SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

(UT1+UT2)	JEE ADVANCE	Date: 25-04-2020
Time: 3 Hours	IIT 2016 PAPER-1 MODEL – (54 BITS)	Max. Marks: 186

PHYSICS

Syllabus: Mechanics (Kinematics (1D and 2D), Laws of Motion, Work, Energy and Power and Rotational Motion, Gravitation, Oscillations and waves.

Section – 1 : (Maximum Marks : (15)

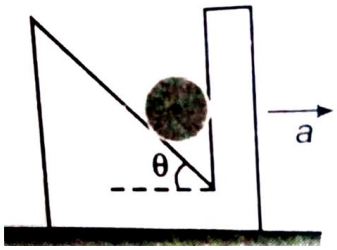
- This section contains **FIVE** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each questions, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : –1 In all other cases.

1. The relation between time t and displacement x is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is

A) $2\alpha v^3$ B) $2\beta v^3$ C) $2\alpha\beta v^3$ D) $2\beta^2 v^3$

2. In the figure, the minimum value of a at which the cylinder starts rising up the inclined surface is



A) $g\tan\theta$ B) $g\cot\theta$ C) $g\sin\theta$ D) $g\cos\theta$

3. Initially the system shown in figure is in equilibrium. At the moment, the string is cut the downward acceleration of blocks A and B are respectively a_1 and a_2. The magnitudes of a_1 and a_2 are

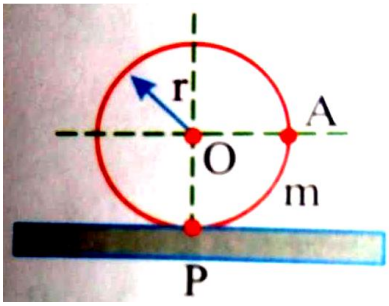
A) zero and zero B) 2g and zero C) g and zero D) None of the above

4. Two satellites S_1 and S_2 are revolving round a planet in coplanar and concentric circular orbits of radii R_1 and R_2 in the same direction respectively. Their respective periods of

revolution are 1 hr and 8 hr. The radius of the orbit of satellite S_1 is equal to 10^4 km. Their relative speed when they are closest, in kmph is

A) $\frac{\pi}{2}\times10^4$ B) $\pi\times10^4$ C) $2\pi\times10^4$ 40 $4\pi\times10^4$

5. A particle of mass 'm' is rigidly attached at 'A' to a ring of mass '3m' and radius 'r'. The system is released from rest and rolls without sliding. The angular acceleration of ring just after release is



A) $\frac{g}{4r}$ A) $\frac{g}{6r}$ C) $\frac{g}{8r}$ D) $\frac{g}{2r}$

Section – 2 : (Maximum Marks : (32)

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- For each questions, marks will be awarded in one of the following categories :

Full Marks	: +4	If only the bubble(s) corresponding to all the correct option(s) is(are) darkened.
Partial Marks	: +1	For darkening a bubble corresponding to **each correct option,** provided NO incorrect option is darkened.
Zero Marks	: 0	If none of the bubbles is darkened.
Negative Marks	: –2	In all other cases.

- For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 Marks; darkening only (A) and (D) will result in +2 marks and darkening (A) and (B) will result in –2 marks, as a wrong option is also darkened.

6. A particle having a velocity $v=v_0$ at t=0 is decelerated at the rate $|a|=\alpha\sqrt{v}$, where a is positive constant

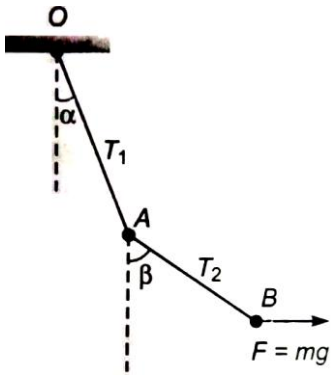
A) The particle comes to rest at $t=\frac{2\sqrt{v_0}}{\alpha}$

B) The particle will come to rest at infinity

C) The distance travelled by the particle before coming to rest is $\frac{2v_2^{3/2}}{\alpha}$

D) The distance travelled by the particle before coming to rest is $\frac{2v_2^{3/2}}{3\alpha}$

7. Two particles A and B, each of mass m are kept stationary by applying a horizontal force=mg on particle B as shown in figure. Then



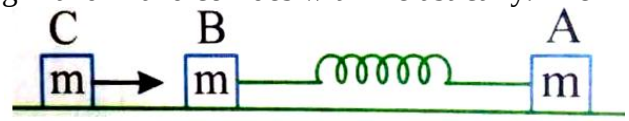
A) $\tan\beta = 2\tan\alpha$ B) $2T_1 = 5T_2$ C) $\sqrt{2}T_1 = \sqrt{5}T_2$ D) $\alpha = \beta$

8. **The potential energy of a particle is given by formula** $U = 100 - 5x + 100x^2$, where U and x are in SI units. If mass of the particle is 0.1 kg then magnitude of it's acceleration

A) At 0.05 m from the origin is 50 ms^{-2} B) At 0.05 m from the mean position is 100 ms^{-2}

C) At 0.05 m from the origin is 150 ms^{-2} D) At 0.05 m from the mean position is 200 ms^{-2}

9. **Two blocks A and B each of mass m are connected by a massless spring of natural length** l and spring constant K. The blocks are initially resting on a smooth horizontal floor with the spring at its natural length as shown. A third identical block C also of mass m, moves on the floor with a speed v along line joining B and A and collides with B elastically. Then



A) The frequency of oscillation of the system AB is $\frac{1}{2\pi}\sqrt{\frac{2K}{m}}$

B) The K.E of the system at maximum compression of the spring is $mv^2/4$

C) The maximum compression of the spring is $v\sqrt{\frac{m}{K}}$

D) The maximum compression of the spring is $v\sqrt{\frac{m}{2K}}$

10. **When a wave travels from a denser to rarer medium, then**

A) speed of wave increases B) Wavelength of wave decreases

C) Amplitude of wave increases D) there is no change in phase angle

11. **A solid cylinder is rolling down the inclined plane without slipping. Which of the following is/are correct**

A) The friction force is dissipative B) The friction force is necessarily changing

C) The friction force will aid rotation but opposes translation

D) The friction force is reduced if θ is reduced

12. **A double star consists of two stars having masses M and 2M. The distance between their centres is equal to r. They revolve under their mutual gravitational interaction. Then, which of the following statements are not correct?**

A) Heavier star revolves in orbit of radius 2r/3

B) Both the stars revolve with same speed, period of which is equal to $\left(2\pi/r^3\right)\left(2GM^2/3\right)$

C) Kinetic energy of the heavier star is twice that of the other star

D) Havier star revolves in orbit of radius r/3

13. **Second overtone frequency of a closed pipe and fourth harmonic frequency of an open pipe are same. Then, choose the correct options**

A) Fundamental frequency of closed pipe is more than the fundamental frequency of open pipe

B) First overtone frequency of closed pipe is more than first overtone frequency of open pipe

C) Fifteenth harmonic frequency of closed pipe is equal to twelfth harmonic frequency of open pipe

D) Tenth harmonic frequency of closed pipe is equal to eighth harmonic frequency of open pipe

Section – 3 : (Maximum Marks : (15)

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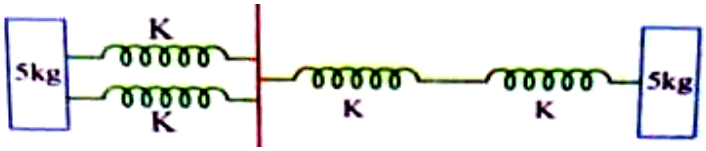
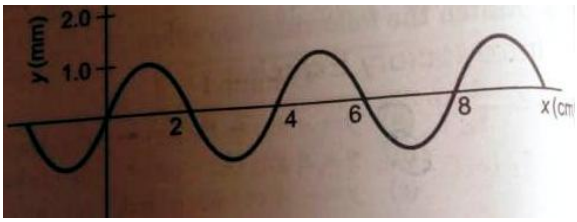
14. In the given spring blocks system if $k = 25\pi^2 Nm^{-1}$, find time period of oscillation.



15. A rod of mass m and length l is released from rest from vertical position as shown in the figure. The normal force as a function of θ, which is exerted on the rod by the ground as it falls downward, assuming that it does not slip is $mg\left(\frac{3\cos\theta - 1}{n}\right)^2$ then n=

16. Figure shows a plot of the transverse displacement of the particle of a string at t=0 through which a travelling wave is passing in the positive x-direction. The wave speed is 20 cm/s. Find the frequency of the wave.



17. Two satellites of mass ratio 1:2 are revolving around the earth in circular orbits such that the distance of the second satellite is four times as compared to the distance of the first satellite. Find the ratio of their centripetal forces.
18. An infinite collection of equal masses of 2 kg are kept on a horizontal line (x-axis) at positions x= 1, 2, 4, 8, ……. Find the gravitational potential at x= 0 in GJ units.

CHEMISTRY

Syllabus: 1st and 2nd year Organic Chemistry.

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19. Hydrogenium and oxygenium combine to give two products A and B . The wt. ratio of one with the fixed weight of the other is in the ratio of 1:2. They follow

A) Law of definite proportions B) Law of reciprocal proportions

C) Law of multiple proportions D) Law of fixed proportions

20. An allotrope of oxygenium reacts with potassium manganate(X) to give purple coloured compound(Y) in aqueous medium. The folrmulae of X and y are:

A) MnO_2, Mn_2O_7 B) K_2MnO_4,MnO_2 C) MnO_2,$MnSO_4$ D) K_2MnO_4,$KMnO_4$

21. Which of the following is highly explosive in nature ?

A) NF_3 B) XeO_3 C) $NH_3.NI_3$ D) PH_3

22. Br_2 reacts with hot and concentrated aqueous sodiumcarbonate solution to give X,Y and Z. Y is a good oxidising agent. Y is:

A) NaOBr B) $NaBrO_4$ C) $NaBrO_3$ D) NaBr

23. The number of d-electrons in BF_3 is

A) 10.0 B) 0.0 C) 11.0 D) 5.0

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24. The correct statements regarding HNO_3 is /are

A) It is a good oxidising agent B) It is good nitrating agent

C) Very dilute HNO_3 with Zn gives N_2O D) Zn with Conc. HNO_3 gives NO_2

25. Which of the following reaction products are true?

A) $2Ca_3(PO_4)_2 + 6SiO_2 + 10C \rightarrow 6CaSiO_3 + P_4 + 10CO$

B) $P_{(black)} \xleftarrow{470K/under\ presure} P_4 \xrightarrow{560K,inert\ atmosphere} P_{red}$

C) $P_4 + 20\ AgNO_3 + 16H_2O \rightarrow 20Ag + 20HNO_3 + 4H_3PO_4$

D) P and S combine to give P_2S_3,P_2S_5, P_4S_3, P_4S_7 etc.

26. The correct products could be among the given:

A) $9O_3 + 2I_2 \rightarrow I_4O_9 + 9O_2$

B) $O_3 + 2K_4[Fe(CN)_6] + H_2O \rightarrow 2K_3[Fe(CN)_6] + 2KOH + O_2$

C) $FeS + CO_2$ (at 1000^0C) $\rightarrow FeO + CO + S$

D) $H_2S + SO_2$ (Fe_2O_3-Catalyst)(303K) $\rightarrow$ 3/8 $S_8 + 2H_2O$

27. The correct statements among these:

A) S_8 has puckered ring structure B) $Ca(OH)_2 + H_2S \rightarrow CaS + 2H_2O$

C) HgS,CuS,PbS, CoS, NiS, FeS are black ppt. ZnS- dirty white ppt. Sb_2S_3 –Orange ppt.
D) CdS, SnS_2, As_2S_3 – yellow, SnS-Chocolate colur ppt. Bi_2S_3 –brown ppt.

28. The correct reactions among these are:
A) $C_2H_5OH+6KOH+4I_2 \rightarrow CHI_3 + HCOOK+5KI+5H_2O$
B) $2HgO+2I_2 \rightarrow HgI_2.HgO+2HIO$
C) $4Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_6S_8O_{12}$
D) $8NH_3.NI_3 \rightarrow 5N_2+6NH_4I+9I_2$

29. In which of the following reactions iodine is liberated?
A) $CuSO_4 + KI \rightarrow$ B) $NaIO_3 + NaI + H_2SO_4 \rightarrow$
C) $KI+H_2O+O_3 \rightarrow$ D) $KI+MnO_2+H_2SO_4 \rightarrow$

30. The correct ones among these are:
A) I_3^-, I_5^-, I_7^-, I_8^- ,Cl_3^-.Br_3^- are known and are stabilized by large cations.
B) $2KI+2Cl_2 \rightarrow 2KICl_4$ C) $CsI_3 \rightarrow CsI + I_2$
D) $I(ClO_4)_3$, $I(CH_3COO)_3$, IPO4,ICl_3, $I(NO_3)_3$ contain I^{3+} ion.

31. Which of the following pairs can be reduced by H_2?
A) CuO,MoO_3 B) UO_3, In_2O_3 C) Cr_2O_3 , Na_2O D) Fe_3O_4,Ag_2O

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32. Hot /conc. NaOH reacts with Cl_2 to give --- moles of $NaClO_3$
33. The number of oxygens shared in frame work silicates is :
34. In the formation of inorganic benzene ---- moles of H_2 is liberated.
35. The moles of sodiumtetrathionate produced when hypo reacts with one mole of I_2 is ____
36. $CaCO_3$ decomposes to give fire extinguisher. It is passed through $BaO_{2(aq)}$, the product formed converts black lead sulphide to white lead sulphate. The moles of oxidising agent required for the process is :

MATHEMATICS

Syllabus:
MATHS: Ut-1 & 2 Syllabus

Section – 1 : (Maximum Marks : (15)

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37. **Let X be the universal set for sets A and B. If** $n(A)=200, n(B)=300$ and $n(A\cap B)=100$, then $n(A^1\cap B^1)=300$, provided $n(X)=$_____

A) 600 B) 700 C) 800 D) 900

38. **If** $f(x)=\frac{x}{x-1}, x\neq 1$, then $(fofofo.....of)(x)$ is equal to _____

A) $\frac{x}{x-1}$ B) $\left(\frac{x}{x-1}\right)^{19}$ C) $\frac{19x}{x-1}$ D) x

39. **In a right angled triangle, if the hypotenuse is four times as long as the perpendicular drawn to it from the opposite vertex. One of the acute angle is_____**

A) 15^0 B) 30^0 C) 45^0 D) 60^0

40. **If** $\tan A-\tan B=x$ and $\cot B-\cot A=y$ then $\cot(A-B)=$_____

A) $\frac{1}{y}-\frac{1}{x}$ B) $\frac{1}{x}-\frac{1}{y}$ C) $\frac{1}{x}+\frac{1}{y}$ D) $x-y$

41. **If** $x_r=\cos\left(\frac{\pi}{2^r}\right)+i\sin\left(\frac{\pi}{2^r}\right)$, then the value of $x_1x_2x_3.....\infty$ is _____

A) – 1 B) 1 C) 0 D) ∞

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42. **The number ways in which we can choose 2 distinct integers from 1 to 100, such that the difference between them is atmost 10, is _____**

A) $100_{C_2}-90_{C_2}$ B) $100_{C_{98}}-90_{C_{88}}$ C) $100_{C_2}-90_{C_{88}}$ D) 100_{C_2}

43. **Suppose** $x_1, x_2, x_3, ..., x_n\ (n>2)$ **are real numbers such that** $x_i=-x_{n-i+1}$ **for** $1\le i\le n$**. Consider the sum** $S=\sum\sum\sum x_ix_jx_k\ (1\le i, j, k\in N)$ **(I, j, k distinct), then which of the following is not true?**

A) $S=n!.x_1.x_2....x_n$ B) $S=(n-3)(n-4)$

C) $S=(n-3)(n-4)(n-5)$ D) $S=0$ for all n

44. **Consider the equation** $x^2+x-a=0, a\in N$. If equation has integral roots, then

A) a= 2 B) a =6 C) a = 12 D) a = 20

45. **If** $0\le x, y\le 180^0$ and $\sin(x-y)=\cos(x+y)=\frac{1}{2}$ then x and y are given by

A) $x=45^0, y=15^0$ B) $x=45^0, y=135^0$ C) $x=165^0, y=15^0$ D) $x=165^0, y=135^0$

46. **If** $\sin\theta+\sqrt{3}\cos\theta=6x-x^2-11,\ 0\le\theta\le4\pi,\ n\in R$ then holds for

A) no value of x and θ B) one value of x and two values of θ

C) two values of x and two values of θ D) two pairs of values of (x,θ).

47. **The equation** $1+x^2+2x\sin\left(\cos^{-1}y\right)=0$ **is satisfied by** $(\forall x\in R)$

A) exactly one value of x B) exactly two values of x

C) exactly one value of y D) exactly two values of y

48. **If sides of triangle ABC are a, b, c such that** $2b=a+c$ **then**

A) $\frac{b}{c}>\frac{2}{3}$ B) $\frac{b}{c}>\frac{1}{3}$ C) $\frac{b}{c}<2$ D) $\frac{b}{c}<\frac{3}{2}$

49. **If** z_1,z_2,z_3 **and** z_4 **are roots of the equation** $a_0z^4+a_1z^3+a_2z^2+a_3z+a_4=0$ **where** a_0,a_1,a_2 & a_4 **are real, then**

A) $\bar{z}_1,\bar{z}_2,\bar{z}_3,\bar{z}_4$ are also roots of equation

B) $\bar{z}_1$ is equal to atleast one of $\bar{z}_1,\bar{z}_2,\bar{z}_3,\bar{z}_4$

C) $-\bar{z}_1,-\bar{z}_2,-\bar{z}_3,-\bar{z}_4$ are also roots of equation

D) None of the above

Section – 3 : (Maximum Marks : (15)

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50. If the matrix $A=\begin{bmatrix}1&2&3&0\\2&4&3&2\\3&2&1&3\\6&8&7&\alpha\end{bmatrix}$ is of rank 3, then $\alpha=$ _____

51. The number of solutions of $\sec x.\cos5x+1=0$ in the interval $[0,2\pi]$ is _____

52. If $K=\sin\left(\frac{\pi}{18}\right)\sin\left(\frac{5\pi}{18}\right)\sin\left(\frac{7\pi}{18}\right)$ then $\frac{1}{K}=$ _____

53. If $f(\theta)=(\sin\theta+\cos ec\theta)^2+(\cos\theta+\sec\theta)^2$, then minimum value of $f(\theta)$ is _____

54. In ΔABC, $\sin A\sin B+\sin B\sin C+\sin C\sin A=\frac{9}{4}$ and a= 2, then the value of $\sqrt{3}\Delta$, where Δ is area of triangle is _____

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KEY SHEET

PHYSICS

1) **A**	2) **A**	3) **B**	4) **B**	5) **B**
6) **A, D**	7) **A,C**	8) **A,B,C**	9) **A,B,D**	10) **A,C,D**
11) **C,D**	12) **A,C**	13) **B,C,D**	14) **1**	15) **2**
16) **5**	17) **8**	18) **4**		

CHEMISTRY

19) **C**	20) **D**	21) **B**	22) **C**	23) **B**
24) **A,B,D**	25) **A,B,C,D**	26) **A,B,C,D**	27) **A,B,C,D**	28) **A,B,D**
29) **A,B,C,D**	30) **A,B,C,D**	31) **A,B,D**	32) **1**	33) **4**
34) **12**	35) **1**	36) **4**		

MATHS

37) **B**	38) **A**	39) **A**	40) **B**	41) **A**
42) **A,B,C**	43) **A,B,C**	44) **A,B,C,D**	45) **A,D**	46) **B, D**
47) **A,C**	48) **A,C,D**	49) **A,B**	50) **5**	51) **8**
52) **8**	53) **9**	54) **3**		

HINTS & SOLUTIONS

1. $\frac{dt}{dx} = (2\alpha x + \beta)$

$\frac{dx}{dt} = v = \left[\frac{1}{2\alpha x + \beta}\right]$

$a = \frac{dv}{dt} = -2\alpha\left[\frac{1}{2\alpha x + \beta}\right]^2 \frac{dx}{dt}$

$= 2\alpha\left(V^2\right)(V) = 2\alpha V^3$

2. On the cylinder

If N = Normal reaction between cylinder and inclined plane

$N\sin\theta =$ horizontal component of N = ma……..(1)

$N\cos\theta =$ vertical component of $N = mg$ ……(2)

$\frac{(1)}{(2)}\frac{N\sin\theta}{N\cos\theta} = \frac{ma}{mg}$

$\tan\theta = \frac{a}{g}$

$a = g\tan\theta$

3. T= 2 mg

As soon as string is cut T on A suddenly becomes zero. Therefore a force of 2 mg acting on upward direction on A suddenly becomes zero

So net force on it will become 2 mg down wards

$a_1 = \frac{2mg}{m} = 2g(\downarrow)$

Spring force does not become instantly zero. So acceleration of B will not change a_2 =0

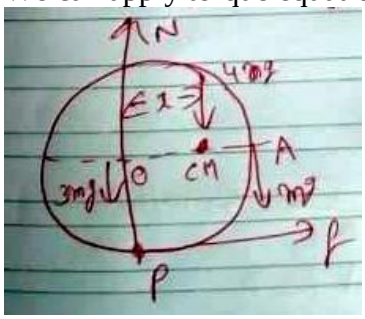
4. $T^2 \alpha R^3, V_0 = \frac{2\pi R}{T}$

Rel velocity $= V_{0_1} - V_{0_2}$

5. The distance of CM from the ring centre O

$x = \frac{3m(0) + m(n)}{3m + m} = \frac{r}{4}$

We can apply torque equation about point of contact as the ring is rolling



$\tau_P = I_P\alpha$

$4mg\left(\frac{r}{4}\right) = \left[\left(3mr^2 + mr^2\right) + m(AP)^2\right]\alpha$

$$mgr = \left[4mr^2 + m\left(\sqrt{2}r\right)^2 \right]\alpha$$

$$mgr = 6mr^2\alpha$$

$$mgr = 6mr^2\alpha$$

6. a) $a = -\alpha\sqrt{v}$

$$\frac{dv}{dt} = -\alpha\sqrt{v}$$

$$\int_0^t dt = -\frac{1}{2}\int_{v_0}^{0} v^{-\frac{1}{2}}dv$$

$$t = \frac{2\sqrt{v_0}}{\alpha}$$

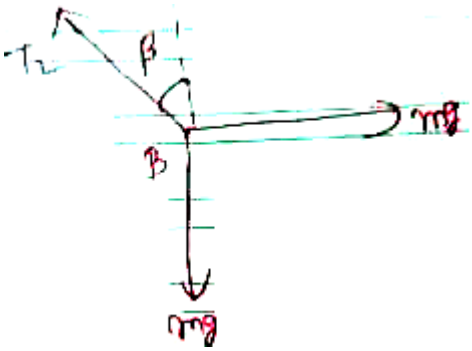
b) $a = -\alpha\sqrt{v}$

$$v\frac{dv}{dt} = -\alpha\sqrt{v}$$

$$\int_0^s ds = \frac{1}{\alpha}\int_{v_0}^{0} v^{\frac{1}{2}}dv$$

$$S = \frac{2v_0^{\frac{3}{2}}}{3\alpha}$$

7.



$$T_2\cos\beta = mg$$

$$T_2\sin\beta = mg$$

8. $$F = \frac{-dV}{dx} = 5 - 200x$$

At origin, $x = 0 \quad F = 5N$

$$a = \frac{F}{m} = \frac{5}{0.1} = 50\ m/\sec^2$$

Mean position is at F=0

$$x = \frac{5}{200} = 0.025m$$

$$a = \frac{F}{m} = \frac{5 - 200x}{0.1} = \left(50 - 20000\right)\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

At 0.05 m from the origin

$x = +0.05m$

$x = -0.05m$

Substitute in equation (1) we have

$$|a| = |50m|\sec^2$$

$$= 50m/\sec^2$$

At 0.05 m from the mean position means

$x = 0.075 \qquad x = -0.025m$

Substitute in equation (1) we have

$|a| = 100 \ \ m/\sec^2 0$

9. Let V_1 is the velocity acquired by A and B then

$mV = mV_1 + mV_1 \qquad \therefore V_1 = \frac{V}{2}$

So, $\frac{1}{2}mV^2 = \frac{1}{L}mV_1^2 + \frac{1}{2}mV_1^2 + \frac{1}{2}KX^2$

Where x is displacement $x = V\frac{M}{2K}$

So (d) is correct.

At maximum compression, KE of A – B system is

$\Rightarrow \frac{1}{2}mV_1^2 + \frac{1}{2}mV_1^2 = mV_1^2 = \frac{1}{2}mV^2$

(6) is correct

10. Conceptual
11. Conceptual
12. $M(r-x) = 2Mx \quad Mr - Mx = 2Mx$

$\therefore l = \frac{n}{3}$

13. Conceptual
14. $K_{eff} = \frac{2k \times \frac{k}{2}}{2k + \frac{k}{2}} = \frac{2k}{5}$

Refluxed mass of system $= \frac{5 \times 5}{5+5} = \frac{5}{2}$

$T = 2\pi\sqrt{\frac{\mu}{keq}} = 2\pi\sqrt{\frac{\frac{5}{2}}{\frac{2k}{5}}} = 5\pi\sqrt{\frac{1}{k}} = 5\pi\sqrt{\frac{1}{25\pi^2}} = 1$

15. At angle θ

$\frac{1}{2}IW2 = mg\frac{l}{2}(1-\cos\theta)$

$W^2 = \frac{3g}{l}(1-\cos\theta) \ldots\ldots\ldots\ldots (1)$

Difference ate w.r.to θ

$\alpha = \frac{mg\frac{1}{2}\sin\theta}{\frac{ml^2}{3}} = \frac{3g\sin\theta}{2l}$

$a_n = \frac{1}{2}\omega^2 = \frac{3g}{2}(1-\cos\theta)$

$a_f = \frac{1}{2}\alpha = \frac{3}{4}g\sin\theta$

$f = ma_x = m(a_f\cos\theta - a_n\sin\theta)$

$= m\left(\frac{3}{4}g\sin\theta\cos\theta - \frac{3g\sin\theta}{2}(1-\cos\theta)\right)$

$= \frac{3mg}{2}\sin\theta\left[\frac{3}{2}\sin\theta - 1\right]$

$N = m\left(g - a_f\right)$

$= \frac{mg}{4}\left(1 - 3\cos\theta\right)^2 \qquad \theta = \cos^{-1}\left(\frac{1}{3}\right)$

16. $V = f\lambda$

17. Centripetal force $= \frac{mv^2}{r} - \frac{GMm}{r^2}$

Where m is the mass of the satellite and m is the mass of the satellite of eanks

$\frac{f_1}{f} = \frac{1}{2}\frac{(4r)^2}{r^2} = 8$

18. $V = -Gm\left[1 + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + ...\right]$

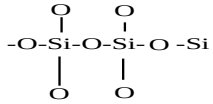
$= \frac{GM}{1 - \frac{1}{2}} \quad V = 2m = 4$

CHEMISTRY

19. $2H_2 + \frac{3}{2}O_2 \longrightarrow H_2O + H_2O_2$

H_2O:H_2O_2The wt. ratio of oxygen with fixed wt.of hydogen is 16:32=1:2 which is a simple multiple ratio hence it follows law of multiple propotions

20. $2K_2MnO_4$ (X) Green coloured)+O_3+H_2O $\rightarrow$2$KMnO_4$(Y)(purple colour)+2KOH+O_2
Oxygenium(O_2) allotrope is O_3
21. XeO_3 20 times more explosive than TNT(trinitrotoluene) 2XeO_3 $\rightarrow$2Xe+3O_2
22. 3$Na_2CO_{3(aq)}$ (hot/conc.)+3Br_2 $\rightarrow$5NaBr+$NaBrO_3$ +3CO_2 Y= $NaBrO_3$ Br is in +5 oxidation state to act like good oxidising agent
23. zero as there is no d-orbital in both B and F.
24. 4 Zn+10 HNO_3(6%)(very dilute) $\rightarrow$4 $Zn(NO_3)_2$ +NH_4NO_3 + 3H_2O
25. They are experimental observations. Hence are true.
26. A and B oxidising power of O_3, C and D are methods of preparation of "s"
27. A) S_8 has puckered ring structure B) $Ca(OH)_2$ +H_2S $\rightarrow$ CaS+ 2H_2O
C) HgS,CuS,PbS, CoS, NiS, FeS are black ppt. ZnS- dirty white ppt. Sb_2S_3 –Orange ppt
D) CdS, SnS_2, As_2S_3 – yellow, SnS-Chocolate colur ppt. Bi_2S_3 –brown ppt.
28. C) 2$Na_2S_2O_3$ +I_2 $\rightarrow$ $Na_2S_4O_6$+2NaI is correct. Remaining are correct
29. A) 2$CuSO_4$+4KI $\rightarrow$ 2K_2SO_4+Cu_2I_2+I_2 B) $NaIO_3$ + 5NaI+6H_2SO_4 $\rightarrow$ 6$NaHSO_4$+3H_2O+3I_2
C) 2KI+H_2O+$O_3$$\rightarrow$ 2KOH+ O_2+I_2 D) 2KI+MnO_2+3H_2SO_4 $\rightarrow$ 2$KHSO_4$+$MnSO_4$+2H_2O+2I_2
30. A) KI+I_2 $\rightarrow$ KI_3 =K^+ + I_3^- , KBr+Br_2 $\rightarrow$ KBr_3 =K^+ + Br_3^-
B) formation of polyhalogen compound C) CsI_3 dissociates on heating to give I_2
D) $I(ClO_4)_3$ $\rightarrow$ I^{3+} +3ClO_4^- .
31. C) Cr_2O_3 +3H_2 $\rightarrow$ 2Cr+3H_2O , Na_2O+H_2 $\rightarrow$ no reduction because sodium is highly electropositive Na_2O is strong oxide. A,B and D pairs are reduced by hydrogen.
32. 6NaOH(hot/Conc.) + 3Cl_2 $\rightarrow$ 5NaCl +$NaClO_3$ + 3H_2O



33. Each silicon is surrounded by four Oxygens. Each Si is surrounded by 4-oxygens
34. 3B_2H_6.2NH_3 $\rightarrow$ 2$B_3N_3H_6$(inorganic benzene)+12H_2
35. 2$Na_2S_2O_3$ +I_2 $\rightarrow$ $Na_2S_4O_6$(sodiumtetrathionate)+2NaI
36. $CaCO_3$ $\rightarrow$ CaO +CO_2, BaO_2+H_2O+CO_2 $\rightarrow$ $BaCO_3$ +H_2O_2

(oxidising agent) $4H_2O_2+PbS \rightarrow PbSO_4+4H_2O$

MATHS

37. $n(A\cup B)=n(A)+n(B)-n(A\cap B)$

$=200+300-100=400$

And $n(A^1\cap B^1)=n(A\cup B)^1$

$\Rightarrow 300=n(X)-n(A\cup B)$

$\Rightarrow n(X)=300+400=700$

38. $(fof)(x)=f(f(x))=f\left(\frac{x}{x-1}\right)=\frac{\frac{x}{x-1}}{\frac{x}{x+1}-1}$

$=\frac{\frac{x}{x-1}}{\frac{x-x+1}{x-1}}=x$

Now, $(fofof)(x)=f((fof))(x)=f(x)=\frac{x}{x-1}$

(i.e.,) $(fofo.....odd\ terms)(x)=\frac{x}{x-1}$

39. Let $BP=p$ then given

$AC=4P$ and $AB=x, BC=y$

$\therefore x^2+y^2=16p^2$ .....(1)

From $\Delta ABD.\sin\theta=\frac{p}{x}$

$\Rightarrow x=p\cos ec\theta$

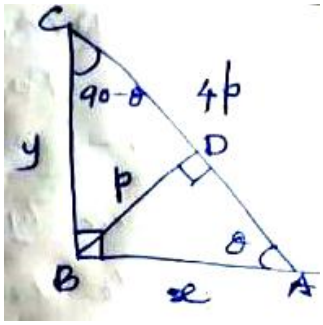
And from $\Delta BCD, \sin(90-\theta)=\frac{p}{y}$

$\Rightarrow y=p\sec\theta$

Now from (1), $p^2\cos ec^2\theta+p^2\sec^2\theta=16p^2$

$\therefore \cos ec^2\theta+\sec^2\theta=16$ .....(2)

$\therefore \theta=15^0$.



40. Given $\tan A-\tan B=x$;

$y=\cot B-\cot A=\frac{1}{\tan B}-\frac{1}{\tan A}=\frac{\tan A-\tan B}{\tan A\tan B}$

$=\frac{x}{\tan A\tan B}\Rightarrow \tan A\tan B=\frac{x}{y}$

Now $\cot(A-B)=\frac{1}{\tan(A-B)}=\frac{1-\tan A\tan B}{\tan A-\tan B}$

$$= \frac{1-\frac{x}{y}}{x} = \frac{y-x}{xy}$$
$$= \frac{1}{x} - \frac{1}{y}$$

41. Given $x_r = cis\left(\frac{\pi}{2^r}\right)$

$$\therefore x_1.x_2.x_3.....\infty = cis\frac{\pi}{2}.cis\frac{\pi}{2^2}.cis\frac{\pi}{2^3}.....\infty$$
$$= cis\left(\frac{\pi}{2}+\frac{\pi}{2^2}+\frac{\pi}{2^3}.....\infty\right)$$
$$= cis\pi\left(\frac{1/2}{1-1/2}\right) = cis\pi = -1$$

42. Let x_1, x_2 be the choosen numbers.

Let 'a' be the integer before te x_1, 'b' be the integer between x_1 and x_2 and 'c' be the integer after x_2.

$\therefore a+b+c=98$, where $a \geq 0, b \geq 10, c \geq 0$.

Now, we consider the choices, where difference is atleast 11, then the no. of solutions is

$88+3-1C_{3-1} = 90C_2$

$\therefore$ The no. of ways in which 'b' is less than 10 is, $100C_2 - 90C_2$.

$\therefore$ Options (A), (B), (C) are correct.

43. Since i, j, k are distinct.

$n-i+1, n-j+1, n-k+1$ are also distinct and they lie between 1 to n.

Now $S = \sum\sum\sum x_i.x_j.x_k$

$$= \sum\sum\sum(-x_{n-i+1})(-x_{n-j+1})(-x_{n-k+1})$$
$$= -\sum\sum\sum x_{n-i+1}.x_{n-j+1}.x_{n-k+1}$$
$$= -\sum\sum\sum x_i, x_j, x_k$$
$$= -S \quad (\because \text{they are also distinct})$$

$\Rightarrow S = 0$ for all n.

$\therefore$ (A), (B), (C) are all not correct.

44. $x = \frac{-1 \pm \sqrt{1+4a}}{2} =$ integer

$\therefore 1+4a$ should be a perfect square

But 1+4a is an odd number

$\Rightarrow 1+4a = (2n+1)^2, n \in Z^+$

$\Rightarrow 4a = 4n^2 + 4n$

$\Rightarrow a = n(n+1)$

$\therefore a = 2, 6, 12, 20$ all are possible

45. $\sin(x-y) = \cos(x+y) = \frac{1}{2}$

$\Rightarrow x-y = 30^0 \,(or)\, 150^0$ and $x+y = 60^0 \;\; (or) \;\; 300^0$

$\therefore x = 45^0 \,(or)\, 165^0 \,(or)\, 125^0 \,(or)\, 105^0$

$y = 15^0 \,(or)\, 135^0 \,(or)\, 95^0 \,(or)\, 75^0$

But $0 \leq x, y \leq 180^0$

$\therefore x = 45^0, y = 15^0 \,(or)\, x = 165^0, y = 135^0$

Satisfying given equations.

46. Given $\sin\theta + \sqrt{3}\cos\theta = -x^2 + 6x - 11$

$\sin\theta + \sqrt{3}\cos\theta \in [-2, 2]$

And $-x^2 + 6x - 11 = -\left(x^2 - 6x + 11\right)$

$= -\left(x^2 - 6x + 9 + 2\right)$

$= -(x-3)^2 - 2$

$\therefore -x^2 + 6x - 11 \le -2 \;\&\; \sin\theta + \sqrt{3}\cos\theta \ge -2$

(i.e., Both are equal to - 2.

But $-x^2 + 6x - 11 = -2$ if $x = 3$ only

Now $\sin\theta + \sqrt{3}\cos\theta = -2$

$\Rightarrow \cos\left(\theta - \frac{\pi}{6}\right) = -1 = \cos\theta\,(or)\cos 3\pi$

$\therefore \theta - \frac{\pi}{6} = \pi\,(or)\,3\pi$

$\therefore \theta - \frac{7\pi}{6}\,(or)\,\frac{19\pi}{6}$

$\therefore$ Two values for θ $\left(\because 0 \le \theta \le 4\pi\right)$

47. Since 'x' is real, $\Delta \ge 0$

$\Rightarrow 4\left(\sin\left(\cos^{-1} y\right)\right)^2 - 4 \ge 0$

$\Rightarrow \left(\sin\left(\cos^{-1} y\right)\right)^2 - 1 \ge 0$

$\Rightarrow \left(\sin\left(\cos^{-1} y\right)\right)^2 \ge 1$

But $\left(\sin\left(\cos^{-1} y\right)\right)^2 = 1$ $\left(\because \sin^2\theta \in [0,1]\right)$

$\therefore \sin\left(\cos^{-1} y\right) = \pm 1$

$\Rightarrow \cos^{-1} y = \pm\frac{\pi}{2}$

$\Rightarrow y = 0$

Put $y = 0$ then the given equation is,

$x^2 + 2x + 1 = 0 \Rightarrow x = -1.$

48. w. k.t. a + b >c

$\Rightarrow 2b - c + b > c \quad \left(\because 2b = a + c\right)$

$\Rightarrow 3b > 2c$

$\Rightarrow \frac{b}{c} > \frac{2}{3}$

Now $b + c > a \Rightarrow b + c > 2b - c$

$\Rightarrow 2c > b \Rightarrow \frac{b}{c} < 2.$

49. Since $a_0, a_1, a_2, a_3 \;\&\; a_4$ are real and z_1, z_2, z_3 and z_4 are the roots of the equation

$\Rightarrow \bar{z}_1, \bar{z}_2, \bar{z}_3, \bar{z}_4$ are also roots.

And w.k.t. if coefficients of the equation are real then the roots occurs pairwise.

$\therefore z_1$ is equal to atleast one of $\bar{z}_1, \bar{z}_2, \bar{z}_3 \;\&\; \bar{z}_4$.

50. $R_2 \to R_2 - 2R_1, R_3 \to R_3 - 3R_1, R_4 \to R_4 - 6R_1$

$$\square\begin{bmatrix}1 & 2 & 3 & 0\\ 0 & 0 & -3 & 2\\ 0 & -4 & -8 & 3\\ 0 & -4 & -11 & \alpha\end{bmatrix}\square\begin{bmatrix}1 & 2 & 3 & 0\\ 0 & -4 & -11 & \alpha\\ 0 & -4 & -8 & 3\\ 0 & 0 & -3 & 2\end{bmatrix}$$

$R_2 \leftrightarrow R_4 \qquad R_3 \to R_3 - R_2$

$$\square\begin{bmatrix}1 & 2 & 3 & 0\\ 0 & -4 & 11 & \alpha\\ 0 & 0 & 3 & 3-\alpha\\ 0 & 0 & -3 & 2\end{bmatrix}\square\begin{bmatrix}1 & 2 & 3 & 0\\ 0 & -4 & 11 & \alpha\\ 0 & 0 & 3 & 3-\alpha\\ 0 & 0 & 0 & 5-\alpha\end{bmatrix}$$

$R_4 \to R_4 + R_3$

Whose rank should be 3 if and only if $5-\alpha=0 \Rightarrow \alpha=5$

51. $\sec x.\cos 5x+1=0$

$\therefore x \neq (2n+1)\dfrac{\pi}{2}$

Now $\cos 5x+\cos x=0(\cos x\neq 0)$

$\Rightarrow 2\cos 3x.\cos 2x=0$

$\Rightarrow \cos 3x=0(or)\cos 2x=0$

$\Rightarrow 3x=(2n+1)\dfrac{\pi}{2}(or)2x=(2n+1)\dfrac{\pi}{2}, n\in Z$

$\Rightarrow x=(2n+1)\dfrac{\pi}{6}(or)\,x=(2n+1)\dfrac{\pi}{4}, n\in Z$

$\therefore x=\dfrac{\pi}{6},\dfrac{3\pi}{6},\dfrac{5\pi}{6},\dfrac{7\pi}{6},\dfrac{9\pi}{6},\dfrac{11\pi}{6}\to 4$

& $x=\dfrac{\pi}{4},\dfrac{3\pi}{4},\dfrac{5\pi}{4},\dfrac{7\pi}{4}\to 4$

$\therefore$ No. of solutions is 8 in $[0,2\pi]$

52. $K=\sin\left(\dfrac{\pi}{18}\right)\sin\left(\dfrac{5\pi}{18}\right)\sin\left(\dfrac{7\pi}{18}\right)$

$=\cos\left(\dfrac{\pi}{2}-\dfrac{\pi}{18}\right)\cos\left(\dfrac{\pi}{2}-\dfrac{5\pi}{18}\right)\cos\left(\dfrac{\pi}{2}-\dfrac{7\pi}{18}\right)$

$=\cos\left(\dfrac{8\pi}{18}\right)\cos\left(\dfrac{4\pi}{18}\right)\cos\left(\dfrac{2\pi}{18}\right)$

$=\cos\dfrac{\pi}{9}.\cos\left(\dfrac{2\pi}{9}\right).\cos\left(\dfrac{4\pi}{9}\right)$

Let $\dfrac{\pi}{9}=\theta \Rightarrow \pi=9\theta$

$\therefore k=\cos(\theta).\cos(2\theta).\cos\left(2^2\theta\right)$

$=\dfrac{\sin\left(2^3\theta\right)}{2^3\sin\theta}=\dfrac{\sin\dfrac{8\pi}{9}}{8\sin\dfrac{\pi}{9}}$

$=\dfrac{\sin\left(\pi-\dfrac{\pi}{9}\right)}{8\sin\dfrac{\pi}{9}}=\dfrac{\sin\dfrac{\pi}{9}}{8\sin\dfrac{\pi}{9}}$

$\therefore \frac{1}{k} = 8$

53. $f(\theta) = \sin^2\theta + \cos ec^2\theta + 2 + \cos^2\theta + \sec^2\theta + 2$

$= 5 + \cos ec^2\theta + \sec^2\theta$

$= 5 + \frac{1}{\sin^2\theta\cos^2\theta} = 5 + \frac{4}{\sin^2 2\theta}$

$0 \le \sin^2 2\theta \le 1 \Rightarrow \frac{1}{\sin^2 2\theta} \ge 1$

$\Rightarrow \frac{4}{\sin^2\theta} \ge 4$

$\therefore f(\theta) \ge 5 + 4 = 9$

$\therefore$ the minimum value of $f(\theta)$ is 9.

54. Given $4\sin A\sin B + 4\sin B\sin C + 4\sin C\sin A = 9$

$\therefore A = B = C = 60^0$

$\therefore$ Area of triangle $\Delta = \frac{\sqrt{3}}{4}a^2 = \sqrt{3}$

$\therefore \sqrt{3}\Delta = \sqrt{3}.\sqrt{3} = 3$