PART-A-PHYSICS

SECTION-I(i)

1) Maximum range of a projectile on a inclined plane are in ratio of 3 : 1 when projected once down the inclined plane and once projected up the inclined plane with same speed respectively. Find angle of inclined plane with horizontal

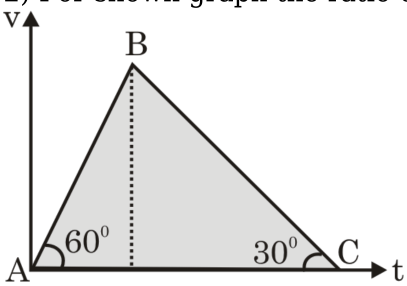
(A) 30°

(B) 60°

(C) 45°

(D) none of these

2) For shown graph the ratio of the average velocity during the interval AB and BC is



(A) 1 : 3

(B) $1 : \sqrt{3}$

(C) 3 : 1

(D) 1 : 1

3) A butterfly is flying with a velocity $4\sqrt{2}$m/s in North-East direction with respect to the wind. Wind is slowly blowing at 1m/s from North to South. The resultant displacement of the butterfly in 3 seconds is:

(A) 3 m

(B) 20 m

(C) $12\sqrt{2}$m

(D) 15 m

4) The displacement of a particle is given by $\sqrt{x} = 2t + 5$. What is the nature of the motion of the particle :-

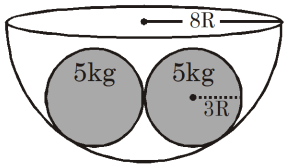
(A) Uniformly accelerated

(B) Uniform motion

(C) Retarded

(D) Non uniformly accelerated

5) In a hemispherical bowl of radius 8R, two balls of mass 5kg are placed in the equilibrium. Radius of the ball is 3R. Normal contact force between the two balls is given by



(A) $\frac{75}{2}$

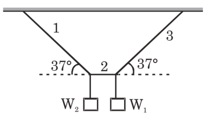
(B) $\frac{75}{4}$

(C) $\frac{75}{6}$

(D) 15

6)

In given figure system is in equilibrium. If W_1 = 400 N, then W_2 is equal to



(A) 500 N

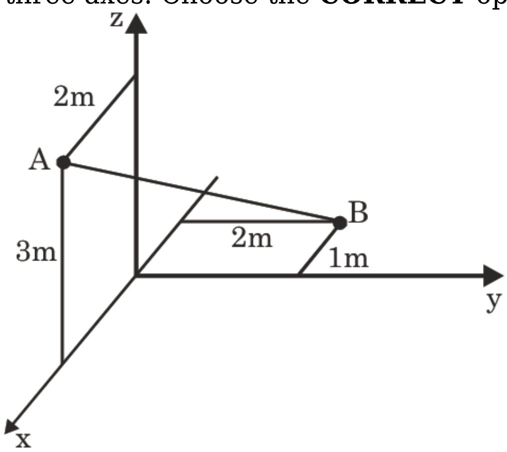
(B) 400 N

(C) 670 N

(D) 300 N

SECTION-I(ii)

1) Figure shows points A & B in 3-Dimensional co-ordinate system. Origin is at intersection of the three axes. Choose the **CORRECT** option(s).



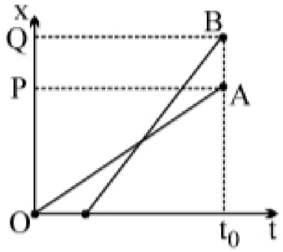
(A) Position vector of A is $2\hat{i} + 3\hat{k}$

(B) Position vector of B is $2\hat{j} - \hat{i}$

(C) $\overrightarrow{AB} = -3\hat{i} + 2\hat{j} - 3\hat{k}$

(D) $\overrightarrow{OB} = \hat{j} - 2\hat{i}$

2) The position-time (x–t) graphs for two children A and B returning from their school O to their homes P and Q respectively along straight line path (taken as x axis) as shown in figure below.



Choose the CORRECT statement (s) :

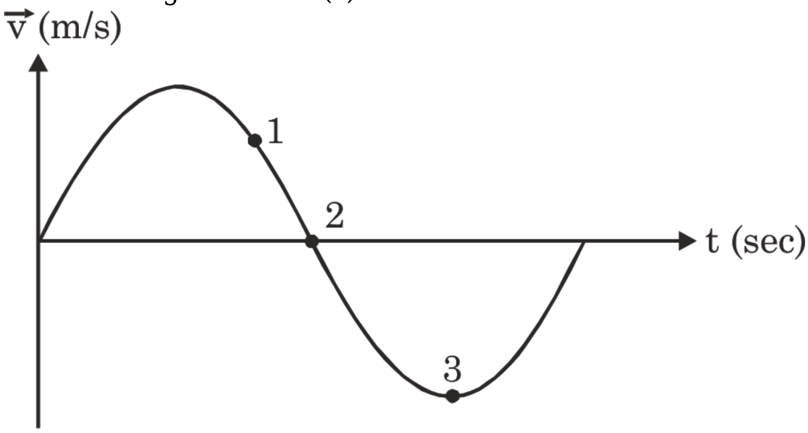
(A) A lives closer to the school than B

(B) A starts from the school earlier than B

(C) A and B have equal average velocities from 0 to t_0.

(D) B overtakes A on the way

3) Figure shows the velocity time (v – t) graph of a particle travelling on a straight road. Which of the following statement(s) are ***INCORRECT*** :-



(A) Velocity and acceleration have same sign at point 1

(B) Particle changes its direction of motion at point 3

(C) Velocity of particle is equal to zero but acceleration is not equal to zero at point 2.

(D) Speed of particle is continously decreasing from point 1 to 3.

4) The displacement x of a particle moving along a straight line varies with time according to the relation $x = x_0\,(1–e^{-at})$, where x_0 and a are positive constants then

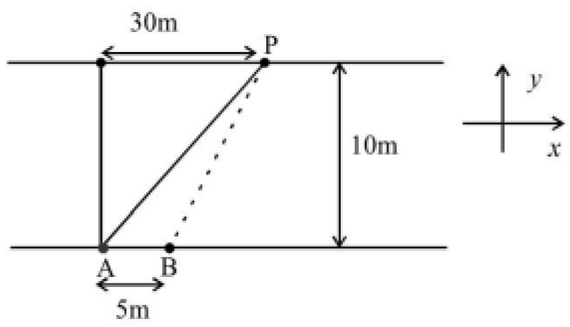
(A) Maximum displacement of the particle is x_0

(B) Maximum velocity of the particle is ax_0

(C) Acceleration of the particle is negative

(D) Particle's speed decreases with time

5) Two persons A and B start swimming from different positions on the same bank as shown in figure. Person A swims at angle 90° with respect to river to reach point P. He takes 120seconds to cross the river of width 10m. Person B also takes same time to reach P



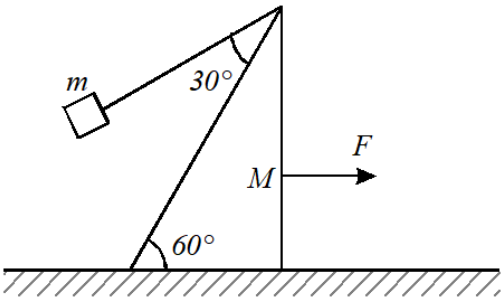
(A) Velocity of A with respect to river is $\frac{1}{6}$m/s

(B) River flow velocity is $\frac{1}{4}$m/s

(C) Velocity of B along y-axis with respect to earth is $\frac{1}{3}$m/s

(D) Velocity of B along x-axis with respect to earth is $\frac{5}{24}$m/s

6) Figure shows a block of mass m = 1 kg attached to the top of a wedge of mass M = 2 kg through a string. M is pulled on a horizontal smooth surface by an external force such that string attached to it makes an angle 30° with inclined plane as shown. Choose the correct option from below. (Take g = 10 m/s^2)



(A) External force F = $30\sqrt{3}$N

(B) String tension T = 20 N

(C) Normal reaction on ground is 30 N

(D) Normal reaction on ground is $(20 + 10\sqrt{3})$ N

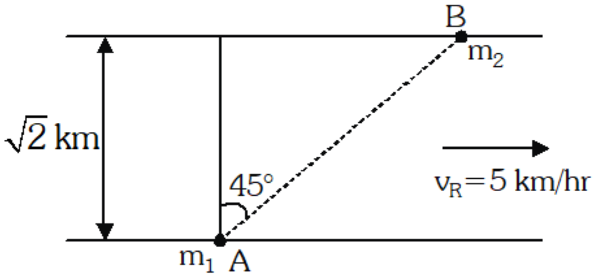
SECTION-III

1) A projectile at any instant during its flight has velocity 5 m/s at 30° above the horizontal. How long after this instant, will it be moving at right angle to the given direction?

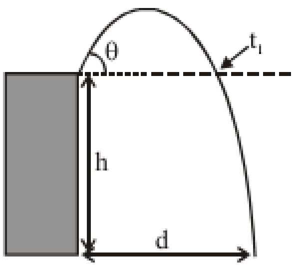
2) In a new system of units, unit of mass is 2kg, unit of length is 4m and unit of time is 2 second. How much joule is equal to 1 unit of energy in this new system ?

3) The river is flowing forwards right with 5 km/hr. Each person can swim w.r.t. river with maximum velocity of 4 km/hr. At same instant they start swimming from initial points A and B. The minimum

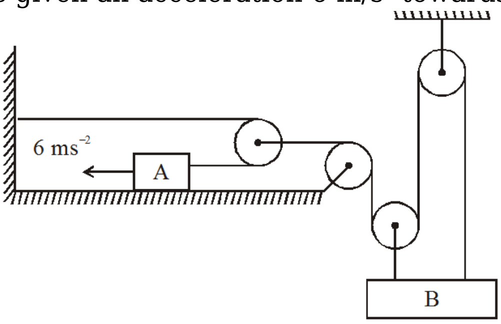
time after which they can meet each other is found to be k times 5 minutes find k.



4) A projectile is launched from a cliff a height h = 10 m above the ground at an angle θ above the horizontal. After a time t_1 = 1 sec has elapsed since the launch, the projectile passes the level of the cliff top moving downward. It eventually lands on the ground a horizontal distance d = 10 m from its launch site. Find 2 tanθ and fill it in OMR sheet.



5) Block A is given an acceleration 6 m/s^2 towards left as shown in figure. Then the acceleration of B (in m/s^2) is



PART-B-CHEMISTRY

SECTION-I(i)

1) A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of h/λ (where λ is wavelength associated with electron wave) is given by :

(A) me V

(B) 2me V

(C) $\sqrt{meV}$

(D) $\sqrt{2meV}$

2) A green bulb and a red bulb are emitting the radiations with equal power. The correct relation

between numbers of photons emitted by the bulbs per second is

(A) $n_g = n_r$

(B) $n_g < n_r$

(C) $n_g > n_r$

(D) unpredictable

3) 300 gm, 30% (w/w) NaOH solution is mixed with 500 gm 40% (w/w) NaOH solution. What is % (w/v) NaOH if density of final solution is 2 gm /mL :–

(A) 72.5

(B) 65

(C) 62.5

(D) 60

4) What is the period number of element having atomic number equal to 32?

(A) Second

(B) Third

(C) Fourth

(D) Fifth

5) Which one of the following dimeric form of compounds is planar ?

(A) B_2H_6

(B) Al_2Cl_6

(C) Al_2Br_6

(D) I_2Cl_6

6) Which of the following is not correct regarding C_2 molecule ?

(A) C_2 molecule has two pi bonds

(B) It has a total 12 electrons, out of which 8 electrons occupy bonding orbitals while 4 electrons occupy antibonding orbitals.

(C) The molecule is diamagnetic

(D) C_2 molecule has one σ and one π bond.

SECTION-I(ii)

1) If n + ℓ =5, $|m| = 1$ then

(A) Number of possible orbitals are 4

(B) Maximum number of electrons that can be filled with m_s = +1/2 is 6 in an atom with above condition

(C) for iron (Z = 26) atom, number of electron with above condition must be 1 only

(D) For Germanium (Z = 32), the minimum number of electron with above condition can be 5

2) 110 gm sample of P_4O_6 contains (Atomic weight of P = 31)

(A) $3N_A$ number of O atoms

(B) $5N_A$ number of total atoms

(C) 62 gram of P atoms

(D) $12N_A$ number of P – O bonds

3) 50ml of 20.8% w/v $BaCl_2$(aq.) and 100 ml of 9.8 % w/v H_2SO_4(aq) solution are mixed. Then in final solution : (Atomic weight of Ba = 137)

(A) $[Cl^-]$ = 0.66M

(B) $[H^+]$ = 1.33M

(C) $[Ba^{2+}] \approx 0$ M

(D) $[SO_4^{2-}]$ = 0.33 M

4) Which among the following is/are correct about chromium ?

(A) Its electronic configuration is $[Ar]3d^5\ 4s^1$

(B) Total spin of chromium = 3

(C) Spin multiplicity of 3d-subshell of chromium = 6

(D) Magnetic moment of chromium = $\sqrt{48}$ B.M

5) The wave function for 2s orbital is given as $\psi = \left(\frac{1}{4\sqrt{2}}\right)\left(\frac{1}{a_0}\right)^{3/2}\left(2-\frac{r}{a_0}\right).e^{-r/2a_0}$ Where a_0 = First Bohr's radius in H atom = 0.529 Å.
Read the given statement and pick out the correct statement(s).

(A) The number of radial nodes is equal to three

(B) The probability density is independent of direction

(C) The number of radial node is equal to 1

(D) The radial node occur at a distance $2a_0$ from nucleus

6) Which of the following is/are correct order ?

(A) KCl > KBr (Lattice energy)

(B) AlN > MgO (Lattice energy)

(C) $Li^+_{(aq.)} > Cs^+_{(aq.)}$ (ionic mobility)

(D) $Li^+_{(aq.)} < Cs^+_{(aq.)}$ (Electrical conductivity)

SECTION-III

1) Find the sum of angular nodes and radial nodes in 6f ?

2) Find number of moles of Na_3PO_4 which contain as many ions as are present in 1368 gm of $Al_2(SO_4)_3$. (Assuming complete dissociation of salt and no reaction with H_2) [At wt of Na = 23, P = 31, O = 16, Al = 27, S = 32]

3) 64 g of an organic compound has 24 g carbon and 8 g hydrogen and the rest is oxygen. The empirical formula of the compound is $C_xH_yO_z$.Find the value of x + y + z. (At.wt of C = 12, O = 16, H = 1)

4) An electron in H atom makes a transition from 4^{th} excited state to n = 2. What are the total possible number of different radiations that may fall in UV region?

5) The maximum number of electrons that can have principal quantum number, n = 3, and spin quantum number, m_s = –1/2, is

PART-C-MATHEMATICS

SECTION-I(i)

1) Number of real solutions of the equation $\sqrt{\log_{10}(-x)} = \log_{10}\sqrt{x^2}$ is

(A) None
(B) Exactly 2
(C) Exactly 1
(D) 4

2) Number of solutions of the equation tanx + 2tan2x + 4tan4x + 8cot8x = 1 in the interval [–2π, 2π] is equal to

(A) 0
(B) 1
(C) 2
(D) 4

3) Let 'a' be the arithmetic mean and b,c be two geometric means between any two positive numbers then $\frac{b^3+c^3}{2abc}$ is

(A) 1
(B) 2
(C) 3
(D) $\frac{1}{2}$

4) If $100^{th,}$ 200^{th} and 400^{th} term of an arithmetic progression are in geometric progression, then

common ratio of geometric progression is

(A) $\frac{1}{2}$

(B) 2

(C) $\frac{3}{2}$

(D) 4

5) The sum of all distinct real solutions of the equation $(x^2 - 3)^3 - (4x + 6)^3 + 216 = 18(4x + 6)(3 - x^2)$ is

(A) –3

(B) 4

(C) 1

(D) –7

6) If A = {1, 2, 4}, B = {2, 4, 5}, C = {2, 5}, then (A – C) × (B – C) is equal to

(A) {(1, 4)}

(B) {(1, 4), (4, 4)}

(C) {(4, 1), (4, 4)}

(D) {(1, 2), (2, 5)}

SECTION-I(ii)

1) If $\lambda = \frac{1}{6\sin(x).\cos(x) + 8\cos^2(x) + 2}$ then

(A) $\lambda \in \left[-1, \frac{1}{9}\right]$

(B) Sum of integral values of $\lambda = 0$

(C) $\lambda \in \left[\frac{1}{11}, 1\right]$

(D) Sum of integral values of $\lambda = 1$

2) Which of the following is/are correct ?

(A) $\frac{1}{\ell ne} + \frac{1}{\ell ne^2} + \frac{1}{\ell ne^4} + \frac{1}{\ell ne^8} + \ldots\infty = 2$

(B) $\frac{2}{1.4} + \frac{3}{2.9} + \frac{4}{3.16} + \ldots\infty = 1$

(C) Number of digits in 2^{100} are 30

(D) Number of solution of sin(x) + cos(x) = 1.5 is zero

3) If $a_1, a_2, a_3, \ldots, a_{40}$ are in A.P. and $\sum_{r=1}^{20} a_{2r} = 400$ and $\sum_{r=1}^{20} a_{2r-1} = 300$ then choose correct option(s)

(A) $a_7 - a_6 = \frac{4}{3}$

(B) $a_{10} - a_9 = 5$

(C) $a_1 = -80$

(D) $a_{40} = 185$

4) The expression $\sqrt{\sin^4 (37.5)^\circ + 4\cos^2 (37.5)^\circ} + \sqrt{\cos^4 (37.5)^\circ + 4\sin^2 (37.5)^\circ}$ simplifies to

(A) an irrational number

(B) a prime number

(C) a natural number which is not composite

(D) a real number of the form $a + \sqrt{b}$ where a and b are prime

5) Consider the series $\frac{8}{5} + \frac{16}{65} + \frac{24}{325} + \ldots$. If S_n is the sum of first n terms and a_n is the n^{th} term of the series, then

(A) $S_\infty = 2$

(B) $a_5 = \frac{40}{2601}$

(C) $S_{10} = \frac{440}{221}$

(D) $S_n = \frac{4n^2 + 4n}{n^2 + 2n + 2}$

6) If $\log_a x = b$ for permissible values of a and x then identify the statement(s) which can be correct?

(A) If a and b are two irrational numbers then x can be rational.

(B) If a rational and b irrational then x can be rational.

(C) If a irrational and b rational then x can be rational.

(D) If a rational and b rational then x can be rational.

SECTION-III

1)

Given $f_n(x) = \frac{1}{n}(\sin^n x + \cos^n x)$ for n = 1, 2, 3, ... Then the value of $24(f_4(x) - f_6(x))$ is equal to

2) The complete solutions of the inequality $(x^2 - x - 1)(x^2 - x - 7) < -5$ is $(-a, -b) \cup (c, d)$ then find the value of $(a + b + c + d)$ is, where $a, b, c, d \in N$

3) If A and B are two sets such that n(A) = 150, n(B) = 250 and $n(A \cup B) = 300$.

Then $\frac{n(B-A)-n(A-B)}{100}$ is

4) If $\sum_{r=1}^{100} r.2^{r-1}$ = m.2^n + t, where m, n, t are positive integers with HCF 1, then value of $\frac{m+n+t}{100}$ is

5)

Find the minimum integral value of x such that $\sqrt{\log_2\left(\frac{2x-3}{x-1}\right)} < 1$.

ANSWER KEYS

PART-A-PHYSICS

SECTION-I(i)

Q.	1	2	3	4	5	6
A.	A	D	D	A	A	B

SECTION-I(ii)

Q.	7	8	9	10	11	12
A.	A,B,C	A,B,D	A,B,D	A,B,C,D	B,D	A,B,C

SECTION-III

Q.	13	14	15	16	17
A.	1	8	3	2	1

PART-B-CHEMISTRY

SECTION-I(i)

Q.	18	19	20	21	22	23
A.	D	B	A	C	D	D

SECTION-I(ii)

Q.	24	25	26	27	28	29
A.	A,D	A,B,C	A,B,C,D	A,B,C,D	B,C,D	A,B,D

SECTION-III

Q.	30	31	32	33	34
A.	5	5	6	0	9

PART-C-MATHEMATICS

SECTION-I(i)

Q.	35	36	37	38	39	40
A.	B	A	A	B	C	A

SECTION-I(ii)

Q.	41	42	43	44	45	46
A.	C,D	A,B,D	B,C	B,C	A,C	A,B,C,D

SECTION-III

Q.	47	48	49	50	51
A.	**2**	**8**	**1**	**2**	**2**

SOLUTIONS

PART-A-PHYSICS

1) $R_{down} = 3R_{up}$

$$\frac{u^2}{g(1-\sin\theta)} = 3\frac{u^2}{g(1+\sin\theta)}$$

$$\frac{1+\sin\theta}{1-\sin\theta} = 3$$

By theorem on ratios

$$\frac{2\sin\theta}{2} = \frac{2}{4}$$

$$\sin\theta = \frac{1}{2}$$

$\Rightarrow \theta = 30°$

2)

Here acceleration = constant. Therefore body reaches the farthest point after 20/2=10s and then starts coming back towards the initial point. Hence position of body at 13s=(10+3) s will be same as at (10–3) = 7s

3) $V_b = \vec{V}_{b\omega} + \vec{V}_{b\omega}$

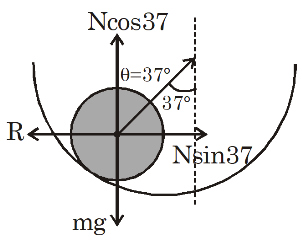
$= 4\hat{i} + 4\hat{j} + \left(-1.\hat{j}\right) = 4\hat{i} + 3\hat{j}$

$S = u \times t = \left(4\hat{i} + 3\hat{j}\right) \times 3 = 15\text{m}$

4)

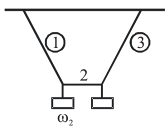
$x = (2t+5)^2 \Rightarrow v = 2(2t+5) \Rightarrow a = 4$

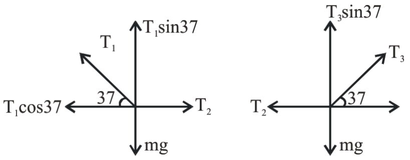
5)



Ncos37°= mg $\Rightarrow N = \frac{5mg}{4}$ [Newton]

R = Nsin37° $\Rightarrow \frac{3mg}{4} = \frac{75}{2}$

6) 



$T_3\sin 37 = 400 \quad T_2 = T_3\cos 37$

$T_3 \times \frac{3}{5} = 400 \qquad T_2 = \frac{2000}{3} \times \frac{4}{5} = \frac{1600}{3}$

$T_3 = \frac{2000}{3}$

$T_1\cos 37 = \frac{1600}{3}$

$T_1 = \frac{2000}{3}$

$T_1 \sin 37 = W_2$

$\frac{2000}{3} \times \frac{3}{5} = W_2$

$400 = W_2$

7)

$\overrightarrow{OA} = 2\hat{i} + 3\hat{k}$

$\overrightarrow{OB} = -\hat{i} + 2\hat{j}$

$\Rightarrow \overrightarrow{AB} = -3\hat{i} + 2\hat{j} - 3\hat{k}$

8)

9)

At point 1, v = positive & acceleration is negative (slope of v-t graph gives acceleration)
At point 2, v = zero & acceleration is negative (slope of v-t graph gives acceleration)
At point 3, v = negative & acceleration is zero (slope of v-t graph gives acceleration)
From 1 to 3 speed of the particle first decreases, becomes zero and then increases. Particle is changing its direction at point 2.

10)

For (A) : At $t \to \infty$, x will be maximum so $x_{max} = x_0(1-e^{-\infty}) = x_0$

For (B) : $v = \frac{dx}{dt} = x_0\left[0 - \left(e^{-at}\right)(-a)\right] = ax_0e^{-at} \Rightarrow v_{max} = ax_0$

For (C) : $a = \frac{dv}{dt} = ax_0\left(e^{-at}\right)(-a) = -a^2x_0e^{-at} < 0$

For (D) : a (-ve) & v (+ve) $\Rightarrow$ speeding down

11)

$u \times 120 = 30$ (x displacement)

$u = \frac{1}{4}$ m/s

$V_B \times 120 = 25$ (displacement in x dir)

$V_B = \frac{5}{24}$ m/s

12)

T cos 60° = mg = 10

T sin 60° = 1a

$a = 20 \times \frac{\sqrt{3}}{2} = 10\sqrt{3}$ m/s^2

$F = (M + m)a = 3 \times 10\sqrt{3} = 30\sqrt{3}$ N

Normal Reaction on ground is

$N_1 = Mg + T \cos 60° = (M+m)g = 30$ N

13)

$$t = \frac{u}{g \sin \theta} = \frac{5}{10 \times \frac{1}{2}} = 1$$

14)

$$n_1[\text{kg m}^2\text{s}^{-2}] = 1\ [2\text{ kg} \times 16\text{ m}^2 \times \frac{1}{4}\text{ sec}^{-2}]$$

$n_1 = 8$

15)

$\left|\vec{u}_{rel}\right| = 8$ km/hr

$\left|\vec{s}_{rel}\right| = 2$ km

$t = \frac{2}{8} - \frac{1}{4}$hr

$$t_1 = \frac{2u \sin \theta}{g} \Rightarrow u = \frac{10}{2 \sin \theta}$$

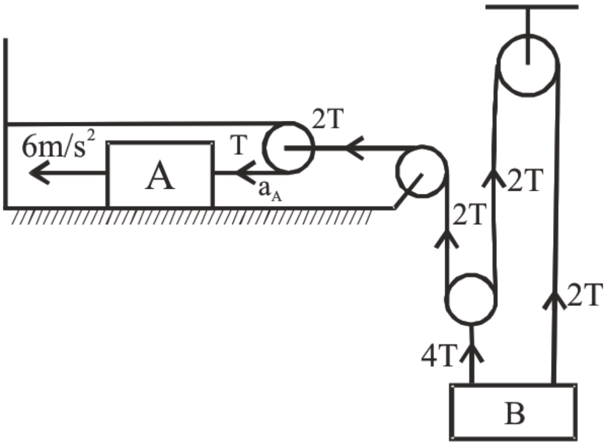
$$-h = d \tan \theta - \frac{1}{2} g \frac{d^2}{u^2 \cos^2 \theta}$$

16)

$$-10 = 10 \tan \theta - \frac{1}{2} \times \frac{10 \times 10}{25} \tan^2 \theta$$

$$2\tan^2\theta - \tan \theta - 1 = 0$$

$$\tan \theta = \frac{1 \pm \sqrt{1+8}}{4} = \frac{1+3}{4}, \frac{1-3}{4} = 1, -\frac{1}{2}$$



17)
Tension on Block A is T
then tension on Block B is 6T
by constrained motion equation.
$T(6) = 6T/a_B$

$a_B = 1 m/s^2$

PART-B-CHEMISTRY

18)

$$\lambda_{de} = \frac{h}{\sqrt{2meV}}$$
$$\frac{h}{\lambda} = \sqrt{2meV}$$

19)

$E = nh\nu$

$\Rightarrow \quad \frac{n_g h\nu_g}{t} = \frac{n_r h\nu_r}{t}$ $\qquad n_g$ = no. of photons (green)

$\Rightarrow \quad n_g \nu_g = n_r \nu_r$ $\qquad n_r$ = no. of red photons

$\Rightarrow \quad \frac{\nu_g}{\nu_r} = \frac{n_r}{n_g}$ $\qquad \nu \rightarrow$ frequency

$\nu_g > \nu_r \Rightarrow n_r > n_g$

20) $W_{1NaoH} = \frac{30}{100} \times 300 = 90g$

$W_{2NaoH} = \frac{40}{100} \times 500 = 200$

$W_{t(NaoH)} = 200+90 = 290$

$W_{t(Soln)} = 300+500 = 800$

$D = 2 \quad \frac{800}{V}$

$V = 400$

$\frac{W}{V} = \frac{290}{400} \times 100$

$= 72.5$

21)

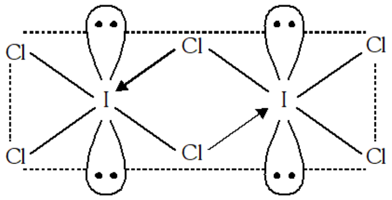
$Z = 32 : 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^2$

max. principal quantum number = 4

∴ period number = 4

22)

B_2H_6, Al_2Cl_6, Al_2Br_6 are non-planar with sp_3 centre and I_2Cl_6 is planar with sp^3d^2 centre.



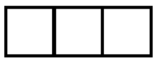
23)

C_2 is $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \begin{matrix}\pi_{2p_x}^2 \\ \pi_{2p_y}^2\end{matrix}$ (C_2 molecule has two π–bonds)

24)

If $n + \ell = 5$, $|m| = 1$

$m = +1$ or -1



$n = 4 \quad l = 1 \quad 4p \qquad m = +1 \qquad -1$

$n = 3 \quad l = 2 \quad 3d \qquad m = \qquad +1 \qquad -1$

no. of posible orbitals = 4

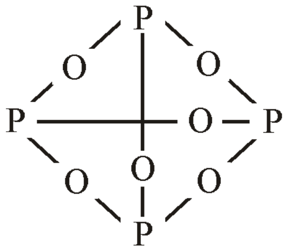
25)

No. of moles of $P_4O_6 = \frac{110}{220} = \frac{1}{2}$ moles.

(A) No. of 'O' atoms $= \frac{1}{2} \times 6N_A = 3N_A$

(B) No. of total atoms $= 10 \times \frac{1}{2} \times N_A = 5N_A$

(C) Moles of 'P' atoms = $4 \times \frac{1}{2} = 2$ moles
weight of 'P' atoms = 2 × 31 = 62 gm

(D) 

No. of P-O bonds = $12 \times \frac{1}{2} N_A = 6N_A$

26)

$n_{BaCl_2} = \frac{20.8}{100} \times \frac{50}{208} = \frac{1}{20} = 0.05$;

$n_{H_2SO_4} = \frac{9.8}{100} \times \frac{100}{98} = 0.1$

Moles 0.05 0.01

After 0 0.05 0.05 0.01

reaction

$\Rightarrow n_{SO_4^{2-}}$ remaining = 0.05

$\Rightarrow [SO_4^{2-}] = \frac{0.05}{150} \times 1000 = \frac{1}{3} = 0.33$;

$[H^+] = \frac{0.2}{0.15} =$ = 1.33 M; $[Cl^-]$

$= \frac{0.1}{0.15} = 0.66M$ $[Ba^{2+}] = 0$

27)

Cr24 → $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

Total spin = Number of unpaired electrons × $\frac{1}{2} = 6 \times \frac{1}{2} = 3$

Magnetic moment = $\sqrt{n(n+2)}$, where n = number of unpaired electrons

$= \sqrt{6 \times 8} = \sqrt{48}$ B.M.

* no of radial node = $n - l - 1 = 2 - 0 - 1 = 1$

* Probability density ψ^2

* Since ψ contain no θ or ϕ terms – probability of finding electron do not depend upon direction

* Also since at $r = 0$,

$$\psi = \left(\frac{1}{4\sqrt{2}}\right)\left(\frac{1}{a_0}\right)^{3/2}.(2);$$

28) ψ^2 is non zero at $r = 0$

* $\psi = 0$ when the term $\left(2 - \frac{r}{a_0}\right)$ vanishes

putting $2 - \frac{r}{a_0} = 0$

$\Rightarrow \quad r = 2a_0$

at $r = 2a_0$, $\psi = 0$: Corresponds to radial node.

29)

Theory based.

30)

Angular nodes = 3
Radial nodes = 2

31)

Ions in $Al_2(SO_4)_3$ = $\frac{1368}{342} \times N_A \times 5 = 20 \times N_A$
Ions in Na_3PO_4 = (n moles) × N_A × 4
$\Rightarrow n \times N_A \times 4 = 20 \times N_A \Rightarrow n = 5$ moles.

32)

	C	H	O
Mole ratio	$\frac{24}{12}$	$\frac{8}{1}$	$\frac{32}{16}$

= 2 : 8 : 2
= 1 : 4 : 1
= CH_4O; hence x + y + z = 6

33)

For UV region. $n_2 = 1$

34)

In third orbit 3s, 3p, 3d sub levels are present and a total of nine orbitals are present. Each orbital has one electron with $m_s = -1/2$.

PART-C-MATHEMATICS

35) $\log_{10}(-x) = \log_{10}|x|$

Either $\Rightarrow \log_{10}(-x) = 1 \Rightarrow x = \frac{-1}{10}$

or $\log_{10}(-x) = 0$ or $x = -1$

36) We know that, cotx â€“ tanx = 2cot2x

Now, tanx + 2tan2x + 4tan4x + 8cot8x = 1

⇒ cotx â€“ 2cot2x + 2tan2x + 4 tan4x + 8cot8x=1

⇒ cotx â€“ 4cot4x + 4tan4x + 8cot8x = 1

⇒ cotx â€“ 8 cot8x + 8cot8x = 1

⇒ cotx = 1 for which tan2x is not defined

⇒ so no solution.

37)

x a y x b c y

$2a = x + y$, $b^2 = cx$, $c^2 = by$

$$\frac{b^3 + c^3}{2abc} = \frac{bcx + bcy}{(x+y)bc} = 1$$

38) $\frac{A_{200}}{A_{100}} = \frac{A_{400}}{A_{200}} = \frac{A_{200} - A_{400}}{A_{100} - A_{200}} = 2$

39)

$(x^2 - 3)^3 + (-4x - 6)^3 + (6)^3$

$= 3(x^2 - 3)(-4x - 6)(6)$

$\Rightarrow x^2 - 3 - 4x - 6 + 6 = 0$

or $x^2 - 3 = -4x - 6 = 6$

$\Rightarrow x^2 - 4x - 3 = 0$ or $x = -3$

$x_1 + x_2 = 4$ or $x_3 = -3$

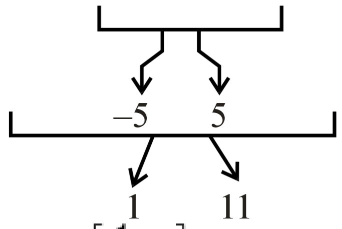
sum of all distinct real solution = 1.

41)

 6 sinxcosx + 8 $\cos^2 x$ + 2

= 3sin2x + 4(1 + cos2x) + 2

= 6 + 3sin2x + 4cos2x



$\therefore \lambda \in \left[\frac{1}{11}, 1\right]$

& sum of integers = 1

42) (A) $\frac{1}{1}+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ \dots\ \infty = \frac{1}{1-\frac{1}{2}} = 2$

(B) $\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+\ \dots\ \infty$

$= \left(\frac{1}{1}-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\left(\frac{1}{3}-\frac{1}{4}\right)+\ \dots\ \infty = 1$

(C) $\log_{10}(2)^{100} = 100 \times 0.3010 = 30.10$

$\therefore$ C = 30 & No. of digit = C + 1 = 30 + 1 = 31

(D) Range of sinx + cosx is $\left[-\sqrt{2},\ \sqrt{2}\right]$

43)

$S_{40} = 400 + 300 = 700$

$\frac{40}{2}(2a_1 + 39 \times d) = 700$

$2a_1 + 39d = 35$

$\sum_{r=1}^{20} \underbrace{(a_{2r} - a_{2r-1})}_{d} = 400 - 300$

$20d = 100$

$d = 5$

$a_1 = -80$

$a_{40} = 115$

44)

$$\sqrt{\sin^4\theta + 4\cos^2\theta} + \sqrt{\cos^4\theta + 4\sin^2\theta} = \sqrt{(1-\cos^2\theta)^2 + 4\cos^2\theta} + \sqrt{\left(1-\sin^2\theta\right)^2 + 4\sin^2\theta}$$

45)

$$S_n = \sum_{r=1}^{n} \frac{8r}{4r^4+1}$$

$$= \sum_{r=1}^{n} \frac{8r}{(2r^2-2r+1)\ (2r^2+2r+1)}$$

$$= 2\sum_{r=1}^{n} \left(\frac{1}{2r^2-2r+1} - \frac{1}{2r^2+2r+1}\right)$$

$$f_4(x) - f_6(x)$$

$$= \frac{1}{4}\left(\sin^4 x + \cos^4 x\right) - \frac{1}{6}\left(\sin^6 x + \cos^6 x\right)$$

47) $$= \frac{1}{4}(1 - 2\sin^2 x \cos^2 x) - \frac{1}{6}(1 - 3\sin^2 x\cos^2 x)$$

$$= \frac{1}{4} - \frac{1}{6} = \frac{1}{12} \Rightarrow 24(f_4(x) - f_6(x)) = 2.$$

48)

$(x^2 - x - 1)(x^2 - x - 7) + 5 < 0$

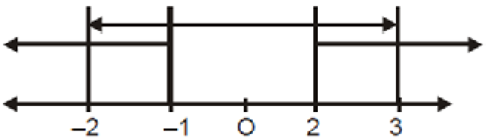
Let $x^2 - x = y$

$(y - 1)(y - 7) + 5 < 0$

$\Rightarrow$ $y^2 - 8y + 12 < 0$

$(y - 6)(y - 2) < 0$

$\Rightarrow$ $2 < y < 6 \quad 2 < x^2 - x < 6$



$x^2 - x - 2 > 0$ and $x^2 - x - 6 < 0$

$(x - 2)(x + 1) > 0$ and $(x - 3)(x + 2) < 0$

$x \in (-2, -1) \cup (2, 3)$

49)

$n(A) = 150 \quad n(B) = 250 \quad n(A \cup B) = 300$

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

$\Rightarrow 300 = 150 + 250 - n(A \cap B)$

$n(A - B) = 50$

$n(B - A) = 150$

Then, $\dfrac{n(B - A) - n(A - B)}{100} = \dfrac{150 - 50}{100} = \dfrac{100}{100} = 1$

50)

$S = 1 + 2.2 + 3.2^2 + 4.2^3 + \underline{\quad\quad} + 100.2^{99}$

$2S = 1.2 + 2.2^2 + 3.2^3 + \underline{\quad\quad} 99.2^{99} + 100.2^{100}$

$-S = 1 + 2 + 2^2 + 2^3 + \underline{\quad\quad} 2^{99} - 100.2^{100}$

$S = 100.2^{100} - (2^{100} - 1) = 99.2^{100} + 1$

hence $m = 99$, $n = 100$ & $t = 1$.

$\dfrac{m + n + t}{100} = 2.$

Inequality is true if

$$0 \le \log_2\left(\frac{2x-3}{x-1}\right) < 1$$

i.e. $1 \le \frac{2x-3}{x-1} < 2$

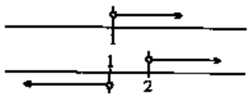
let, $\frac{2x-3}{x-1} - 2 < 0 \Rightarrow \quad \frac{2x-3-2x+2}{x-1} < 0$

$\Rightarrow \quad \frac{-1}{x-1} < 0 \quad \Rightarrow \quad \frac{1}{x-1} > 0 \Rightarrow x > 1 \quad \text{....(1)}$

and $\frac{2x-3}{x-1} \ge 1 \Rightarrow \frac{2x-3}{x-1} - 1 \ge 0$

$\Rightarrow \quad \frac{2x-3-x+1}{x-1} \ge 0 \quad \Rightarrow \quad \frac{x-2}{x-1} \ge 0 \Rightarrow x \ge 2 \text{ or } x < 1 \quad \text{....(2)}$

$\Rightarrow$



taking intersection of (1) and (2)

51) $x \ge 2$ i.e. minimum integral x is 2