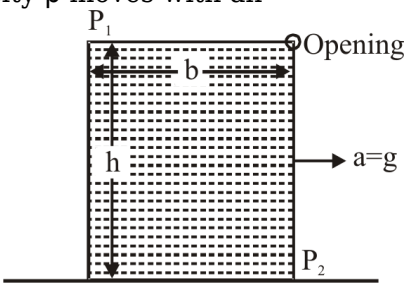
PART-1 : PHYSICS

SECTION-I

1) A wire suspended vertically from one of its ends is stretched by attaching a weight of 200 N to the lower ends. The weight stretches the wire by 1mm. Then the elastic energy stored in the wire is-

(A) 0.2 J
(B) 10 J
(C) 20 J
(D) 0.1 J

2) A closed rectangular vessel completely filled with a liquid of density ρ moves with an acceleration a = g. The value of the pressure difference ($P_1 - P_2$) is :

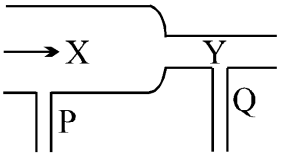


(A) ρgb
(B) $\frac{\rho g(b+h)}{2}$
(C) ρ(ab – gh)
(D) ρgh

3) When an air bubble rises from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble :-

(A) is greater than the pressure outside it
(B) is less than the pressure outside it
(C) increases as the bubble moves up
(D) remains same as the bubble moves up

4) A steady flow of water passes along a horizontal tube from a wide section X to the narrower section Y, see figure. Manometers are placed at P and Q at the sections. Which of the statements A, B, C, D, is most correct?



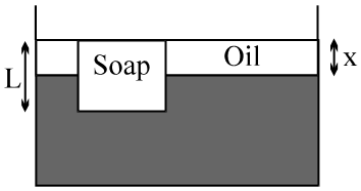
(A) water velocity at X is greater than at Y

(B) the manometer at P shows lower pressure than at Q

(C) kinetic energy per m^3 of water at X = kinetic energy per m^3at Y

(D) the manometer at P shows greater pressure than at Q

5) A rectangular bar of soap has density 800 kg/m^3 floats in water of density 1000 kg/m^3. Oil of density 300 kg/m^3 is slowly added, forming a layer that does not mix with the water. When the top surface of the oil is at the some level as the top surface of the soap. What is the ratio of the oil layer thickness to the soap's thickness, x/L ?



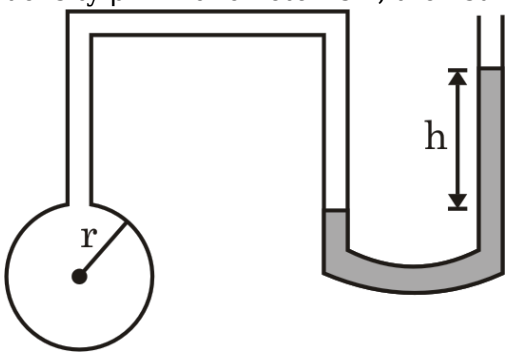
(A) $\frac{2}{10}$

(B) $\frac{2}{7}$

(C) $\frac{3}{10}$

(D) $\frac{3}{8}$

6) If the radius of the Soap-bubble on one side of tube is r and difference in height of liquid of density ρ in manometer is h, then surface tension of liquid used to make the bubble is :



(A) T = 2rρhg

(B) $T = \frac{rh\rho g}{4}$

(C) $T = \frac{2\pi rh\rho g}{2}$

(D) $T = \frac{rh\rho g}{2}$

7) Two capillary tubes of same diameter are put vertically one each in two liquids whose relative densities are 0.8 and 0.6 and surface tensions are 60 dyne/cm and 50 dyne/cm respectively and both have same angle of contact. Ratio of heights of liquids in the two tubes is $\frac{h_1}{h_2}$:–

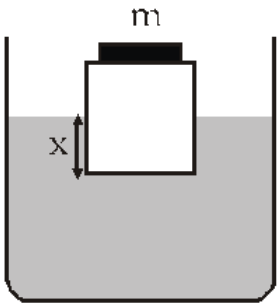
(A) $\frac{10}{9}$

(B) $\frac{3}{10}$

(C) $\frac{10}{3}$

(D) $\frac{9}{10}$

8) A cubical block (a × a × a), with a coin of mass 'm' over it is floating over a liquid of density ρ. In this case x_1 depth of the block is immersed. Now the coin is removed & it is found that x_2 depth is



immersed in liquid. Value of $(x_1 - x_2)$ is :-

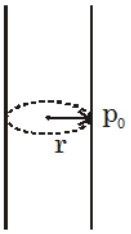
(A) $\frac{m}{\rho a^2}$

(B) $\frac{\rho a^4}{m}$

(C) $\frac{m}{2\rho a^2}$

(D) data insufficient

9) A cylindrical stream of water is falling in air. If radius of cylinder is r, atmospheric pressure is p0



and surface tension is S, pressure inside cylinder is

(A) $p_0 + \frac{2s}{r}$

(B) $p_0 + \frac{4s}{r}$

(C) $p_0 + \frac{s}{r}$

(D) $p_0 + \frac{3s}{r}$

10) In a steel factory it is found that to maintain M kg of iron in the molten state at its melting point an input power P watt is required. When the power source is turned off, the sample completely solidifies in time t second. The latent heat of fusion of iron is

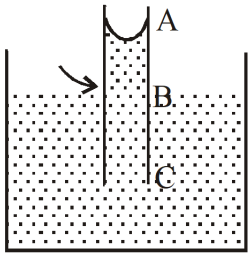
(A) 2 Pt / M

(B) Pt / 2M

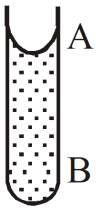
(C) Pt / M

(D) PM / t

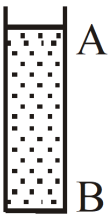
11) A glass capillary tube open at both ends is dipped in water, we can see that the water first rises in the tube and finally remains at rest at certain height as shown in figure. If this capillary tube is cut from B then the diagram of part AB is :- (B is the point where water level intersects the tube)



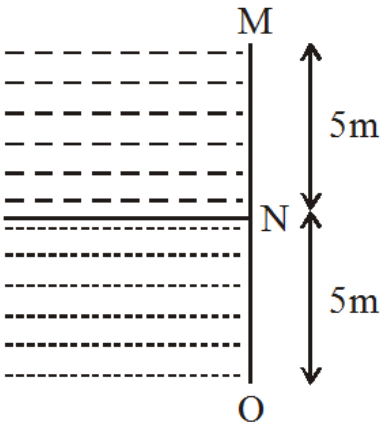
(A)


(B)


(C)


(D)


12) Two liquids of densities ρ_1 an ρ_2 ($\rho_2 = 2\rho_1$) are filled up behind a square wall of side 10 m as shown in figure. Each liquid has a height of 5 m. The ratio of the forces due to these liquids exerted on upper part MN to that at the lower part NO is (Assume that the liquids are not mixing)



(A) 1/4

(B) 2/3

(C) 1/3

(D) 1/2

13) A ball falling in a lake of depth 200 m shows 0.1% decrease in its volume at the bottom. What is the bulk modulus of the material of the ball :– Hint : [P = ρgh]

(A) 19.6×10^{8} N/m^2

(B) 19.6×10^{-10} N/m^2

(C) 19.6×10^{10} N/m^2

(D) 19.6×10^{-8} N/m^2

14) A steel plate of face-area 4 cm^2 and thickness 0.5 cm is fixed rigidly at the lower surface. A force of 9.6 N is applied parallel to the upper surface. Find the lateral displacement of the upper surface. Rigidity modulus of steel = 8×10^{10} N/m^2.

(A) 1.5×10^{-9} m

(B) 1.5×10^{-8} m

(C) 1.5×10^{-10} m

(D) 1.5×10^{-7} m

15) An unknown metal of mass 192 g heated to a temperature of 100°C was immersed into a brass calorimeter of mass 128g containing 240 g of water at a temperature of 8.4ºC. Calculate the specific heat of the unknown metal if water temperature stabilizes at 21.5°C. (Specific heat of brass is 394 J kg^{-1} K^{-1})

(A) 916 J kg^{-1} K^{-1}

(B) 1232 J kg^{-1} K^{-1}

(C) 654 J kg^{-1} K^{-1}

(D) 458 J kg^{-1} K^{-1}

16) The coefficient of apparent expansion of a liquid in a copper vessel is C and in a silver vessel is S. The coefficient of volume expansion of copper is γ_c. What is the coefficient of linear expansion of silver?

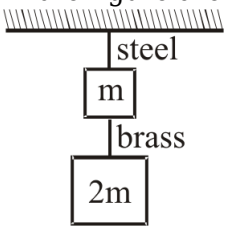
(A) $\frac{(C+\gamma_c+S)}{3}$

(B) $\frac{(C-\gamma_c+S)}{3}$

(C) $\frac{(C+\gamma_c-S)}{3}$

(D) $\frac{(C-\gamma_c-S)}{3}$

17) If the ratio of lengths, radii and Young's moduli of steel and brass wires in the figure are a,b and c respectively, then the corresponding ratio of increase in their lengths is :-



(A) $2a^2c/b$

(B) $3a/2b^2c$

(C) $2ac/b^2$

(D) $3c/2ab^2$

18) An excess uniform pressure P_0 is exerted on all sides of a solid cube. It is heated through $\Delta t°$ in order to bring its volume back to the value it had before the application of pressure. If coefficient of linear expansion of material of cube is α and bulk modulus is B then :

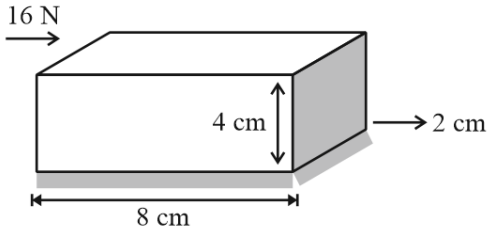
(A) $\Delta t = \frac{P_0}{B \cdot 3\alpha}$

(B) $\Delta t = \frac{P_0}{3\alpha}$

(C) $\Delta t = \frac{P_0}{6B \cdot \alpha}$

(D) $\Delta t = \frac{P_0}{B\alpha}$

19) A rubber eraser of dimensions 2 cm × 4 cm × 8 cm is fixed to the horizontal surface at its bottom surface with 4 cm edge vertical. A horizontal force of 16 N is applied at the top face. Then the shear strain developed is (The shear modulus of rubber = 1.5×10^5 N/m^2)



(A) $\frac{2}{15}$

(B) $\frac{1}{15}$

(C) $\frac{1}{5}$

(D) $\frac{2}{5}$

20) A thin steel ring of inner radius r and cross-sectional area A is fitted on to a wooden disc of radius R (R > r). If Young's modulus be Y, then the tension in the steel ring is

(A) $AY\left(\frac{R}{r}\right)$

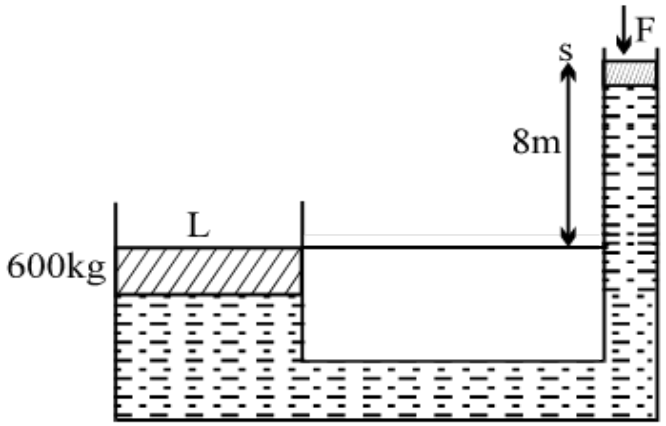
(B) $AY\left(\frac{R-r}{r}\right)$

(C) $\frac{Y}{A}\left(\frac{R-r}{r}\right)$

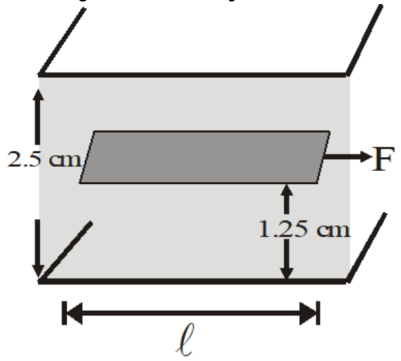
(D) $\frac{Yr}{AR}$

SECTION-II

1) For the system shown in the figure, the cylinder on the left at L has a mass of 600 kg and a cross sectional area of 800 cm^2. The piston on the right, at S, has cross sectional area 25 cm^2 and negligible weight. If the apparatus is filled with oil. (ρ = 0.75 gm/cm^3)
Find the force (in newton) F required to hold the system in equilibrium.

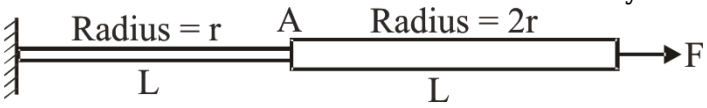


2) A space 2.5 cm wide between two large plane surfaces is filled with oil. Force required to drag a very thin plate of area 0.5 m^2 just midway the surfaces at a speed of 0.5 m/s is 1N. The coefficient of viscosity in kg/sec m is:



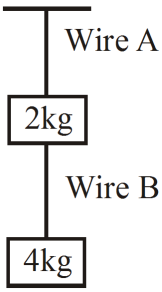
3) A vessel contains oil (density = 0.8 gm/cm^3) over mercury (density = 13.6 gm/cm^3). A homogeneous sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of the sphere in gm/cm^3 is :

4) Two steel wires of same length but radii r and 2r are connected together end to end and tied to a wall as shown. The force stretches the combination by 10 mm. How far (in mm) does the midpoint A move?



5)

Two wires of same cross-section area are suspended as shown in figure. Then ratio of stress produced in wire A to wire B is x. The value of x is :-



PART-2 : CHEMISTRY

SECTION-I

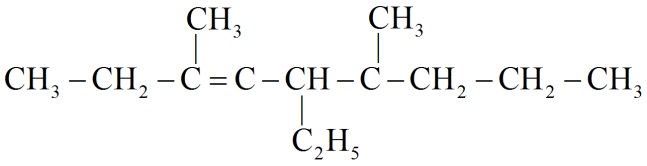
1) How many 1°, 2°, 3° C atoms does 1, 3, 5-Trimethyl cyclohexane have?

(A) 3, 6, 0
(B) 3, 4, 2
(C) 0, 3, 6
(D) 3, 3, 3

2) The compound which has one isopropyl group is:

(A) 2,2,3,3-Tetramethyl pentane
(B) 2,2-Dimethyl pentane
(C) 2,2,3-Trimethyl pentane
(D) 2-Methyl pentane

3) The correct IUPAC name of the compound

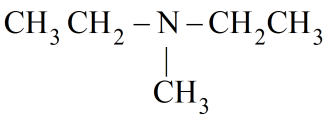

:

(A) 5-Ethyl-3, 6-dimethyl non-3-ene
(B) 5-Ethyl-4, 7-dimethyl non-3-ene
(C) 4-Methyl-5, 7-diethyl oct-2-ene
(D) 2,4-Ethyl-5-methyl oct-2-ene

4) IUPAC name of CH_2=CH – CN is:

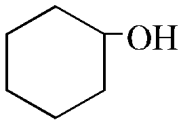
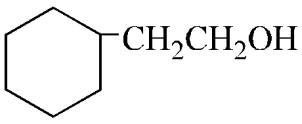
(A) Ethenenitrile
(B) Vinyl cyanide
(C) Cyono ethene
(D) Prop-2-enenitrile

5)


The IUPAC name of is:

(A) N-Methyl-N-ethyl ethanamine
(B) Diethyl methanamine
(C) N-Ethyl-N-methyl ethanamine
(D) Methyl diethyl ethanamine

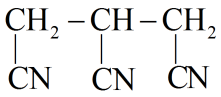
6) True statement for the above compounds is :

(a)  and (b) 

(A) (a) is phenol while (b) is alcohol
(B) Both (a) and (b) are primary alcohol
(C) (a) is primary and (b) is secondary alcohol
(D) (a) is secondary and (b) is primary alcohol

7) The IUPAC name of C_6H_5CH=CH–COOH is :

(A) Cinnamic acid
(B) 1-Phenyl-2-carboxy ethane
(C) 3-Phenyl prop-2-enoic acid
(D) Dihydroxy-3-phenyl propionic acid

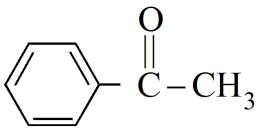
8) IUPAC name will be 

(A) 1,2,3-Tricyano propane

(B) Propane-1,2,3- trinitrile

(C) 1,2,3-Cyano propane

(D) Propane-1,2,3-tricarbonitrile

9) The IUPAC name of  is:

(A) Phenyl ethanone

(B) Methyl phenyl ketone

(C) Acetophenone

(D) Phenyl methyl ketone

10) The number of sigma and pi-bonds in 1-butene 3-yne are:

(A) 5 sigma and 5 pi

(B) 7 sigma and 3 pi

(C) 8 sigma and 2 pi

(D) 6 sigma and 4 pi

11) Minimum number of carbon atom required by a Hydrocarbon alkane, alkene and alkyne to show chain isomerism respectively are :

(A) 4, 4, 4

(B) 4, 3, 3

(C) 4, 4, 3

(D) 4, 4, 5

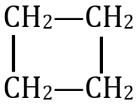
12) C_7H_7Cl shows how many benzenoid aromatic isomers ?

(A) 4

(B) 3

(C) 5

(D) 6

13) $H_3C—CH=CH—CH_3$ and  are :-

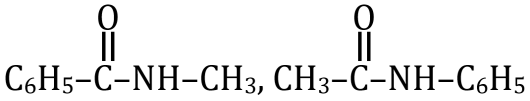
(A) Ring-chain Isomers

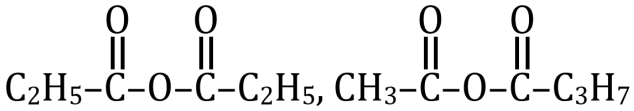
(B) Chain Isomers

(C) Metamers

(D) Position Isomers

14) The pair of metamers is :-

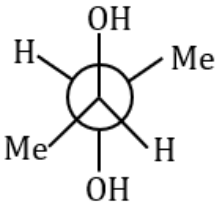
(A) 

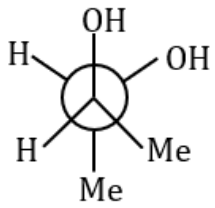
(B) 

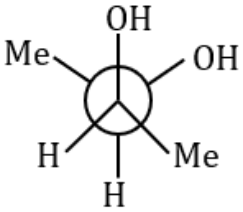
(C) Both the above

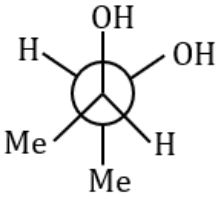
(D) None of the above

15) Among the following, the conformation that corresponds to the most stable conformation of *meso*–butane–2,3–diol is

(A) 

(B) 

(C) 

(D) 

16) Which of the following compound show geometrical isomerism ?

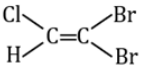
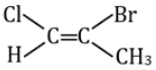
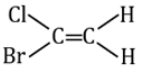
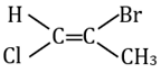
(A) CH_2Cl_2

(B) $CH_2Cl—CH_2Cl$

(C) CHBr = CHCl

(D) $CH_2Cl—CH_2Br$

17) Which is a pair of geometrical isomers ?

(i) 
(ii) 
(iii) 
(iv) 

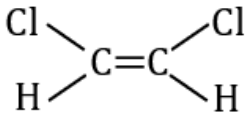
(A) I and II

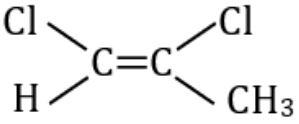
(B) I and III

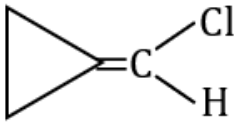
(C) II and IV

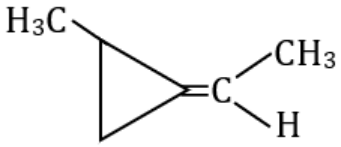
(D) III and IV

18) Which Compound don’t show Geometrical isomerism:

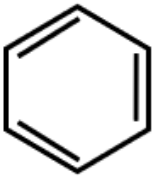
(A) 

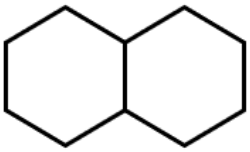
(B) 

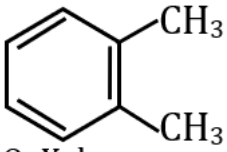
(C) 

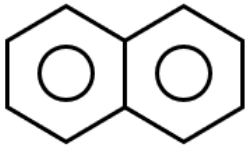
(D) 

19) Which of the following will show geometrical isomerism?

(A) 
Benzene

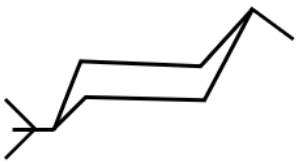
(B) 
Decalin

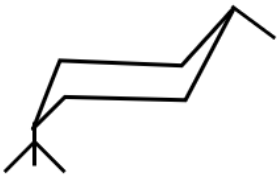
(C) 
O–Xylene

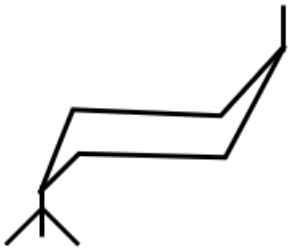
(D) 

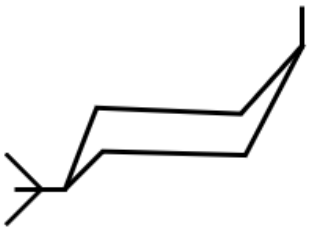
Naphthalene

20) Which is the most stable conformation :

(A) 

(B) 

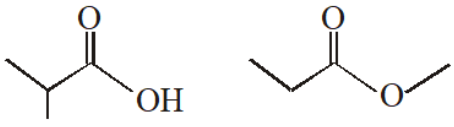
(C) 

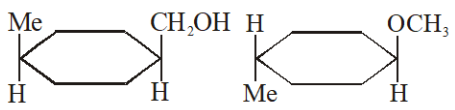
(D) 

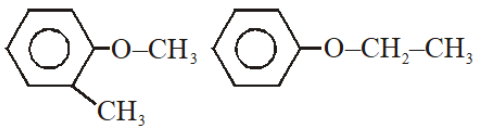
SECTION-II

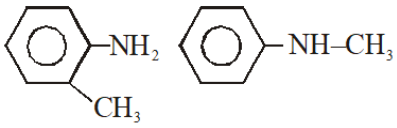
1) How many compounds are theoretically possible for formula C_3H_6O (excluding stereoisomers) ?

2) How many of the following are represents pair of functional group isomer.

(i) 

(ii) 

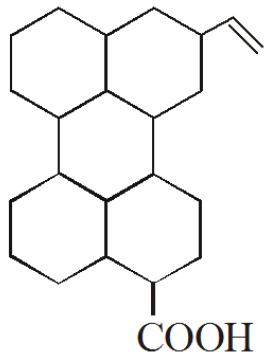
(iii) 

(iv) 

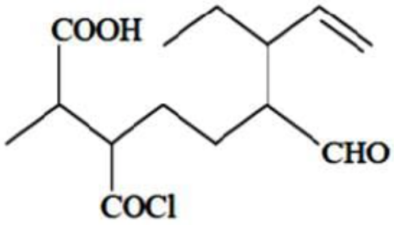
3) Total number of isomeric alcohols with formula $C_4H_{10}O$ are (excluding stereoisomers)

4)

Double bond equivalent (DBE) of the following compound is



5) According to IUPAC rules number of carbon atoms present in principal chain_____.



PART-3 : MATHEMATICS

SECTION-I

1) The value of $^{50}C_4 + \sum_{r=1}^{6} {}^{56-r}C_3$ is

(A) $^{56}C_4$

(B) $^{56}C_3$

(C) $^{55}C_3$

(D) $^{55}C_4$

2) From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. Then the number of such arrangements is

(A) At least 750 but less than 1000

(B) At least 1000

(C) Less than 500

(D) At least 500 but less than 750

3) The number of points, having both co-ordinates as integers, that lie in the interior of the triangle with vertices (0, 0), (0, 41) and (41, 0) is

(A) 820

(B) 780

(C) 901

(D) 861

4) Assuming the balls to be identical except for difference in colours, the number of ways in which one or more balls can be selected from 10 white, 9 green and 7 black balls is

(A) 879

(B) 880

(C) 629

(D) 630

5) Let T_n be the number of all possible triangles formed by joining vertices of n sided regular polygon. If $T_{n+1} - T_n = 10$, then the value of n is

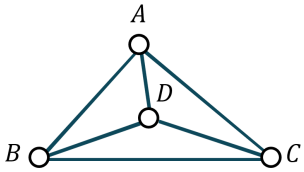
(A) 7

(B) 5

(C) 10

(D) 8

6) A road network as shown in the figure connect four cities. In how many ways can you start from any city (say A) and come back to it without travelling on the same road more than once?



(A) 8

(B) 12

(C) 9

(D) 16

7) If all the words (with or without meaning) having five letters, formed using the letters of the word SMALL and arranged as in a dictionary; then the position of the word SMALL is

(A) 58^{th}

(B) 46^{th}

(C) 59^{th}

(D) 52^{th}

8) A debate club consists of 6 girls and 4 boys. A team of 4 members is to be selected from this club including the selection of a captain (from among these 4 member) for the team. If the team has to include at most one boy, then the number of ways of selecting the team is

(A) 380
(B) 320
(C) 260
(D) 95

9) Given 4 flags of different colours, how many different signals can be generated, if a signal requires the use of 2 flags one below the other?

(A) 10
(B) 11
(C) 12
(D) 13

10) How many four digits Even numbers can be made by using 0, 1, 3, 4, 7, 9 (Repetition not allowed)

(A) 98
(B) 108
(C) 118
(D) 128

11) Number of 4 digit numbers of the form N = abcd which satisfy following three conditions
(i) $4000 \leq N < 6000$
(ii) N is multiple of 5
(iii) $3 \leq b < c \leq 6$ is equal to

(A) 12
(B) 18
(C) 24
(D) 48

12) The sides AB, BC, CA of a triangle ABC have 3, 4, 5 points respectively on them. Find the number of triangle that can be constructed using these points as vertices.

(A) 105
(B) 205
(C) 305
(D) 405

13)

Find the number of permutations of letters a, b, c, d, e, f, g taken all at a time if neither 'beg' nor 'cad' pattern appear.

(A) 7! + 5! + 5! + 3!

(B) 7! - 5! - 5! - 3!

(C) 7! - 5! + 5! - 3!

(D) 7! - 5! - 5! + 3!

14) A person invites a group of 10 friends at dinner. Find number of ways, in which 5 of them sit on 1 round table and the other 5 on other round table.

(A) $\frac{10!}{25}$

(B) $\frac{11!}{25}$

(C) $\frac{12!}{24}$

(D) $\frac{13!}{26}$

15) Number of non-negative integral solution of the inequality $x + y + z + t \leq 30$.

(A) ${}^{31}C_4$

(B) ${}^{32}C_4$

(C) ${}^{33}C_4$

(D) ${}^{34}C_4$

16) In a unique hockey series between India & Pakistan, they decide to play on till a team wins 5 matches. The number of ways in which the series can be won by India, if no match ends in a draw is

(A) 126

(B) 252

(C) 225

(D) none

17) The number of ways of choosing 10 objects out of 31 objects of which 10 are identical and the remaining 21 are distinct, is

(A) 2^{20}

(B) $2^{20} - 1$

(C) $2^{20} + 1$

(D) 2^{21}

18) Consider word ALLENDIGITAL, find number of ways of arranging the letters. If relative position of vowels and consonant remain same.

(A) 25600

(B) 31600

(C) 25200

(D) 22500

19) Let A and B be two sets containing four and two elements respectively. Then the number of subsets of the set A × B, each having at least three elements is

(A) 275

(B) 510

(C) 219

(D) 256

20) Number of cyphers at the end of ${}^{2002}C_{1001}$ is

(A) 0

(B) 1

(C) 2

(D) 200

SECTION-II

1)

Using only 0, 1, 2, 3, 4, if number of all four digit numbers where sum of digit is 12, is N, then digit at unit place of N, is

2)

Total divisors of 2520 which are also divisible by 4 is 16k, then the value of 'k' is

3) All the letters of the word 'HUDHUD' are written in all possible orders and these words are written out as in a dictionary. If the rank of the word 'DUHDUH' is 'N', then sum of digits of 'N' is

4) Let ABCDEF be a regular hexagon and let point O be the center of the hexagon. How many ways can you color these seven points either red or blue such that there doesn't exist any equilateral triangle with vertices of all the same color?

5) Let N be the number of three digit natural numbers having digits in non-decreasing order from left to right then find the value of $\left[\frac{N}{50}\right]$.
[Note: [k] denotes greatest integer function less than or equal to k]

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.	D	C	A	D	B	B	D	A	C	C	A	A	A	A	A	C	B	A	B	B

SECTION-II

Q.	21	22	23	24	25
A.	37.5	0.025	7.2	8.00	1.50

PART-2 : CHEMISTRY

SECTION-I

Q.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
A.	D	D	A	D	C	D	C	D	A	B	D	A	A	C	B	C	C	C	B	A

SECTION-II

Q.	46	47	48	49	50
A.	9.00	3.00	4.00	7.00	9.00

PART-3 : MATHEMATICS

SECTION-I

Q.	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
A.	A	B	B	A	B	B	A	A	C	B	C	B	D	A	D	A	A	C	C	B

SECTION-II

Q.	71	72	73	74	75
A.	4.00	1.5	5.00	20.00	3.00

SOLUTIONS

PART-1 : PHYSICS

1) Elastic energy stored in wire $= \frac{1}{2}(mg)x = \frac{1}{2}(200)\left(10^{-3}\right)J = 0.1\ J$

2)

$P_2 = \rho gh$, $P_1 = rab$ hence $P_1 - P_2 = \rho(ab - gh)$

3)

(i) As the bubble rises up, pressure inside the bubble will decrease
(ii) Pressure on concave side is always greater then the pressure on convex side.

4)

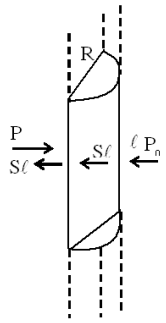
(A) Av = constant
(B) $P + \frac{1}{2}\rho V^2 = \text{constant}$

5) $800\ LA = 1000\ (L - x)A + 300\ xA$
$\Rightarrow 8L = 10\ (L - x) + 3x$
$7x = 2L$
$\frac{x}{L} = \frac{2}{7}$

6) $P_0 + \frac{4T}{r} = P_0 + \rho gh$
$h\rho g = \frac{4T}{r}$
$\left[T = \frac{\rho ghr}{4}\right]$

7) $\frac{h_1}{h_2} = \frac{T_1}{T_2} \cdot \frac{\rho_2}{\rho_1} = \frac{60}{50}\frac{0.6}{0.8} = \frac{6}{5} \times \frac{3}{4} = \frac{9}{10}$

8) $mg = (x_1 - x_2)\,a^2 \rho g$, $(x_1 - x_2) = \frac{m}{\rho a^2}$



9)

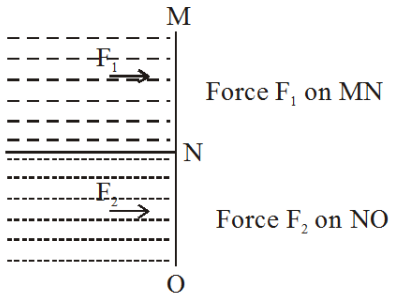
$2SR = (P - P_0)(2R \times \square)$

$(P - P^0) = \frac{S}{R}$

$P = P^0 + \frac{S}{R}$

10)

$Pt = ML \quad L = \frac{Pt}{M}$



12)

$F_1 = \frac{\rho gh}{2} \times A$

$F_2 = \left(\rho gh + \frac{2\rho gh}{2}\right) A$

$\frac{F_1}{F_2} = \frac{1}{4}$

13) $B = \frac{\Delta P}{|\Delta V/V|} = \frac{1000 \times 9.8 \times 200}{1/1000}$ 1.96×10^9 N/m^2

14) $G = \frac{F/A}{\delta/h} \Rightarrow \delta = \frac{Fh}{AG} = \frac{9.6 \times 0.5 \times 10^{-2}}{4 \times 10^{-4} \times 8 \times 10^{10}} = 1.5 \times 10^{-9} m$

15) Heat given is equal to heat taken.

$192 \times S(100\text{-}21.5) = 128 \times 0.394 \times (21.5\text{-}8.4) + 240 \times 4.18 \times (21.5\text{-}8.4)$

$\Rightarrow S = \frac{660.65 + 13142}{15072}$

$\Rightarrow S = 916 Jkg^{-1}K^{-1}.$

16) $C = \gamma_L - \gamma_C$ ....(i)

$S = \gamma_L - \gamma_S$ ....(ii)

$\gamma_S = 3\alpha_S$ ....(iii)

$C + \gamma_C = S + \gamma_S$

$$\alpha_S = \frac{C + \gamma_C - S}{3}$$

17)

$T_S = 3mg$

$$\frac{3mg}{A_s} = y_S \times \frac{\Delta \ell_S}{\ell_S}$$

$$\frac{2mg}{A_b} = y_b \times \frac{\Delta \ell_b}{\ell_b}$$

$$\frac{\Delta \ell_s}{\Delta \ell_b} = \frac{3}{2} \times \frac{\ell_s}{\ell_b} \times \frac{A_b}{A_S} \times \frac{y_b}{y_S} = \frac{3}{2} \times \frac{a}{b^2 c}$$

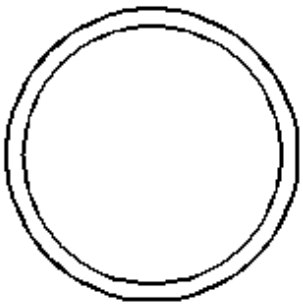
18) $3\alpha = \gamma \Rightarrow \beta\gamma\, \Delta T = \Delta P_0$

$\Rightarrow$ So $\Delta T = \dfrac{P_0}{\beta \cdot 3\alpha}$

19) $$\text{Shear stress} = \frac{F}{A} = \frac{16}{8 \times 2 \times 10^{-4}} = 10^4 \text{N/m}^2$$

$$= \frac{\text{Shear stress}}{\text{Shear moldulus}} = \frac{10^4}{1.5 \times 10^5} = \frac{1}{15}$$

20) $$\text{Strain} = \frac{\Delta l}{l} = \left(\frac{2\pi R - 2\pi r}{2\pi r}\right)$$



$$\text{Strain} = \left(\frac{R - r}{r}\right)$$

$$Y = \frac{R/A}{\frac{\Delta l}{l}}, Y\frac{\Delta l}{l}A = F$$

$$F = AY\left(\frac{R - r}{r}\right) \quad \text{...Ans.}$$

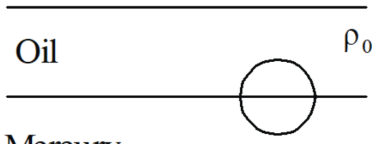
21) **(37.5 *N*)**

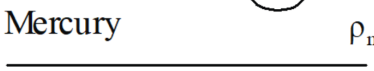
$$\frac{F}{a} + \rho gh = \frac{M_g}{A}$$

$F = 37.5\ N$

22) $2\eta(0.5)\dfrac{0.5}{1.25 \times 10^{-2}} = 1$

$\eta = 2.5 \times 10^{-2}$

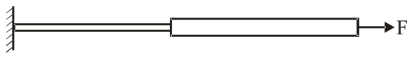




23) $mg = (f_B) + (f_B)_{Hg}$

$\rho vg = \rho_0 \frac{v}{2} g + \rho Hg \cdot \frac{v}{2} \cdot g$

$\rho = \dfrac{13.6 + 0.8}{2} = 7.2\ g/cm^3$

24) 

$\dfrac{F}{A_1} = y\ \dfrac{\Delta\ell_1}{\ell}$

$\dfrac{F}{A_2} = y\ \dfrac{\Delta\ell_2}{\ell}$

$\Delta\ell_1 + \Delta\ell_2 = 10$ mm

$\dfrac{F\ell}{A_1 y} + \dfrac{F\ell}{4A_1 y} = 10$ mm

$\dfrac{F\ell}{A_1 y} + \dfrac{F\ell}{4A_1 y} = 10$ mm

$\Rightarrow \dfrac{F\ell}{A_1 y} = 8$ mm

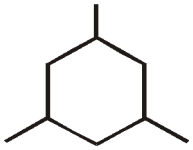
25) $T_A = 60$ N

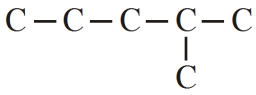
$T_B = 40$ N

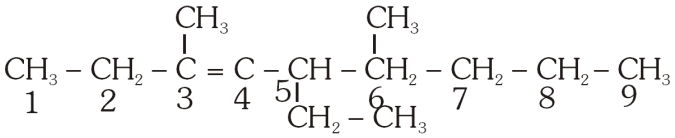
Ratio $= \dfrac{60}{40}$

$= 1.5$

PART-2 : CHEMISTRY

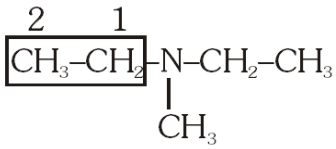
26) 

27) 

28) 

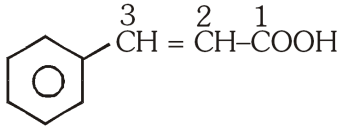
5 – Ethyl – 3, 6 – dimethyl non – 3 – ene

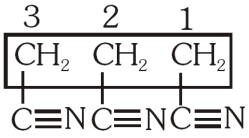
29) Not required

30) 

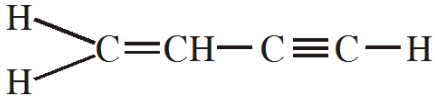
N–Ethyl – N –Methyl ethanamine

31) Not required

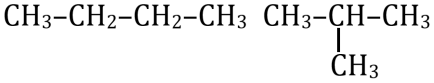
32) 

33) 

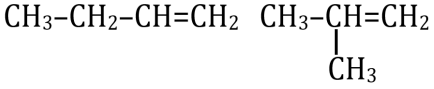
34) Not required

35) 

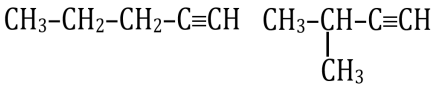
36) For Alkane ⇒ 4 carbon



For Alkine ⇒ 4 carbon



For Alkyne ⇒ 5 carbon



37) C_7H_7 - Cl

$$DU = \frac{1}{2}(2C + 2 - -m + t)$$

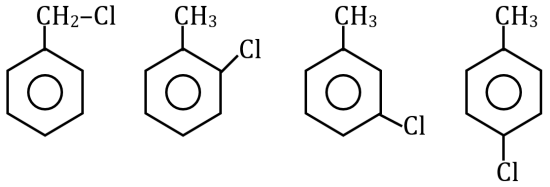
where m ⇒ no. of mono valent atoms

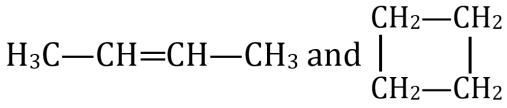
t ⇒ no. of trivalent atoms

$$= \frac{1}{2}(2 \times 7 + 2 - -8)$$

$$= \frac{1}{2}(16 - -8) = 4$$

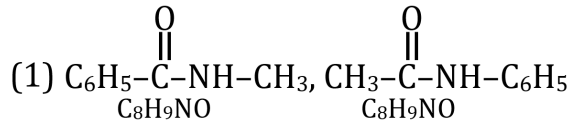
Benzoidal isomers





C_4H_8	C_4H_8
Acyclic	Cyclic
38) DU = 1	DU = 1

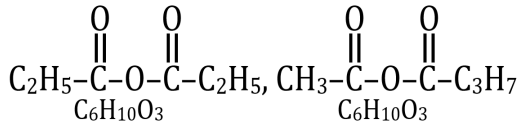
⇒ ring chain isomers.

39) (1) 

⇒ same bivalent functional group

⇒ Two different groups on same side of functional group

⇒ Metamers

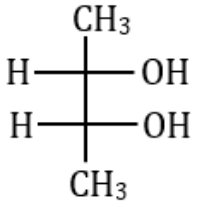
(2) 

⇒ same bivalent functional group

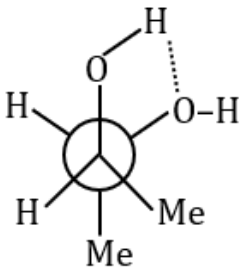
⇒ Two different groups on same side of functional group

⇒ Metamers

40)



=

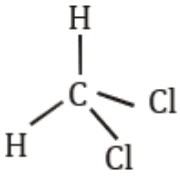


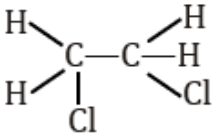
Most stable conformation
with intramolecular H–bonding

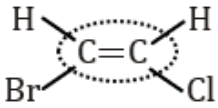
Meso butane–2,3–diol

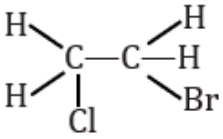
41)

G.I

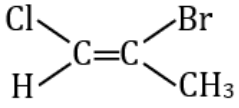
(A)  ×

(B)  ×

(C)  ✓

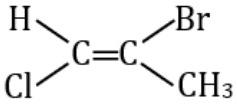
(D)  ×

42)



(II)

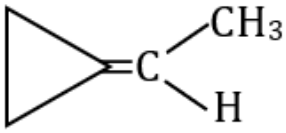
and



(IV)

→ Geometrical (isomers)

43)

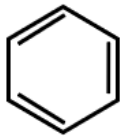


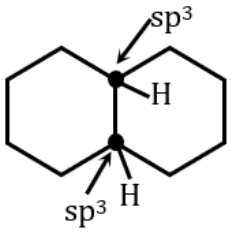
G.I. is absent

Identical groups

G.I

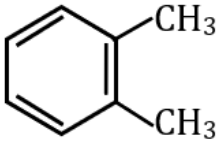
44)

(1)  ×

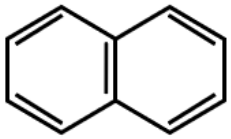
(2) 

✓

Bicyclo compound

(3) 

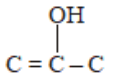
×

(4)  ×

45) In (1) both groups are at equatorial position. So, least repulsion. Hence, more stable.

46)

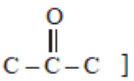
C–C–CHO



HO – C = C – C

C = C–O–C

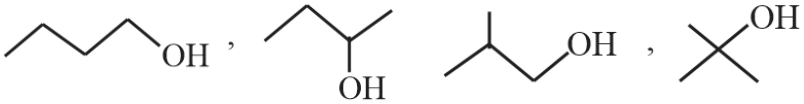
C=C–C–OH



47) (i), (ii) & (iv) are functional group isomer of each other.

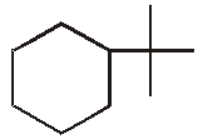
48)

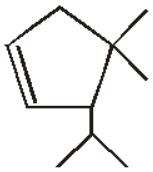
isomeric alcohol = $C_4H_{10}O$

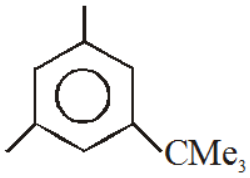


Ans : (4)

49) number of Ring = 5
number of II bond = 2

(A) 

(C) 

(E) 

(G) 

50)

PART-3 : MATHEMATICS

51)

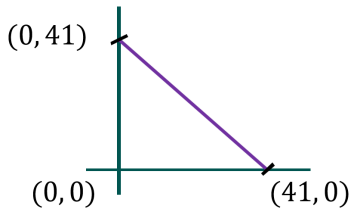
$^{50}C_4 + {}^{55}C_3 + {}^{54}C_3 + {}^{53}C_3 + {}^{52}C_3 + {}^{51}C_3 + {}^{50}C_3$
$= {}^{51}C_4 + {}^{51}C_3 + {}^{52}C_3 + {}^{53}C_3 + {}^{54}C_3 + {}^{55}C_3 = {}^{56}C_4$

52)

The no. of ways to select 4 novels & 1 dictionary from 6 different novels & 3 different dictionary are $^{6}C_4 \times {}^{3}C_1$
and to arrange these things in shelf so that dictionary is always in middle _ _ *D* _ _ are 4!
Required No. of ways $^{6}C_4 \times {}^{3}C_1 \times 4! = 1080$

53)

Let *P* be *(x, y)*



$x \geq 1$
$y \geq 1$
$\Rightarrow x + y < 41$
$x + y \leq 40$
$x + y + t = 40,\ t \geq 0$
$(x - 1) + (y - 1) + t = 38$
$\Rightarrow$ No. of points $= {}^{38+3-1}C_{3-1} = {}^{40}C_2 = 780$

54)

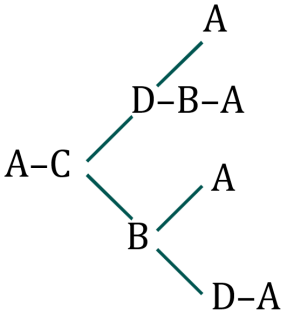
Ans. (1)

W^{10}, G^9, B^7
Selection of one or more balls
$= (10 + 1)(9 + 1)(7 + 1) - 1$
$= 11 \times 10 \times 8 - 1 = 879$

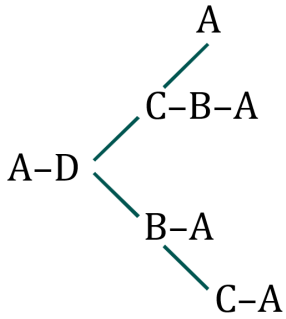
55)

$T_n = {}^nC_3 \Rightarrow {}^{n+1}C_3 - {}^nC_3 = 10$
$(n + 1)n(n - 1) - n(n - 1)(n - 2) = 60$
$n(n - 1) = 20 \Rightarrow n = 5$

56) Paths are shown as :



4 paths
Similarly if we start from A towards D we get another 4 paths.



Similarly if we start from A towards B
Again 4 paths
Total different paths = $4 \times 3 = 12$
II Method → ${}^3C_1 \times {}^2C_1 \times {}^2C_1 = 12$

57)

Total number of words which can be formed using all the letters of the word 'Small'
$= \frac{5!}{2!} = 60$
Now, 60^{th} word is → SMLLA
59^{th} word is → SMLAL
58^{th} word is → SMALL

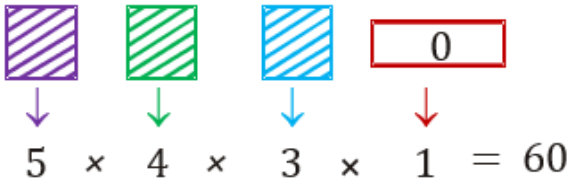
58) $({}^6C_4 + {}^6C_3 . {}^4C_1) . {}^4C_1 = 380$

59)

There will be as many signals as there are ways of filling in 2 vacant places

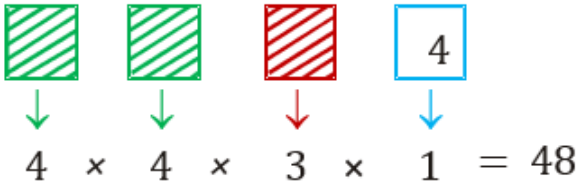
in succession by the 4 flags of different colours. The upper vacant place can be filled in 4 different ways by anyone of the 4 flags; following which, the lower vacant place can be filled in 3 different ways by anyone of the remaining 3 different flags.
Hence, by the multiplication principle, the required number of signals = $4 \times 3 = 12$.

Case-1:

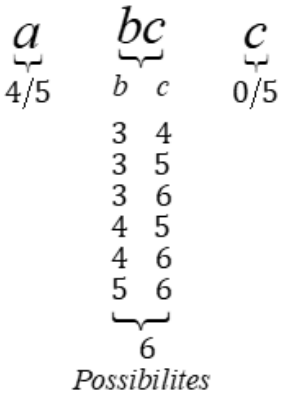


60)

Case-2:

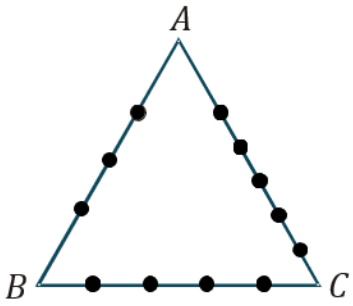


(zero not include)
Total Number : 60 + 48 = 108



61)

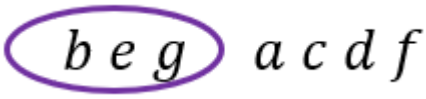
$\square$ 2 × 6 × 2 = 24



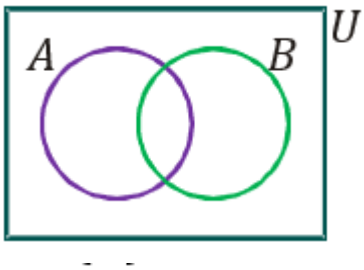
62) Total ways = ${}^{12}C_3 - {}^{3}C_3 - {}^{4}C_3 - {}^{5}C_3 = 205$

63)

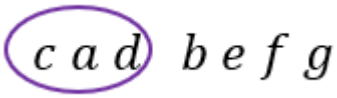
The total number of permutations without any restrictions; n (U) = 7!



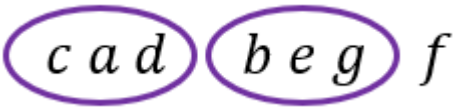
Let A be the set of all possible permutations in which 'beg' pattern always appears



: n(A) = 5!



Let B be the set of all possible permutations in which 'cad' pattern always appears : n(B) = 5!



n(A∩B) : Number of all possible permutations when both 'beg' and 'cad' patterns appear.

n(A∩B) = 3!.
Therefore, the total number of permutations in which 'beg' and 'cad' patterns do not appear
n(A'∩B') = n(U)–n(A∪B) = n(U)–n(A)–n(B)+n(A∩B)
= 7! – 5! – 5! + 3!.

64)

The number of ways of selection of 5 friends for first table is ${}^{10}C_5$. Remaining 5 friends are left for second table.
The total number of permutations of 5 guests at a round table is 4!. Hence, the total number of arrangements is

${}^{10}C_5 \times 4! \times 4! = \frac{10!4!4!}{5!5!} = \frac{10!}{25}$

65)

$(x + y + z + t) + w = 30$

↓

(False begger)

Required condition is equivalent to giving 30 coin's to 5 begger's = ${}^{30+5-1}C_{5-1} = {}^{34}C_4$.

66) Last match is won by India.

0 match won by Pakistan = ${}^4C_0 = 1$

1 match won by Pakistan = ${}^5C_1 = 5$

2 matches won by Pakistan = ${}^6C_2 = 15$

3 matches won by Pakistan = ${}^7C_3 = 35$

4 matches won by Pakistan = ${}^8C_4 = 70$

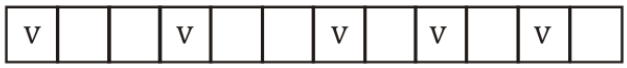
Total = 126

10 Identical	21Distinct	10 Object
0	10	${}^{21}C_{10} \times 1$
1	9	${}^{21}C_9 \times 1$
⋮	⋮	⋮
10	0	${}^{21}C_0 \times 1$

${}^{21}C_0 + ... + {}^{21}C_{10} + {}^{21}C_1 + ... + {}^{21}C_0 = 2^{21}$

67) $({}^{21}C_0 + ... + {}^{21}C_{10}) = 2^{20}$

68) If relative position of vowels and consonant remain same.



$$\text{Total ways} = \underbrace{\frac{5!}{2!\,2!}}_{\substack{\text{arrangement}\\ \text{of vowels}}} \times \underbrace{\frac{7!}{3!}}_{\substack{\text{arrangement}\\ \text{of consonants}}}$$

$$= 25200$$

69) $n(A) = 4, \quad n(B) = 2$

$\Rightarrow \quad n(A \times B) = 8$

hence No. of subsets having at least '3' elements is

${}^8C_3 + {}^8C_4 + {}^8C_5 + {}^8C_6 + {}^8C_7 + {}^8C_8$

= 28 – 37

= 219

70) $\frac{2002!}{1001!.\,1001!} = \frac{5^x}{5^{24}} = 5x - 240 \Rightarrow 5^{999-998}$.

71)

Case-I : $4\ 4\ 4\ 0 \rightarrow 3$ ways (0 can't be in first position)

Case-II : $4\ 4\ 2\ 2 \rightarrow \frac{4!}{2!\,2!} = 6$

Case-III : $4\ 4\ 3\ 1 \rightarrow \frac{4!}{2!} = 12$

Case-IV : $4\ 3\ 3\ 2 \rightarrow \frac{4!}{2!} = 12$

Case-V : $3\ 3\ 3\ 3 \rightarrow 1$

Total = 34

72)

$2520 = 23 \times 32 \times 51 \times 71$

A divisor is divisible by 4 if atleast two 2's are selected.

- Total ways $= 2 \times 3 \times 2 \times 2$
  $= 24$
- k = 3

73) D D ..... $\frac{4!}{2!2!} = 6$

D H ..... $\frac{4!}{2!} = 12$

D U D ..... $\frac{3!}{2!} = 3$

DUHDHU = 1

DUHDUH = 1

74) Without loss of generality, let O he blue. Then we can't have any two adjacent blues on the perimeter of ABCDEF. However, because of the two larger equilateral triangles ACE and BDF, we need at least two blues to keep us from having an all red equilateral triangle. We can't have three blues on the perimeter without break the rule, so we must have two. With this, they must be diametrically opposite. So, in total, there are 2 x 3 = 6 good colorings.

75) $\boxed{x}\boxed{y}\boxed{z}$ $x < y < z = {}^{9}C_3$

$\boxed{x}\boxed{x}\boxed{y}$ $x < y = {}^{9}C_2$

$\boxed{x}\boxed{y}\boxed{y}$ $x < y = {}^{9}C_2$

$\boxed{x}\boxed{x}\boxed{x}$ $= {}^{9}C_1$

total numbers $= {}^{9}C_3 + {}^{9}C_2 + {}^{9}C_2 + {}^{9}C_1 = 84 + 36 \times 2 + 9$

$\therefore \left[\frac{N}{50}\right] = 3$