alpha\right) dx$$

$$\int_0^v vdv = \int_0^x \left(g\sin\alpha - kxg\cos\alpha\right) dx \Rightarrow \frac{V^2}{2} = gx\sin\alpha - \frac{kx^2}{2} g\cos\alpha$$

$$\therefore V = \sqrt{2gx\sin\alpha - kx^2 g\cos\alpha}$$

Velocity again becomes zero, after $x = \dfrac{2}{k}\tan\alpha$.

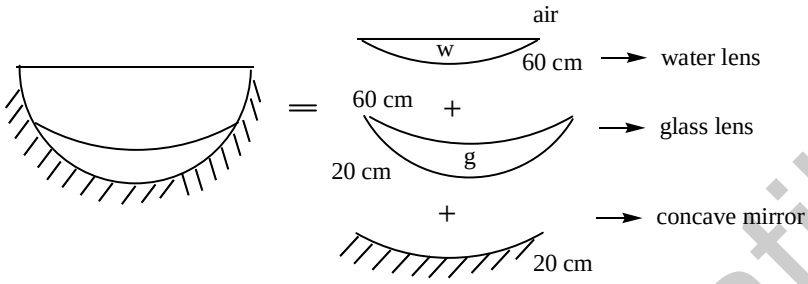
19. Let $\bar{x}$ be the length of the rod immersed in water at any instant 't'. Then, acceleration at that instant is $a = \dfrac{Apparent\ weight}{Mass\ of\ the\ rod}$

$$\frac{dv}{dt} = \frac{\pi r^2 l\rho g - \pi r^2 x\rho_0 \text{ g}}{\pi r^2 l\rho g} = g\left(1 - \frac{x}{\sigma l}\right)$$

$$\left(\frac{dv}{dx}\right)\left(\frac{dx}{dt}\right) = g\left(1 - \frac{x}{\sigma l}\right) \Rightarrow vdv = g\left(1 - \frac{x}{\sigma l}\right)dx$$

On integration, $\int_0^v vdv = \int_0^x g\left(1 - \frac{x}{\sigma x}\right)dx \ \Rightarrow v = \sqrt{2gl\left(1 - \frac{1}{2\sigma}\right)}$

20. Equivalent diagram of compound lens is



Effective power $P_{eff} = 2\left(P_w + P_g\right) + P_m$

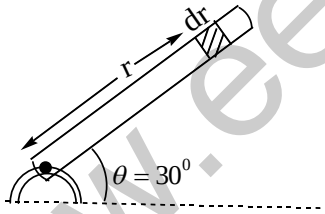
Where $P_w = \dfrac{1}{f_w} = \left(\mu_w - 1\right)\left[\dfrac{1}{\infty} - \dfrac{1}{-60}\right] = \dfrac{1}{180}$

And $P_g = \dfrac{1}{f_g} = \left(\mu g - 1\right)\left[\dfrac{1}{-60} - \dfrac{1}{-20}\right] = \dfrac{1}{60}$

And $P_m = -\dfrac{1}{f_m} = \dfrac{-2}{R} = \dfrac{-2}{-20} = \dfrac{1}{10}$

$\therefore F_{eff} = \dfrac{90}{13} cm$

21.



The spring force when stretched by x is $F = kx$.

The magnetic force experienced by small element dr is $dF = Bidr$. The torque '$d\tau$' due to this force is $d\tau = rdF = \left(Bir\right)dr$

Total torque $\tau = \int d\tau = Bi\int_0^l r\,dr = \dfrac{Bil^2}{2}$

At equilibrium, net torque about the hinge is zero $\left(kx\right)l\sin 30^0 - \dfrac{Bil^2}{2} = 0 \Rightarrow x = \dfrac{Bil}{k}$.

22. $a_x = \frac{qE}{m}$

$\frac{dv_x}{dt} = \frac{q}{m}(5-2x)$

$vdv = \frac{q}{m}(5-2x)dx$

On integration, $\frac{V^2}{2} = \frac{q}{m}(5x-x^2)$

$\therefore V = \sqrt{\frac{2q}{m}(5x-x^2)}$

For 'x' to be maximum, $V = \frac{dx}{dt} = 0$

$\therefore 5x - x^2 = 0 \Rightarrow x = 5m$

MATHEMATICS

23. $a^4+b^4+c^4-2c^2a^2-2c^2b^2+2a^2b^2 = 2a^2b^2 \Rightarrow (a^2+b^2-c^2)^2 = 2a^2b^2 \Rightarrow \cos^2 c = \frac{1}{2}$

24. For $f(x)$ $-1 \le x \le 1$ *and* $-1 \le 1-x \le 1 \Rightarrow -1 \le x \le 1$ *and* $-2 \le -x \le 0$

$\Rightarrow -1 \le x \le 1$ *and* $0 \le x \le 2 \Rightarrow 0 \le x \le 1$

B) $\sin^{-1}(1-x) = \frac{\pi}{2} - 2\sin^{-1}x \Rightarrow 1-x = \cos(2\sin^{-1}x) \Rightarrow 1-x = 1-2x^2 \Rightarrow x = 0, \frac{1}{2}$

25. $A_n = \sum_{r=0}^{n} \frac{\sin\frac{x}{2^{r+1}}}{\cos\frac{x}{2^{r+1}}.\cos\frac{x}{2^r}} = \sum_{r=0}^{n}\left(\tan\frac{x}{2^r} - \tan\frac{x}{2^{r+1}}\right) = \tan x - \tan\frac{x}{2^{n+1}}$

$f(x) = \tan x \quad \therefore f(x) = \underset{x\to 0}{Lt}\frac{\tan x - \sin x}{x^3} = \underset{x\to 0}{Lt}\frac{\sin x.(1-\cos x)}{x.x^2} = \frac{1}{2}$

26. $f\left(\frac{\pi^-}{2}\right) = \underset{h\to 0^+}{Lt}\frac{2\sinh - \sin 2h}{4h^2} = \underset{h\to 0}{Lt}\frac{2\sinh(1-\cosh)}{4h^2} = 0$

$g\left(\frac{\pi^+}{2}\right) = \underset{h\to 0^+}{Lt}\frac{e^{\sin t}-1}{8h} = 1/8$

27. Equation of tangent at t_k is $y - t_k^3 = 3t_k^2(x-t_k)$

$\Rightarrow t_{k+1}^3 - t_k^3 = 3t_k^2(t_{k+1}-t_k) \Rightarrow (t_{k+1}-t_k)(t_{k+1}^2 + t_k t_{k+1} + t_k^2 - 3t_k^2) = 0$

$\Rightarrow (t_{k+1}-t_k)(t_{k+1}^2 - t_k^2 + t_k t_{k+1} - t_k^2) = 0 \Rightarrow (t_{k+1}-t_k)(t_{k+1}-t_k)(t_{k+1}+2t_k) = 0 \Rightarrow \frac{t_{k+1}}{t_k} = -2$

$\Rightarrow t_{k+1} = -2t_k \Rightarrow t_1 = 1, t_2 = -2, t_3 = (-2)^2, ...$

$\underset{n\to\infty}{Lt}\frac{1}{1} + \frac{1}{(-2)} + \frac{1}{(-2)^2} + ... = \frac{2}{3}$

$$\Delta p_2 p_3 p_4 = \frac{1}{2}\times\begin{vmatrix} -2 & -8 & 1 \\ 4 & 64 & 1 \\ -8 & (-8)^3 & 1 \end{vmatrix}$$

$$\Delta p_1 p_2 p_3 = \frac{1}{2}\times\begin{vmatrix} 1 & 1 & 1 \\ -2 & -8 & 1 \\ 4 & 64 & 1 \end{vmatrix} \text{ and length of normal } = \sqrt{1+\frac{1}{9}}$$

28. $\left(ae^{-iB}+be^{iA}\right)^n = \sum_{r=0}^{n} {}^nC_r a^{n-r}b^r$

$e^{i(rA-(n-r)B)} = c^n$

29. $2a = 3, 2ae = 5 \Rightarrow e = \frac{5}{3}$

$\therefore e_1 = \frac{5}{4}$ *and* $b = 2$

30. Centre at $c(2,2)$. Radius of director circle

$= OC = \sqrt{8} = \sqrt{a^2+b^2}$. Also $b^2 = 1\times 3 = 3 \Rightarrow a^2 = 5 \therefore$ Equation of ellipse is

$$\frac{(x-y)^2}{10}+\frac{(x+y-4)^2}{6}=1$$

Put $y = 0 \Rightarrow x = \frac{5}{2}$ Put $x = 0 \Rightarrow y = \frac{5}{2}$

31. P(E) = 1 –P ($\bar{E}$)

$\bar{E}$ = {x/x has none of non-zero digits repeated}

Then 'x' can have 0 or 1 or 2 or 3 zeros.

$$n(\bar{E}) = 5.4.3.2 + ({}^3C_1).(5.4.3) + ({}^3C_2).(5.4) + ({}^3C_3)(5) = 5\times 73$$

$$P(E) = 1-\left(\frac{5\times 73}{5.6.6.6}\right) = \frac{143}{216}$$

32. No. of favourable cases to $(E_1 \cap \bar{E}_2)$

$\begin{cases} \text{no. of arrangements of } (5,1,0,0),(4,2,0,0),(4,1,1,0); \\ (3,3,0,0);(3,2,1,0);(2,2,2,0) \\ \text{to get a 4 digit number} \end{cases}$

= 6 + 6 + 9 + 3 + 18 + 3 = 45

$$P(E_1 \cap \bar{E}_2) = \left(\frac{45}{5\times 6^3}\right) = \frac{1}{24}$$

33-34. Let *x* denote amount of salt in the tank at any time t. Then $\frac{dx}{dt} = 2\times 3 - \frac{x}{300}\times 3$

$$\therefore \frac{dx}{dt} = \frac{600-x}{100} \Rightarrow -\log(600-x)+\log c = \frac{t}{100}$$

$\Rightarrow x = 600 - c.e^{-t/100}$ Put $t = 0, x = 50 \Rightarrow x = 600 - 550e^{-t/100}$

At $t = 50, x = 600 - 550e^{-05}$

35. $I=\int e^x \frac{1-x^2+1}{(1-x)\sqrt{1-x^2}}dx=\int e^x\left(\sqrt{\frac{1+x}{1-x}}+\frac{1}{(1-x)\sqrt{1-x^2}}\right)dx=e^x\sqrt{\frac{1+x}{1-x}}+c$

36. Put $t=\tan^{-1}x \Rightarrow 0<t<\frac{\pi}{2}$

$I=\int e^t.\left(t^2+2t\right)dt=e^t.t^2+c=e^{\tan^{-1}x}.\left(\tan^{-1}x\right)^2+c$

37. Let $A=\begin{bmatrix}a & b\\ b & a\end{bmatrix}\Rightarrow \det A=(a-b)(a+b)$

$a=b\Rightarrow a=0,1,2,.....,p-1$

$a+b=p\Rightarrow (a,b)=(1,p-1),.....,(p-1,1)$

$\therefore$ Total Number = $p+p-1$

38. Trace = $2a\Rightarrow a=1,2,....,p-1$

$\det A=a^2-b^2=(a-b)(a+b)$

$$\left.\begin{array}{l}\text{a}=1\Rightarrow \text{b}=1 \text{ or } \text{p}-1\\ \text{a}=2\Rightarrow \text{b}=2 \text{ or } \text{p}-2\\ .....\\ \text{a}=\text{p}-1\Rightarrow \text{b}=\text{p}-1 \text{ or } 1\end{array}\right\}\Rightarrow \quad \text{no. of pairs } (\text{a, b})=2(\text{p}-1)$$

39. $6\le \sec^4\theta-\tan^4\theta+\sec^2\theta-\tan^2\theta=\sec^2\theta+\tan^2\theta+1\Rightarrow \sec^2\theta\ge 3$

40. $g(x)=x^2-2x\Rightarrow g'(x)=2x-2=2(x-1)\ge 0\Rightarrow g(1)\le g(x)<g(2)$

$\Rightarrow -1\le g(x)<0\Rightarrow [g(x)]=-1$

$$f(x)=\begin{cases}1-4x^2 & 0\le x\le \frac{1}{2}\\ 4x^2-1 & \frac{1}{2}\le x<1\\ -1 & 1\le x<2\end{cases}$$

$\therefore f(x)$ is not differentiable at $x=\frac{1}{2},1$

41. $(x-2007)(y-2007)=(2007)=3^4.223^2$

Number of Pairs (a,b) such that $a.b=3^4.223^2$ is $5\times 3=15$

42. $2^x+3^y+5^z=2^x+(4-1)^y+(4+1)^z=2^x+4k+(-1)^y+1^z$

If $x=1$ then $y=2,4$ and $z=1,2,3,4,5$

If $x=2,3,4,5$ then $y=1,3,5$ and $z=1,2,3,4,5$

$\therefore k=70$

43. Point of intersection is $A(-1,2)$

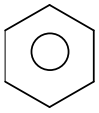
Slope of reflected ray is given by $\frac{m+\frac{2}{3}}{1-\frac{2m}{3}}=\frac{\frac{-2}{3}-\frac{1}{2}}{1-\frac{2}{3}.\frac{1}{2}}\Rightarrow m=\frac{29}{2}$

$\therefore$ Equation of the reflected ray is $29x-2y+33=0$

44. $2y.\frac{dy}{dx}=1\Rightarrow \frac{dy}{dx}=\frac{1}{2y}=1\Rightarrow y=\frac{1}{2}$

$\therefore A\left(\frac{5}{4},\frac{1}{2}\right)$ *and* $B\left(\frac{1}{2},\frac{5}{4}\right)$ $\qquad\qquad$ $\therefore d = AB = \frac{3\sqrt{2}}{4}$

CHEMISTRY

45. Only  with ethanoyl chloride is friedal – crafts acetylation.

46. a, b, c represents correct Reactions

47. Acidified $KMnO_4$ oxidises all the compound in to benzoic acid

48. Due to large size Cs^+ is least hydrated among alkali metal cation due high hydration $Li^+_{(aq)}$ mobility is less. I.P. of Li is more than sodium due to small size.

49. $\underset{(Orange)}{Cr_2O_7^{2-}}+10H^+ + 4Na_2O_2 \rightarrow \underset{blue\,colour}{CrO_5} + 8Na^+ + 5H_2O$.

50. $2O_3 \rightarrow 3O_2$ $\qquad$ $6-2x=3x \Rightarrow x=1.2$

$6-2x \quad 3x$

O_3 moles left = 6-2.4=3.6

O_2 moles formed = 3.6

Mass ratio of ozone to oxygen $=(3.6\times 48):(3.6\times 32)=3:2$

No. of 'O' atoms $=(3.6\times 3)+(3.6\times 2)=18$

51.

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O; E^0_{R.P} = 1.23V$$

$$2SO_4^{2-} \rightarrow S_2O_8^{2-} + 2e^-; E^0_{O.P} = -2.01V$$

(on adding) $O_2 + 2SO_4^{2-} + 4H^+ + 2e^- \rightarrow S_2O_8^{2-} + 2H_2O; E^0_{cell} = -0.78V$

Since the EMF of cell is negative, the reverse reaction is spontaneous.

Hence : water is oxidized to O_2 & $S_2O_8^{2-}$ is reduced to SO_4^{2-}

52. For a I order reaction, $t_{1/2}=\frac{0.693}{k}$

i.e independent of initial concentration of reactants

53. $Ph-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[NaOH]{I_2} CHI_3 + Ph-\overset{O}{\overset{\|}{C}}-ONa$

54. Under Basic medium reactivity of Halogens is $Cl_2 = Br_2 = I_2$

55. $BO \;\; of \;\; O_2 \rightarrow 2; O_2^- \rightarrow 1.5; O_2^+ \rightarrow 2.5;$ In F_2 molecules $\sigma 2P_z$ energy is less than $\pi 2P_x$ and $\pi 2P_y$

$\rightarrow O_2, O_2^-, B_2$ molecules are para due to unpaired e^-

56. O_2^+, NO, N_2^- has bond order 2.5 & para.

57 & 58.

A is $Hg(NO_3)_2$

B is Hg

C is NO_2

D is O_2

E is HgS

F is $HgCl_2$

G is Hg_2Cl_2

H is Hg

I is $K_2[Hg(CN)_4]$

59. Conceptual

60. Conceptual

61. b, c, e, f give Iodoformtest

62. Totally 5 moles are used

63. A is $Cu_2[Fe(CN)_6]$

B is $K_2[Pb(I)_4]$

C is $Na(Ag(CN)_2)$

64. $Ni^{+2}\left(t_{2g}^6 eg^2\right) \Rightarrow$ magnetic moment due to 2 unpaired ρ

65. $\lambda_1 = 2a_0\left(\lambda\alpha\frac{n}{z}; a_0 = \text{cosntant}\right)$

$\lambda_2 = a_0; \lambda_3 = 3a_0$

$\therefore \frac{\lambda_3 - \lambda_2}{\lambda_1} = \frac{3a_0 - a_0}{2a_0} = 1$

66. $P_{NH_3} = P_{HCN} = 0.149atm \Rightarrow K_P = 0.149 \times 0.149 = 0.022atm$

In second case: $NH_4CN_{(s)} \rightleftharpoons NH_{3(g)} + HCN_{(g)}$

Initially :	0.25	0
At Equation :	(0.25 + x)	x

$K_p = (0.25 + x)x = 0.022$

Or $x^2 + 0.25x - 0.022 = 0$

$\therefore x = \frac{-0.25 + \sqrt{(0.25)^2 - 4(1)(0.022)}}{2(1)}$

$= \frac{-0.25 + \sqrt{0.0625 - 0.088}}{2} = \frac{-0.25 + \sqrt{0.1505}}{2} = \frac{-0.25 + 0.388}{2} = 0.07$

$\therefore [HCN] = 7 \times 10^{-2}$

Hence y = 7