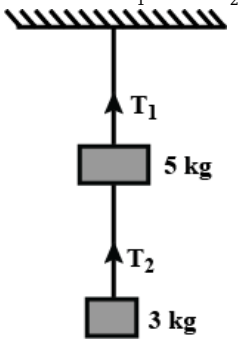
PART-1 : PHYSICS

SECTION-I

1) Two masses of 5 kg and 3 kg are suspended with the help of massless inextensible strings as shown in figure. Calculate T_1 and T_2 when whole system is going upwards with acceleration = 2 m/s^2.



(use g = 9.8 m/s^2)

(A) 86.2 N, 26.5 N

(B) 102.6 N, 42 N

(C) 94.4 N, 35.4 N

(D) 76.6 N, 29.2 N

2) The displacement of a body is given by $2s = gt^2$, where g is a constant. The velocity of the body at any time t is:

(A) 2 gt

(B) gt

(C) gt^2

(D) $\frac{gt}{2}$

3) A ball is thrown upwards at an angle of 60° to the horizontal. It falls on the ground at a distance of 90m. If the ball is thrown with the same initial velocity at an angle of 30°, it will fall on the ground at a distance of -

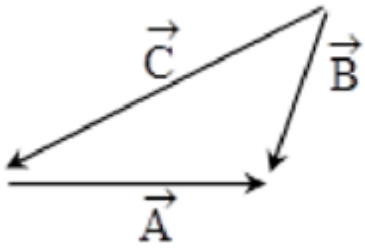
(A) 120 m

(B) 90 m

(C) 60 m

(D) 30 m

4) For the figure :-



(A) $\vec{A} + \vec{B} = \vec{C}$
(B) $\vec{B} + \vec{C} = \vec{A}$
(C) $\vec{C} + \vec{A} = \vec{B}$
(D) $\vec{A} + \vec{B} + \vec{C} = 0$

5) If the net force on a body is zero, will it definitely be at rest ?

(A) Yes
(B) Not necessary. This is possible that the body is moving with accelerating velocity
(C) Not necessary. This is possible that the body is moving with decelerating velocity
(D) Not necessary. This is possible that the body is moving with constant velocity

6) The numerical value of the ratio of displacement to distance is :-

(A) Always less than one
(B) Always equal to one
(C) Always more than one
(D) Equal to or less than one

7) If y = sin x, then $\frac{d^2y}{dx^2}$ will be :

(A) cos x
(B) sin x
(C) –sinx + C
(D) –sinx

8) If $|\vec{a}| = |\vec{b}| = \frac{1}{\sqrt{2}}$ and $|\vec{a} + \vec{b}| = 1$, then find $|\vec{a} - \vec{b}|$

(A) 1
(B) 2
(C) 3
(D) 4

9) Find out the contact force between 2kg & 3kg block placed on the incline plane as shown in

figure.

(A) 16 N

(B) 12 N

(C) 20 N

(D) 10 N

10) The displacement x of a particle varies with time t, $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will :

(A) Go on decreasing with time

(B) Be independent of α and β

(C) Drop to zero when α = β

(D) Go on increasing with time

11) The velocity of a projectile, when it is at the greatest height, is $\sqrt{\frac{2}{5}}$ times its velocity when it is at half of its greatest height. The angle of projection is

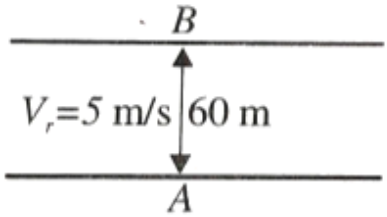
(A) 30°

(B) 45°

(C) $\tan^{-1}\frac{2}{3}$

(D) 60°

12) A man is crossing a river flowing with velocity of 5m/s. He reaches a point directly across the river at a distance of 60 m in 5 sec. His velocity in still water should be :



(A) 12 m/s

(B) 13 m/s

(C) 5 m/s

(D) 10 m/s

13) If a ball is thrown vertically upwards with speed u. The distance covered during the last t seconds of its ascent is :

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

(B) $ut - \frac{1}{2}gt^2$

(C) (u–g)t

(D) utd

14) $\int e^{(2x+3)}\,dx =$?

(A) $2e^{(2x+3)}$

(B) $\frac{e^{(2x+3)}}{2} + c$

(C) $e^{(2x+3)} + c$

(D) None

15) A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. Force P is applied at one end of rope. The force which the rope exerts on the block is

(A) $\frac{P}{(M-m)}$

(B) $\frac{P}{M(m+M)}$

(C) $\frac{PM}{(m+M)}$

(D) $\frac{PM}{(m-M)}$

16)

A particle starts with an initial velocity $(\hat{i}+\hat{j})$ m/s and changes it to $(3\hat{i}-5\hat{j})$ m/s in 2 sec. What is the magnitude of displacement of the particle in 2 s, if the acceleration is constant?

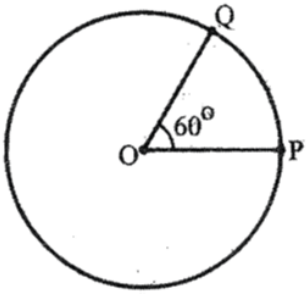
(A) $2\sqrt{2}$ m

(B) $3\sqrt{2}$ m

(C) $4\sqrt{2}$ m

(D) $\sqrt{2}$m

17) As shown in figure an ant moves from point *P* to Q along the circular track of radius 1m. If the



time taken is 1 minute, what is the average velocity of the ant ?

(A) $\frac{\pi}{40}\ ms^{-1}$

(B) $\frac{\pi}{60}\ ms^{-1}$

(C) $\frac{3\pi}{160}\ ms^{-1}$

(D) $\frac{1}{60}\ ms^{-1}$

18)

The greatest and the least resultant of two forces acting at a point are 12N and 8N respectively. Find out the forces.

(A) 12 N & 8 N

(B) 4N & 8 N

(C) 3 N & 9N

(D) 10 N & 2N

19) $\int \sqrt[5]{x}\,dx$ = ?

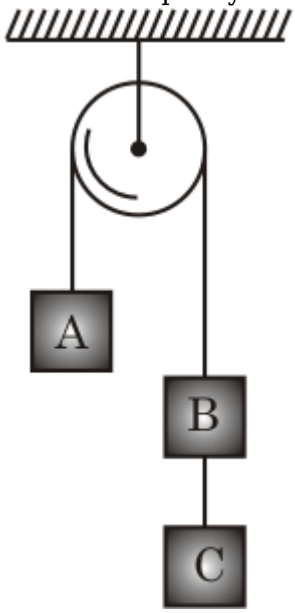
(A) $x^{6/5}$+ C

(B) $\frac{6}{5}\ x^{6/5}$

(C) $\frac{5}{6}\ x^{5/6}$

(D) $\frac{5}{6}\ x^{6/5}$ + C

20) Three equal weights A, B and C of mass 2 kg each are hanging on a string passing over a fixed frictionless pulley as shown in figure. The tension in the string connecting weights B and C is



(A) Zero

(B) 13 N

(C) 3.3 N

(D) 19.6 N

SECTION-II

1) A car is moving with 54 km/h speed at t = 0. Its brakes produces the retardation of 2.5 m/s^2. If he applies brakes at t = 0 and produces constant retardation till car stops then the displacement travelled by car in 10sec is X. Fill $\frac{X}{5}$

2) A particle is projected with some initial velocity from the ground. Its equation of trajectory is given by $y = 8x - 2x^2$. The initial angle of projection form the horizontal is $\tan^{-1}(x)$, find x.

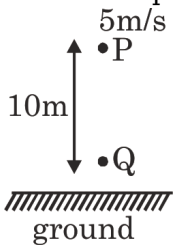
3)

Find the following integrals : $\int_1^9 \frac{dx}{\sqrt{x}}$

4) Two trains are running on parallel straight tracks in the same direction. The train, moving with the speed of 30 m/s overtakes the train ahead, which is moving with the speed of 20 m/s. If the train lengths are 40m each, then find the time elapsed during overtake.

5) Magnitude of vector A is 3 unit & vector B is 5 unit. If $|\vec{A}-\vec{B}| = 7$,Find angle between $\vec{A}$ and $\vec{B}$ in degrees.

6) A ball is thrown vertically upwards with an initial velocity of 5 m/sec from point P as shown. Q is a point 10 m vertically below the point P. Then the speed of the ball at point Q will be (in m/sec): (take



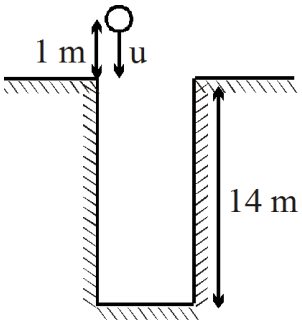
g = 10 m/s^2 and neglect air resistance)

7)

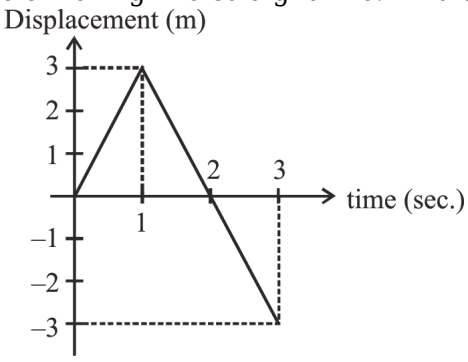
Assume that the largest stone of mass 'm' that can be moved by a flowing river depends upon the velocity of flow v, the density d and the acceleration due to gravity g. If 'm' varies as the K^{th} power of the velocity of flow, then find the value of K.

8) A boy throws a ball with speed u in a well of depth 14 m as shown. On bounce with bottom of the well the speed of the ball gets halved. What should be the minimum value of u (in m/s) such that the

ball may be able to reach his hand again? It is given that his hands are at 1 m height from top of the well while throwing and catching.



9) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average speed (in m/s) for the interval from t = 0 to t = 3 sec.



10) Find the angle (in degrees) between two vectors $\vec{A} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + \hat{j}$.

PART-2 : CHEMISTRY

SECTION-I

1)

Central atom of ICl_2^- contains

(A) 2 bond pairs, 2 lone pairs
(B) 3 bond pairs, 3 lone pairs
(C) 2 bond pairs, 3 lone pairs
(D) 3 bond pairs, 2 lone pairs

2) Which of the following is in order of increasing covalent character ?

(A) $CCl_4 < BeCl_2 < BCI_3 < LiCl$
(B) $LiCl < CCl_2 < BeCl_2 < BCl_3$
(C) $LiCl < BeCl_2 < BCl_3 < CCl_4$
(D) $LiCl < BeCl_2 < CCl_4 < BCl_3$

3) Shape of XeF_4 molecule is :-

(A) Linear

(B) Pyramidal

(C) Tetrahedral

(D) Square planar

4) Electronic conf. of an element having maximum electron affinity is.

(A) [Xe] ns^2np^5

(B) [Ar] ns^2np^5

(C) [Ne] ns^2np^5

(D) All have same EA

5)

Maximum bond angle is present in

(A) BCl_3

(B) BBr_3

(C) BF_3

(D) Same for all

6) Which of the following would result in the formation of strongest π-bond if the molecular axis is x-axis ?

(A) $2p_x + 2p_x$

(B) $2p_y + 2p_y$

(C) $2p_y + 3d_{xy}$

(D) $2p_z + 4p_z$

7)

Match the following regarding nature of the oxide :

Column-I	**Column-II**
(a) N_2O	(i) Basic
(b) BaO	(ii) Amphoteric
(c) As_2O_3	(iii) Acidic
(d) Cl_2O_7	(iv) Neutral

(A) a – (ii), (b) – (i), (c) – (iii), (d) – (iv)

(B) a – (iv), (b) – (i), (c) – (iii), (d) – (ii)

(C) a – (iv), (b) – (i), (c) – (ii), (d) – (iii)

(D) a – (ii), (b) – (i), (c) – (iv), (d) – (iii)

8) Which of the following species is paramagnetic ?

(A) NO^-

(B) O_2^{2-}

(C) CN^-

(D) CO

9) Match the items under list (1) with items under list (2) select the correct answers from the sets (A), (B),(C) and (D)-

List (1) molecule		**List (2) shape**	
(a)	PCl_5	(i)	V-shaped
(b)	F_2O	(ii)	Triangular planar
(c)	BCl_3	(iii)	Trigonal bipyramidal
(d)	NH_3	(iv)	Trigonal pyramidal
		(v)	Tetrahedral

(A) a - i, b - v, c - iv, d - iii

(B) a -ii, b -iii, c - i , d - ii

(C) a - iv , b - iii, c - ii, d - v

(D) a - iii, b - i, c - ii, d - iv

10) Which of the following molecular orbitals has two nodal planes?

(A) $\sigma 2p_x$

(B) $\pi 2p_y$

(C) $\pi * 2p_y$

(D) $\sigma^* 2p_x$

11) A chemist decided to determine the Empirical formula of an unknown compound. He collects following informations :
(i) Compound contains 2 : 1 ratio of H and O atoms (number of atoms)
(ii) Compound has 40% C by mass
(iii) Compound contains C, H and O only
What is the empirical formula of the compound –

(A) CH_3O

(B) CH_2O

(C) C_2H_2O

(D) CH_3O_2

12) From 2 mg calcium 1.2×10^{19} atoms are removed. The number of g - atoms of calcium left is (Ca = 40):

(A) 5×10^{-5}

(B) 2×10^{-5}

(C) 3×10^{-5}

(D) 5×10^{-6}

13)

If R is the Rydberg constant for hydrogen, then wave number of the first line in the Lyman series is :-

(A) 2R

(B) R/2

(C) 3R/4

(D) R/4

14) Molarity of H_2SO_4 is 18 M. Its density is 1.8 g/cm^3 , hence molality is

(A) 18

(B) 100

(C) 36

(D) 500

15) The numbers of moles of $BaCO_3$ which contain 1.5 moles of oxygen atoms is

(A) 0.5

(B) 1

(C) 3

(D) 6.02×10^{23}

16) Threshold frequency of a metal is f_0. When light of frequency $v = 2f_0$ is incident on the metal plate, maximum velocity of e^- emitted is v_1. When frequency of incident radiation is $5f_0$, maximum velocity of emitted e^- is v_2. Find ratio of v_1/v_2:

(A) 1 : 4

(B) 1 : 2

(C) 2 : 1

(D) None of these

17) The Uncertainity in the momentum of an electron is 1.0×10^{-5} kg m s^{-1}. The Uncertainity in its position will be: ($h = 6.626 \times 10^{-34}$ Js)

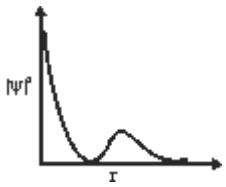
(A) 1.05×10^{-28} m

(B) 1.05×10^{-26} m

(C) 5.27×10^{-30} m

(D) 5.25×10^{-28} m

18) The graph between $|\psi|^2$ and r(radial distance) is shown below. This represents:



(A) 3s orbital
(B) 1s orbital
(C) 2p orbital
(D) 2s orbital

19) What is the total spin only magnetic moment of an atom with atomic number 7 ?

(A) $\sqrt{30}$ BM
(B) $\sqrt{3}$ BM
(C) $\sqrt{15}$ BM
(D) $2\sqrt{15}$ BM

20) Quantum number of some electrons are given below on the basis of it, arrange them from lowest to highest energy order:

	n	□	m	s
(P)	4	1	0	$\frac{1}{2}$
(Q)	5	0	0	$-\frac{1}{2}$
(R)	6	2	0	$+\frac{1}{2}$
(S)	6	3	–1	$+\frac{1}{2}$

(A) P < Q < R < S
(B) Q < R < P < S
(C) Q < R < S < P
(D) S < Q < R < P

SECTION-II

1) No. of millimoles in 0.017g of NH_3 is

2) Find the maximum value of $n + \ell + m$ for a electron present in 4d orbital

3) The number of spectral lines produced according to bohr's concept when one electron jumps from 5^{th} to 2^{nd} shell are

4) A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2. the empirical formula of hydrocarbon is C_xH_y then x + y is _____ ?

5) 100 ml of 0.3 M HCl is mixed with 200 ml of 0.6 M H_2SO_4. Calculate the final molarity of the H^+ ion in the resulting solution,

6) Mole fraction of A in H_2O is 0.2. The molality of A in H_2O is :

7) Total no of Antibonding electrons present in O_2 will be :

8) Number of molecules or ions which has/have any bond angle of 120° is
CH_3^-, $CH_3^{\oplus}$, NH_3, CO_3^{2-}, $BC\ell_3$, $PC\ell_5$

9) Among the given molecules, number of molecules having some net polarity
($\mu \neq 0$) XeF_4, SO_2, SF_4, CH_2Cl_2, NF_3, BF_3

10)

How many elements of the following have at least one unpaired electron? The element with their respective Z are given below.
15, 53, 19, 25, 84, 32, 86

PART-3 : MATHEMATICS

SECTION-I

1) $\frac{1}{3.7} + \frac{1}{7.11} + \frac{1}{11.15} + \ldots\ldots\ldots\ldots \infty$ is equal to

(A) $\frac{1}{3}$

(B) $\frac{1}{6}$

(C) $\frac{1}{9}$

(D) $\frac{1}{12}$

2) $\sqrt{3}\text{cosec}20^\circ - \sec 20^\circ =$

(A) 3

(B) 1

(C) 4

(D) 2

3) If $\sum_{r=1^\circ}^{44^\circ} \frac{\sin(1^\circ)}{\sin(r+1^\circ)\sin(r)} = \tan A^\circ - \tan B^\circ$

where A° & B° ∈ (0, 90°), then value of $\frac{1}{2B-A}$ is

(A) 1

(B) 2

(C) 3

(D) 4

4) A survey shows that 73% of the persons working in an office like coffee, whereas 65% like tea. If x denotes the percentage of them, who like both coffee and tea, then x cannot be

(A) 63

(B) 38

(C) 54

(D) 86

5)

Find the least value of n(n ∈ N) for which sum of the series $1 + 3 + 3^2 + 3^3 + \ldots$ upto n terms exceeds 9000

(A) 6

(B) 9

(C) 10

(D) 12

6) If $0 < \theta < \pi$, then minimum value of
$3\sin\theta + \text{cosec}^3\theta$ is

(A) 4

(B) 3

(C) 5

(D) 6

7) If $a_1, a_2, a_3, \ldots\ldots\ldots a_n$ are in A.P. such that
$a_n = 100$, $a_{50} - a_{49} = \frac{3}{5}$, then
15^{th} term of A.P. from end is

(A) $\frac{454}{5}$

(B) $\frac{448}{5}$

(C) $\frac{452}{5}$

(D) $\frac{458}{5}$

8)

The value of

$\cos\frac{2\pi}{15}.\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}.\cos\frac{16\pi}{15}$ is equal to

(A) $\frac{1}{16}$

(B) $\frac{1}{32}$

(C) $\frac{1}{64}$

(D) $\frac{1}{8}$

9) If $\sum_{R=1}^{N} T_R = \frac{N(N+1)(N+2)(N+3)}{12}$,

then $\sum_{R=1}^{\infty} \frac{1}{T_R}$ is equal to

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

(B) $\frac{3}{4}$

(C) 2

(D) 1

10)

Find the sum of all terms of n^{th} row of given pattern

```
                1
            3   5
        7   9   11
    13  15  17  19
    ----------------------------
----------------------------------------
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(A) n(n + 1)

(B) n^3

(C) n^2

(D) $\frac{n(n+1)(2n+1)}{6}$

11) $\frac{2}{\sqrt{2+\sqrt{2+\sqrt{2+2\cos 4x}}}}$ equals,
if $0 \le x \le \frac{\pi}{4}$

(A) $\sec\left(\frac{x}{2}\right)$

(B) sec x

(C) cosec x

(D) 1

12) If $N_1 = 5^7 + 5^7 + 5^7 + 5^7 + 5^7$ and
$N_2 = 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3 + 10^3$
then the value of $\log_{250}(N_1 N_2)$ is equal to

(A) 4

(B) 8

(C) 10

(D) 21

13) Out of the members of three athletic teams in a school 21 are in the cricket team, 26 are in the hockey team and 29 are in the football team. Among them, 14 play hockey and cricket, 15 play hockey and football and 12 play football and cricket. Eight play all the three games. The total number of members in the three athletic teams is

(A) 43

(B) 40

(C) 45

(D) 48

14) The sum of the roots of the equation,
$x^2 + |2x - 3| - 4 = 0$, is

(A) – 2

(B) $\sqrt{2}$

(C) $-\sqrt{2}$

(D) 2

15)

If $\log_2(4 + \log_3(x)) = 3$, then sum of digits of x, is

(A) 3

(B) 6

(C) 9

(D) 18

16) When f(x) is divided by x^2 –5x + 6 leaves the remainder (ax + b). If f(2) = 5 and f(3) = 8, then (a, b)

(A) (3, 1)

(B) (2, –1)

(C) (3, –1)

(D) (3, –2)

17) If $x = \sqrt[3]{7+5\sqrt{2}} - \frac{1}{\sqrt[3]{7+5\sqrt{2}}}$, then the value of $x^3 + 3x - 14$ is equal to

(A) 1

(B) 0

(C) 2

(D) 4

18) If the arcs of same length in two circles subtended angles of 60° and 75° at their centres. Then the ratio of their radii is

(A) 3 : 2

(B) 6 : 5

(C) 5 : 4

(D) None of these

19) If n^{th} term of an AP is $\frac{1}{3}(2n+1)$, then the sum of its 19 term is

(A) 131

(B) 132

(C) 133

(D) 134

20) The value of sum $\sum_{r=1}^{10}\left(2^{r-1} + 8r - 3\right)$ is equal to

(A) 1343

(B) 1234

(C) 1334

(D) 1433

SECTION-II

1)

If a_1, a_2, a_3,.....a_{21} are in A.P. and

$a_3 + a_5 + a_{11} + a_{17} + a_{19} = 10$

then the value of $\sum_{i=1}^{21} a_i$ is

2) Sum of integral values of x which satisfy inequality

$\frac{\left(x^2-x\right)^2\left(x^2-5x+6\right)}{(x-1)(x-2)} \leqslant 0$ is

3) If a + b = 5 and ab = 3, then value of
$(a^3 + b^3) - 4(a^2 + b^2)$ is

4) $\sin^2 5° + \sin^2 10° + \sin^2 15° + \ldots\ldots + \sin^2 90° =$

5) In a triangle ABC, tanA : tanB : tanC is 1 : 2 : 1, then value of tanAtanC + tanBtanC + tanAtanB is

6) If $3\sin\alpha = 5\sin\beta$, then $\frac{1}{10}\left(\frac{\tan\left(\frac{\alpha+\beta}{2}\right)}{\tan\left(\frac{\alpha-\beta}{2}\right)}\right)$ is equal to

7) For a, b, c $\in$ R – {0} if $a^2 + b^2 + c^2 = ab + bc + ac$ then the value of $\frac{b+c}{a} + \frac{a+c}{b} + \frac{a+b}{c}$ is λ.
Find $\frac{\lambda}{5}$

8) If the complete solution set of the inequality
$(\log_{10} x)^2 \geq \log_{10} x + 2$ is $(0, a] \cup [b, \infty)$
then find the value of ab.

9) Let a,b are two positive integers and their arithmetic mean is A, G.M is G such that $2A + G^2 = 27$,
then integral value of $\frac{(a^2+b^2)}{85}$ is

10) Let X be the set consisting of the first 2018 terms of the arithmetic progression 1, 6, 11, ... ,
and Y be the set consisting of the first 2018 terms of the arithmetic progression 9, 16, 23, ... Then,
the number of elements in the set X ∪ Y is _____

ANSWER KEYS

PART-1 : PHYSICS

SECTION-I

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	C	B	B	C	D	D	D	A	B	D	D	B	A	B	C	C	D	D	D	B

SECTION-II

Q.	21	22	23	24	25	26	27	28	29	30
A.	9.00	8.00	4.00	8.00	120.00	15.00	6.00	30.00	3.00	30.00

PART-2 : CHEMISTRY

SECTION-I

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	C	C	D	C	D	B	C	A	D	C	B	C	C	D	A	B	C	D	C	A

SECTION-II

Q.	51	52	53	54	55	56	57	58	59	60
A.	1.00	8.00	6.00	15.00	0.90	13.88	6.00	4.00	4.00	6.00

PART-3 : MATHEMATICS

SECTION-I

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	D	C	A	D	B	A	D	A	B	B	A	A	A	B	C	C	B	C	C	D

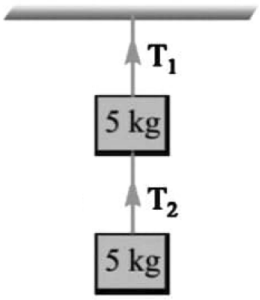
SECTION-II

Q.	81	82	83	84	85	86	87	88	89	90
A.	42.00	2.00	4.00	9.50	10.00	0.40	1.20	10.00	2.00	3748.00

SOLUTIONS

PART-1 : PHYSICS

1) Given, $m_1 = 5$ kg
$m_2 = 3$ kg
$g = 9.8\ m/s^2$
and $a = 2\ m/s^2$ (upwards)



Tension in the upper string
$T_2 = (m_1 + m_2)(g + a)$
$= (5 + 3)(9.8 + 2)$
$= 8 \times 11.8N$
$= 94.4$ N
Tension in the lower string
$T_2 = m_2(g + a)$
$= 3(9.8 + 2)N$
$= 3 \times 11.8$ N
$= 35.4$ N

2) $S = \frac{1}{2}gt^2$ $v = gt$

3) For angles of projection
θ and $(90 - \theta)$, range is same.

4)

Use triangle law of vector addition.
$\vec{A}$ is placed on tail of $\vec{C}$
$\Rightarrow \vec{A} + \vec{C} = \vec{B}$

5)

$\vec{F}_{net} = 0 \Rightarrow$ rest or moving with uniform vel

6)

Displacement can be equal to or less than distance. Hence, their ratio can be equal to or less than one.

7)

$y = \sin x$

$\frac{dy}{dx} = \cos x$

$\frac{d^2y}{dx^2} = -\sin x$

8)

$\left|\vec{a}-\vec{b}\right|^2 = a^2 + b^2 - 2ab\cos\theta$ & $\left|\vec{a}+\vec{b}\right|^2 = a^2 + b^2 + 2ab\cos\theta$

$\Rightarrow \left|\vec{a}-\vec{b}\right|^2 + \left|\vec{a}+\vec{b}\right|^2 = 2\left(a^2+b^2\right)$

$\left|\vec{a}-\vec{b}\right|^2 + 1 = 2$

$\Rightarrow \left|\vec{a}-\vec{b}\right| = 1$

10)

Acceleration = $a\,\alpha^2\,t^2\,e^{-\alpha t} + b\,\beta^2\,t^2\,e^{\beta t} > 0$
So, velocity increases with time

11)

At maximum height $v_1 = v\cos\theta$

At half of maximum height $v_2 = \sqrt{v^2\cos^2\theta + (v_y)^2}$

For $v_{vertical}$ $v_y^2 = v^2\sin^2\theta - 2g\frac{H}{2} = v^2\sin^2\theta - g\frac{v^2\sin^2\theta}{2g} = \frac{v^2\sin^2\theta}{2}$

$\frac{v_1}{v_2} - \sqrt{\frac{2}{5}} \Rightarrow \tan\theta = \sqrt{3}, \theta = 60^\circ$

12) His velocity in x direction should counter the flow so as to reach the point across, i.e. v_x= 5 m/s
Velocity in y should be such that he reaches 60 m in 5 second, i.e. v_y=12 m/s
Thus total velocity, $v = \sqrt{v_x^2 + v_y^2} = 13\text{m/s}$

13)

NCERT XI, Pg. 19
The distance covered by the ball during the last t seconds of its upward motion = distance covered by it in first t seconds of its downward motion.

$h = ut + \frac{1}{2}gt^2$, [u = 0 for downward motion]

$h = \frac{1}{2}gt^2$

14)

$$\int e^{(2x+3)}dx = \frac{e^{(2x+3)}}{2} + C$$

16) $\bar{u} = \hat{i} + \hat{j}$

$\bar{v} = 3\hat{i} - 5\hat{j}$

$t = 2$ sec.

$3\hat{i} - 5\hat{j} = \hat{i} + \hat{j} + \bar{a}\ (2)$

$\frac{2\hat{i} - 6\hat{j}}{2} = \bar{a}$

$\bar{a} = \hat{i} - 3\hat{j}$

$\bar{s} = \bar{u} + \frac{1}{2}\bar{a}t^2$

$= (\hat{i} + \hat{j}) \times 2 + \frac{1}{2}(\hat{i} - 3\hat{j})\ (4)$

$= 2\hat{i} + 2\hat{j} + (\hat{i} - 3\hat{j}) \times 2$

$= \rightarrow 2\hat{i} + 2\hat{j} + \rightarrow 2\hat{i} - 6\hat{j}$

$= 4\hat{i} - 4\hat{j}$

$|\bar{s}| = 4\sqrt{2}$

17)

Total displacement = $1m$

Total time taken = 60 sec

V_{avg} = total displacement / total time

$= \frac{1}{60}$ *m/sec*

18) $(F_{net})_{max} = F_1 + F_2 = 12$ N

$(F_{net})_{max} = F_1 - F_2 = 8$N

on solving ; $F_1 = 10$ N and $F_2 = 2$N

19) You need to indefinite integration of $x^{1/5}$

20)

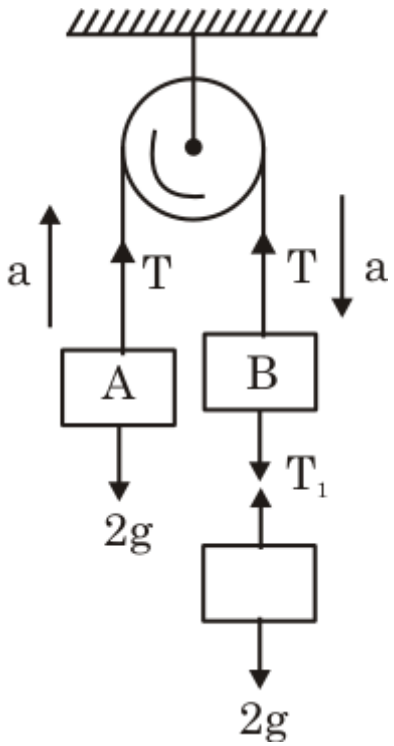
For A : $T - 2g = 2a$ ...(i)

For B : $T_1 - 2g - T = 2a$ ...(ii)

For C : $2g - T_1 = 2a$ ....(iii)

Adding equations (i) and (ii), we get

$T_1 = 4a$ ...(iv)



From equations (iii) and (iv), we get

$2g - 4a = 2a$

or $a = g/3$ ...(v)

From equations (iv) and (v), we get

$$T_1 = 4 \times \frac{g}{3} = 13\,N$$

21)

54 km/h = 15m/s

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

$0 = (15)^2 + 2(-2.5)s$

$$= s = \frac{15^2}{5} = 45m$$

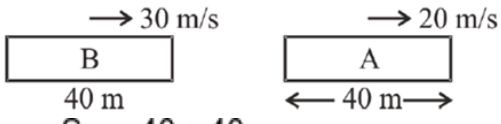
car will stop in 6 sec.

22)

by comparing with the equation of trajectory of projectile motion.

23)

24)



$$t = \frac{S}{V_{x1}} = \frac{40+40}{30-20}$$

$$t = \frac{80}{10} = 8 \text{ sec}$$

25)

$|A| = 3, \ |B| = 5$

$|\vec{A} - \vec{B}| = \sqrt{3^2 + 5^2 + 2.3.5\cos(180 - \theta)}$

$49 = 9 + 25 - 30\cos\theta \Rightarrow \cos\theta = \frac{-1}{2}$

$\Rightarrow \theta = 120°$

26)

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

$v^2 = (5)^2 + 2 \times 10 \times 10$

$v^2 = 25 + 200 \Rightarrow 225$

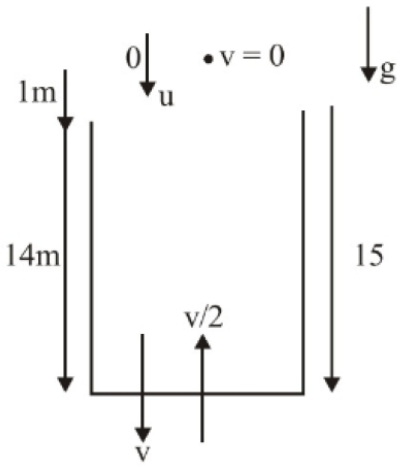
$v = 15$ m/sec

27) $m \propto v^x d^y g^z$

$[M] = [LT^{-1}]^x [ML^{-3}]^y [LT^{-2}]^z$

$\Rightarrow x = 6$ (value of k)

28)



$\left(\frac{V}{2}\right)^2 = (2 \times 15 \times 10)$

$\frac{V^2}{4} = 300$

$V = \sqrt{1200}$

$V^2 = u^2 + 2ax$

$1200 = u^2 + (2 \times 10 \times 15)$

$u = 30$ m/s

29)

$\text{Average speed} = \frac{\text{distance}}{\text{time}}$

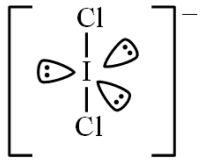
$= \frac{3 + 3 + 3}{3} = 3$ m/s

30)

$\cos\theta = \frac{\bar{A}.\bar{B}}{AB} = \frac{2\times 1}{\sqrt{6}\times\sqrt{2}} = \frac{3}{\sqrt{6}\sqrt{2}} = \frac{\sqrt{3}}{2}$

$\therefore \theta = 30^{\circ}$.

PART-2 : CHEMISTRY

31) 

2 bond pairs and 3 lone pairs

35) No lone pair on central atom

36)

2pπ – 2pπ bond in the strongest π-bond.

37) $\begin{cases} N_2O = \text{Neutral oxide} \\ BaO = \text{Basic oxide} \\ As_2O_3 = \text{Amphoteric oxide} \\ Cl_2O_7 = \text{Acidic oxide} \end{cases}$

41)

C	H	O
40%	x%	60 – x%
$\frac{40}{12}$	$\frac{x}{1}$	$\frac{60-x}{16}$

Given : $x : \frac{60-x}{16} = 2 : 1$

$\frac{x}{\frac{60-x}{16}} = \frac{2}{1}$

$16x = 120 - 2x$

$x = \frac{120}{18} = \frac{20}{3}$

So, C	H	O
1	2	1

42) 2 mg Calcium moles = $2 \times 10^{-3}/40 = 5 \times 10^{-5}$

1 mole = 6.022×10^{23} atoms

$x = 1.2 \times 10^{19}/6.022 \times 10^{23}$

= 1.99×10^{-5} moles removed

 Remaining moles = $5 \times 10^{-5} - 1.99 \times 10^{-5}$

= 3.00×10^{-5} moles

1 g atom = 1 mole

43) Given : Energy level (n) = 2,

We know that wave number in Lyman series

$$= R\left[\frac{1}{(1)^2} - \frac{1}{(n)^2}\right] = R\left[\frac{1}{(1)^2} - \frac{1}{(2)^2}\right] = R \times \frac{3}{4} = \frac{3R}{4}$$

44)

Molarity of H_2SO_4 = 18M

 1000 ml solution has 18 mole H_2SO_4

= 18 × 98 gm H_2SO_4

= 1764 gm H_2SO_4

1000 mL solution weighs 1800 gm (d = 1.8 gm/mL)

Mass of water =1800 gm – 1764 gm H_2SO_4

= 36 gm H_2O

$$\text{m} = 18 \times \frac{1000}{36} = 500$$

$$\because \left(\text{m} = \frac{\text{mole of } H_2SO_4}{\text{Solvent (in Kg)}}\right)$$

47)

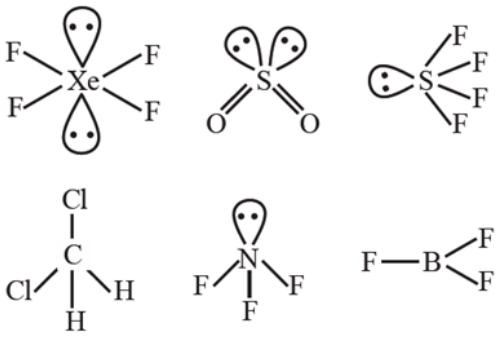
$$\Delta p.\ \Delta x = \frac{h}{4\pi}$$

$$\Rightarrow \Delta x = \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 1 \times 10^{-5}} = 5.27 \times 10^{-30}\ \text{m}.$$

50)

Use (n +) rule

59)



Polar molecules : SO_2, SF_4, CH_2Cl_2, NF_3.

PART-3 : MATHEMATICS

61)

$$\frac{1}{4}\left[\frac{4}{3.7}+\frac{4}{4.11}+\frac{4}{11.15}+\ldots\ldots\ldots\right]$$
$$=\frac{1}{4}\left[\frac{7-3}{3.7}+\frac{11-7}{7.11}+\frac{15-11}{11.15}+\ldots\ldots\ldots\right]$$
$$=\frac{1}{4}\left[\frac{1}{3}-\frac{1}{7}+\frac{1}{7}-\frac{1}{11}+\frac{1}{11}-\frac{1}{15}+\ldots\ldots\ldots\right]$$
$$=\frac{1}{4}\times\frac{1}{3}=\frac{1}{12}$$

62)

$$\text{L. H. S.}=S=\frac{\sqrt{3}}{\sin 20^\circ}-\frac{1}{\cos 20^\circ}=\frac{\sqrt{3}\cos 20^\circ-\sin 20^\circ}{\sin 20^\circ.\cos 20^\circ}$$
$$=\frac{4\left(\frac{\sqrt{3}}{2}\cos 20^\circ-\frac{1}{2}\sin 20^\circ\right)}{2\sin 20^\circ\cos 20^\circ}=\frac{4(\sin 60.\cos 20^\circ-\cos 60^\circ.\sin 20^\circ)}{\sin 40^\circ}$$
$$=4\frac{\sin(60^\circ-20^\circ)}{\sin 40^\circ}=4.\frac{\sin 40^\circ}{\sin 40^\circ}=4=\text{R.H.S.}$$

63)

$$\sum_{r=1^\circ}^{44^\circ}\frac{\sin[(r+1^\circ)-(r)]}{\sin(r+1^\circ).\sin(r)}$$
$$=\sum_{r=1^\circ}^{44^\circ}\frac{\sin(r+1^\circ)\cos(r)-\cos(r+1^\circ)\sin(r)}{\sin(r+1^\circ).\sin(r)}$$
$$=\sum_{r=1^\circ}^{44^\circ}\frac{\sin(r+1^\circ)\cos(r)}{\sin(r+1^\circ).\sin(r)}-\frac{\cos(r+1^\circ)\sin(r)}{\sin(r+1^\circ)\sin(r)}$$
$$=\sum_{r=1^\circ}[\cot(r)-\cot(r+1^\circ)]$$

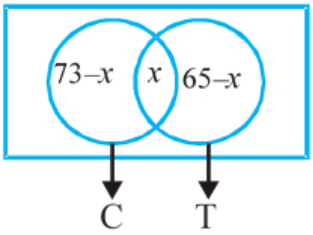
$$= \begin{bmatrix} \cot(1^\circ) - \cot(2^\circ) \\ \cot(2^\circ) - \cot(3^\circ) \\ \cot(3^\circ) - \cot(4^\circ) \\ \vdots \\ \cot(44^\circ) - \cot(45^\circ) \end{bmatrix}$$

$= \cot(1^\circ) - \cot(45^\circ)$

$= \tan(89^\circ) - \tan(45^\circ)$

$\therefore A = 89^\circ \ \& \ B = 45^\circ$

64)



C → person like coffee
T → person like Tea
n(C) = 73
n(T) = 65
$n(C \cup T) \leq 100$
$n(C) + n(T) - n(C \cap T) \leq 100$
$73 + 65 - x \leq 100$
$x \geq 38$ ...(i)
$73 - x \geq 0 \Rightarrow x \leq 73$ ...(ii)
$65 - x \geq 0 \Rightarrow x \leq 65$ ...(iii)
(i) ∩ (ii) ∩ (iii) = $(38 \leq x \leq 65)$

65) $S_n = 1 + 3 + 3^2 + \ldots\ldots + n$ term

$$S_n = \frac{1(3^n - 1)}{3 - 1} > 9000$$

$3^n - 1 > 18000$
$3^n > 18001$
$n \geq 9$
Least value of n = 9

66)

Using A.M. ≥ G.M.

$$\frac{\sin\theta + \sin\theta + \sin\theta + \cos\sec^3\theta}{4} \geqslant (\sin^3\theta . \cos ec^3\theta)^{1/4}$$

Hence, minimum value of 3 sinq + $\text{cosec}^3\theta$ is 4.

Using A.M. ≥ G.M.

$$\frac{\sin\theta + \sin\theta + \sin\theta + \cos\sec^3\theta}{4} \geqslant (\sin^3\theta . \cos ec^3\theta)^{1/4}$$

Hence, minimum value of 3 sinq + $\text{cosec}^3\theta$ is 4.

67)

$a_{50} - a_{49} = \frac{3}{5} = d$

& $T_{15} = a_n - 14d = 100 - 14 \times \frac{3}{5} = \frac{458}{5}$

68) ALITER : Use,

$\cos A \cos 2A \cos 2^2 A \ldots \cos 2^{n-1} A = \frac{\sin 2^n A}{2^n \sin A}$

$\square \quad \cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}\cos\frac{16\pi}{15} = \frac{\sin 2^4.\frac{\pi}{15}}{2^4 \sin\frac{\pi}{15}} = \frac{1}{16}$

69)

$$S_N = \sum_{R=1}^{N} T_R = \frac{N(N+1)(N+2)(N+3)}{12}$$

$$T_N = S_N - S_{N-1} = \frac{N(N+1)(N+2)}{3}$$

$$\Rightarrow \sum_{R=1}^{\infty} \frac{3}{N(N+1)(N+2)} = \frac{3}{2}\sum_{R=1}^{\infty}\left[\frac{1}{N(N+1)} - \frac{1}{(N+1)(N+2)}\right] = \frac{3}{4}$$

Let T_n be the first term of n^{th} group and

$S = 1 + 3 + 7 + \ldots\ldots + T_n$

$S = \quad 1 + 3 + \ldots\ldots + \ldots\ldots + T_n$

---

70) Sub. $T_n = n^2 - n + 1$

So sum of n^{th} group is

$$s_n = \frac{n}{2}\left[2 \times T_n + (n-1)2\right] = n^3$$

71)

$$\sqrt{2 + \sqrt{2 + \sqrt{2 + 2\cos 4x}}}$$

$$= \sqrt{2 + \sqrt{2 + \sqrt{2 + 2\cos^2\left(\frac{x}{2}\right)}}}$$

$$= \sqrt{2 + \sqrt{2 + 2\cos 2x}} = \sqrt{2 + 2\cos^2\left(\frac{x}{2}\right)}$$

$$= 2\cos\left(\frac{x}{2}\right)$$

74) $x^2 + |2x - 5| - 4 = 0$

Case-1

$x \geq \frac{3}{2}$

$x^2 + 2x - 7 = 0$

$x = \frac{-2 \pm \sqrt{4+28}}{2}$

$x = \frac{-2 \pm 4\sqrt{2}}{2}$

$x = -1 + 2\sqrt{2}, -1 - 2\sqrt{2}$ reject

Case-2

$x < \frac{3}{2}$

$x^2 - 2x - 1 = 0$

$x = \frac{2 \pm \sqrt{4+4}}{2}$

$x = 1 \pm \sqrt{2}$

$x = 1 + \sqrt{2}$ reject

$x = 1 - \sqrt{2}$

sum $= -1 + 2\sqrt{2} + 1 - \sqrt{2} = \sqrt{2}$

77)

$$x = \left(7 + 5\sqrt{2}\right)^{1/3} + \left(7 - 5\sqrt{2}\right)^{1/3}$$

$$\Rightarrow x^3 = \left[\left(7 + 5\sqrt{2}\right)^{1/3}\right]^3 + \left[\left(7 - 5\sqrt{2}\right)^{1/3}\right]^3 + 3\left(7 + 5\sqrt{2}\right)^{1/3}\left(7 - 5\sqrt{2}\right)^{1/3}[x]$$

$\Rightarrow x^3 = 14 - 3(x)$

$\Rightarrow x^3 + 3x - 14 = 0$

78) Let r_1 and r_2 be the radii of the given circles and let their arcs of same length s subtend angles of 60° and 75° at their centres.

Now, $60^\circ = \left(60 \times \frac{\pi}{180}\right)^c = \left(\frac{\pi}{3}\right)^R$ and

$75^\circ = \left(75 \times \frac{\pi}{180}\right)^R = \left(\frac{5\pi}{12}\right)^R$

$\therefore \frac{\pi}{3} = \frac{s}{r_1}$ and $\frac{5\pi}{12} = \frac{s}{r_2} \Rightarrow \frac{\pi}{3} r_1 = s$

and $\frac{5\pi}{12} r_2 = s \Rightarrow \frac{\pi}{3} r_1 = \frac{5\pi}{12} r_2$

$\Rightarrow 4r_1 = 5r_2 \Rightarrow r_1 : r_2 = 5 : 4$

Hence, $r_1 : r_2 = 5 : 4$

79)

$T_n = \frac{1}{3}(2n + 1)$

$T_1 = 1, T_2 = \frac{5}{3}$

$d = \frac{5}{3} - 1 - \frac{2}{3}$

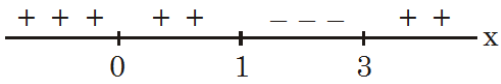
$S_{19} = \frac{19}{2}\left[2 + \frac{18.2}{3}\right] = 133$

80) $\sum_{r=1}^{10}\left(2^{r-1} + 8r - 3\right) = \sum_{r=1}^{10} 2^{r-1} + \sum_{r=1}^{10} 8r - 3 = \frac{2^{10}-1}{2-1} + \frac{10}{2}(5+77)$
= 1024 – 1 + 410 = 1433.

81) $a_1 + 2 + a_1 + 4d + a_1 + 10d + a_1 + 16d + a_1 + 18d = 5a_1 + 50d$
$= 5(a_1 + 10d) = 10$
i.e. $a_1 + 10d = 2$
Now, $\sum_{i=1}^{21} a_i = \frac{21}{2}[2a_1 + 20d] = 21(a_1 + 10d) = 42$

82)

$x^2(x-1)(x-3) \le 0$, where $x \neq 1, 2$



$x \in \{0\} \cup (1,3] \sim \{2\}$

83)

$a^2 + b^2 = (a+b)^2 - 2ab = 19$

$a^3 + b^3 = (a+b)(a^2 + b^2 - ab) = 80$
$\Rightarrow (a^3 + b^3) - (a^2 + b^2) = 4$

84) $\sin^2 5º + \sin^2 10º + \sin^2 15º + \_\_\_\_\_ + \sin^2 90º$
$(\sin^2 5 + \sin^2 85) + (\sin^2 10º + \sin^2 80º) + (\sin^2 15º + \sin^2 75º)$
$+ \_\_\_\_\_ \sin^2 45º + \_\_\_\_\_ \sin^2 90º$
= 9.5

85)

$\tan A + \tan B + \tan C = \tan A \tan B \tan C$
$k + 2k + k = k \cdot 2k \cdot k$
$4k = 2k^3 \Rightarrow k = \sqrt{2}$
$\tan A = \tan C = \sqrt{2}$ & $\tan B = 2\sqrt{2}$
$\tan A \tan C + \tan B \tan C + \tan A \tan B$
$= \left(\sqrt{2}\right)^2 + 2\sqrt{2} \cdot \sqrt{2} + \sqrt{2} \cdot 2\sqrt{2}$
= 2 + 4 + 4 = 10

86)

$$\frac{\sin\alpha}{\sin\beta}=\frac{5}{3}$$

Applying componendo & dividendo,

$$\frac{\sin\alpha+\sin\beta}{\sin\alpha-\sin\beta}=\frac{5+3}{5-3}=4$$

$$\frac{1}{10}\left(\frac{\tan\left(\frac{\alpha+\beta}{2}\right)}{\tan\left(\frac{\alpha-\beta}{2}\right)}\right)=0.40$$

87) $a^2 + b^2 + c^2 = ab + bc + ac$

Multiply by 2 on both side

$2a^2 + 2b^2 + 2c^2 = 2ab + 2bc + 2ac$

$(a^2 + b^2 - 2ab) + (b^2 + c^2 - 2bc) + (a^2 + c^2 - 2ac) = 0$

$(a - b)^2 + (b - c)^2 + (c - a)^2 = 0$

$\Rightarrow a-b=0,\ b-c=0,\ c-a=0$

$\Rightarrow a=b=c \Rightarrow \frac{b+c}{a}+\frac{a+c}{b}+\frac{a+b}{c}=6$

88)

$(\log x)^2 - \log x - 2 \geq 0$

$x > 0$ ...(i)

$(\log x - 2)(\log x + 1) \geq 0$

$\Rightarrow \log x \leq -1$ or $\log x \geq 2$

$\Rightarrow x \leq \frac{1}{10}$ or $x \geq 100$ ...(ii)

From (i) $\cap$ (ii)

$\Rightarrow x \in \left(0, \frac{1}{10}\right] \cup [100, \infty)$.

89)

$A=\frac{(a+b)}{2}$; $G=\sqrt{ab}$

$a + b + ab = 27$

$b(1 + a) = 28 - (1 + a)$

$b=\frac{28}{(1+a)}-1$

$1 + a = 2$

$\Rightarrow a = 1, b = 13$

90)

X : 1, 6, 11, ..., 10086

Y : 9, 16, 23, ..., 14128

X $\cap$ Y : 16, 51, 86, ...

Let $m = n(X \cap Y)$

$\therefore 16 + (m - 1) \times 35 \leq 10086$

$\Rightarrow m \leq 288.71$

$\Rightarrow m = 288$

$\therefore n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

= 2018 + 2018 – 288 = 3748