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JEE • NEET • MHT-CET

2023_JEE Actual Paper_29 Jan_2nd Shift

FULL SYLLABUS

Date : 29-1-2023

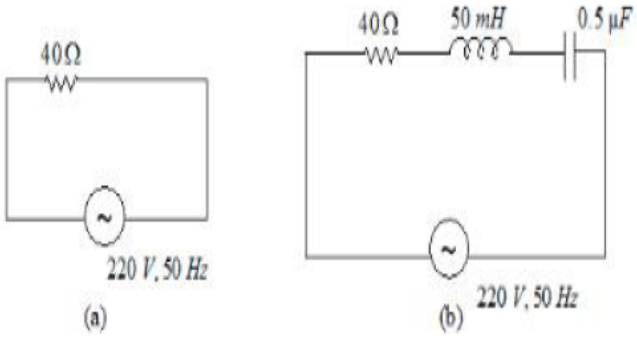
Marks : 300

PHYSICS

1) **A fully loaded boeing aircraft has a mass of 5.4 × 10^5 kg. Its total wing area is 500 m^2. It is in level flight with a speed of 1080 km/h. If the density of air ρ is 1.2 kg m^{-3}, the fractional increase in the speed of the air on the upper surface of the wing relative to the lower surface in percentage will be. (g = 10 m/s^2)**

a) 16 b) 10
c) 8 d) 6

2) **For the given figures, choose the correct options:**



a) The rms current in circuit (b) can be larger than that in (a)

b) The rms current in circuit (b) can never be larger than that in (a)

c) The rms current in figure (a) is always equal to that in figure (b)

d) At resonance, current in (b) is less than that in (a)

3) **At 300 K, the rms speed of oxygen molecules is $\sqrt{\frac{\alpha+5}{\alpha}}$ times to that of its average speed in the gas. Then, the value of α will be (used $\pi = \frac{22}{7}$)**

a) 27 b) 24
c) 28 d) 32

4) **The electric current in a circular coil of four turns produces a magnetic induction 32 T at its centre. The coil is unwound and is rewound into a circular coil of single turn, the magnetic induction at the centre of the coil by the same current will be :**

a) 4 T b) 8 T
c) 16 T d) 2 T

5) **An object moves at a constant speed along a circular path in a horizontal plane with center at the origin. When the object is at x = +2 m, its velocity is $-4\hat{j}$m/s. The object's velocity (v) and acceleration (a) at x = –2 m will be**

a) $v = 4\,\hat{j}\ m/s,\ a = 8\hat{i}\ m/s^2$
b) $v = -4\,\hat{j}\ m/s,\ a = -8\hat{j}\ m/s^2$
c) $v = -4\,\hat{j}\ m/s,\ a = 8\hat{i}\ m/s^2$
d) $v = 4\,\hat{i}\ m/s,\ a = 8\,\hat{j}\ m/s^2$

6) **Substance A has atomic mass number 16 and half life of 1 day. Another substance B has atomic mass number 32 and half life of $\frac{1}{2}$ day. If both A and B simultaneously start undergo radio activity at the same time with initial mass 320 g each, how many total atoms of A and B combined would be left after 2 days.**

a) 6.76×10^{24} b) 6.76×10^{23}
c) 3.38×10^{24} d) 1.69×10^{24}

7) **With the help of potentiometer, we can determine the value of emf of a given cell. The sensitivity of the potentiometer is**

(A) directly proportional to the length of the potentiometer wire

(B) directly proportional to the potential gradient of the wire

(C) inversely proportional to the potential gradient of the wire

(D) inversely proportional to the length of the potentiometer wire

Choose the correct option for the above statements:

a) C only
b) A and C only
c) A only
d) B and D only

8) **A scientist is observing a bacteria through a compound microscope. For better analysis and to improve its resolving power he should. (Select the best option)**

a) Increase the wave length of the light
b) Increase the refractive index of the medium between the object and objective lens
c) Decrease the diameter of the objective lens
d) Decrease the focal length of the eye piece.

9) **Identify the correct statements from the following:**

A. Work done by a man in lifting a bucket out of a well by means of a rope tied to the bucket is negative.

B. Work done by gravitational force in lifting a bucket out of a well by a rope tied to the bucket is negative.

C. Work done by friction on a body sliding down an inclined plane is positive.

D. Work done by an applied force on a body moving on a rough horizontal plane with uniform velocity in zero. E. Work done by the air resistance on an oscillating pendulum in negative.

Choose the correct answer from the options given below:

a) B and E only
b) B. D and E only
c) A and C Only
d) B and D only

10) **The ratio of de-Broglie wavelength of an α particle and a proton accelerated from rest by the same potential is $\frac{1}{\sqrt{m}}$, the value of m is**

a) 16
b) 4
c) 8
d) 2

11) **Heat energy of 184 kJ is given to ice of mass 600 g at –12°C. Specific heat of ice is 2222.3 J $kg^{-1}{}^{\circ} C^{-1}$ and latent heat of ice in 336 kJ/kg^{-1}**

A. Final temperature of system will be 0°C.

B. Final temperature of the system will be greater than 0°C.

C. The final system will have a mixture of ice and water in the ratio of 5:1.

D. The final system will have a mixture of ice and water in the ratio of 1:5.

E. The final system will have water only.

Choose the correct answer from the options given below:

a) B and D Only
b) A and C Only
c) A and E Only
d) A and D Only

12) **A square loop of area 25 cm² has a resistance of 10 Ω. The loop is placed in uniform magnetic field of magnitude 40.0 T. The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in 1.0 sec, will be**

a) 1.0×10^{-3} J
b) 1.0×10^{-4} J
c) 5×10^{-3} J
d) 2.5×10^{-3} J

13) **The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value, then its new time period will become.**

a) 4 hours
b) 3 hours
c) 12 hours
d) 6 hours

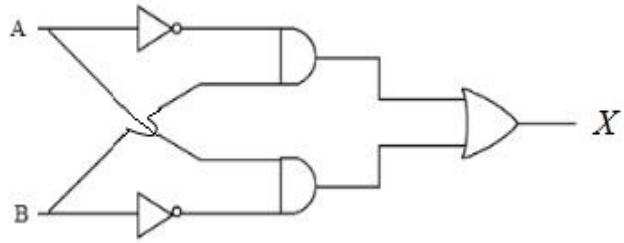
14) **The equation of a circle is given by $x^2 + y^2 = a^2$, where a is the radius. If the equation is modified to change the origin other than (0, 0), then find out the t dimensions of A and B in a new equation: $(x - At)^2 + \left(y - \frac{t}{B}\right)^2 = a^2$. The correct dimensions of t is given as $[T^{-1}]$.**

a) A = $[L^{-1}T^{-1}]$, B = [LT].
b) A = [L-1T], B (LT^{-1}]
c) A = $(L^{-1}T^{-1}]$, B = $[LT^{-1}]$
d) A = [LT], B = $[L^{-}$ $^{1}T^{-1}]$

15) **A point charge 2×10^{-2}C is moved from P to S in a uniform electric field of 30 NC^{-1} directed along positive x-axis. If coordinates of P and S arc (1, 2, 0)m and (0, 0, 0) m respectively, the work done by electric field will be**

a) -1200 mJ
b) 600 mJ
c) 1200 mJ
d) -600 mJ

16) **For the given logic gates combination, the correct truth table will be :**



a)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

b)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

c)

A	B	X
0	0	1
0	1	0
1	0	1
1	1	0

d)

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

17) **Given below are two statements:**

Statement I: Electromagnetic waves are not deflected by electric and magnetic field.

Statement II: The amplitude of electric field and the magnetic field in electromagnetic waves are related to each other as

$E_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} B_0$

In the light of the above statements, choose the correct answer from the options given below:

a) Both Statement I and Statement II are true
b) Statement I is false but statement II is true
c) Statement I is true but statement II is false
d) Both Statement I and Statement II are false

18) **The time taken by an object to slide down 45° rough inclined plane is n times as it takes to slide down a perfectly smooth 45° incline plane. The coefficient of kinetic friction between the object and the incline plane is:**

a) $\sqrt{1 - \frac{1}{n^2}}$ b) $1 + \frac{1}{n^2}$
c) $\sqrt{\frac{1}{1-n^2}}$ d) $1 - \frac{1}{n^2}$

19) **The modulation index for an A.M. wave having maximum and minimum peak-to- peak voltages of 14 mV and 6 mV respectively is-**

a) 1.4 b) 0.2
c) 0.4 d) 0.6

20) **A force acts for 20 s on a body of mass 20 kg, starting from rest, after which the force ceases and then body describes 50 m in the next 10 s. The value of force will be:**

a) 10 N b) 40 N
c) 5 N d) 20 N

21) **A null point is found at 200 cm in potentiometer when cell in secondary circuit is shunted by 5Ω. When a resistance of 15Ω is used for shunting, null point moves to 300 cm. The internal resistance of the cell is _____ Ω.**

)

22) **For a charged spherical ball, electrostatic potential inside the ball varies with r as**

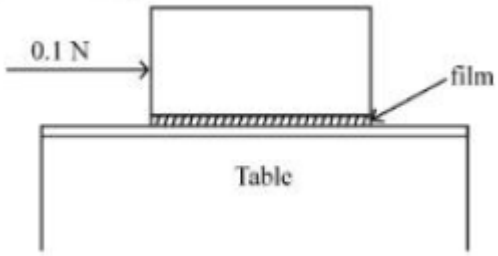
$V = 2ar^2 + b$.

Here, a and b are constant and r is the distance from the center. The volume charge density inside the ball is –λaε. The value of is λ =

ε = permittivity of the medium

)

23) A metal block of base area 0.20 m² is placed on a table, as shown in figure. A liquid film of thickness 0.25 mm is inserted between the block and the table. The block is pushed by a horizontal force of 0.1 N and moves with a constant speed. If the viscosity of the liquid is 5.0×10^{-3} Pl, the speed of block is _____ $\times 10^{-3}$ m/s.



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24) A car is moving on a circular path of radius 600 m such that the magnitudes of the tangential acceleration and centripetal acceleration are equal. The time taken by the car to complete first quarter of revolution, if it is moving with an initial speed of 54 km/hr is $t(1 - e^{-\pi/2})$s. The value of t is _____ .

)

25) A particle of mass 250 g executes a simple harmonic motion under a periodic force F = (–25 x) N. The particle attains a maximum speed of 4 m/s during its oscillation. The amplitude of the motion is _____ cm.

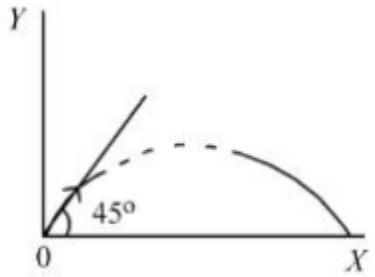
)

26) An inductor of inductance 2 μH is connected in series with a resistance, a variable capacitor and an AC source of frequency 7 kHz. The value of capacitance for which maximum current is drawn into the circuit is $\frac{1}{x}$F, where the value of x is (Take $\pi = \frac{22}{7}$).

)

27) **A particle of mass 100 g is projected at time t = 0 with a speed 20 ms^{-1} at an angle 45° to the horizontal as given in the figure. The magnitude of the angular momentum of the particle about the starting point at time t = 2s is found to be $\sqrt{K}\ kg\ m^2/s$. The value of K is**

(Take g = 10 ms^{-2})



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28) **In an experiment of measuring the refractive index of a glass slab using travelling microscope in physics lab, a student measures real thickness of the glass slab as 5.25 mm and apparent thickness of the glass slab as 5.00 mm. Travelling microscope has 20 divisions in one cm on main scale and 50 divisions on vernier scale is equal to 49 divisions on main scale. The estimated uncertainty in the measurement of refractive index of the slab is $\frac{x}{10} \times 10^{-3}$, where x is**

)

29) When two resistances R_1 and R_2 connected in series and introduced into the left gap of a meter bridge and a resistance of 10 Ω is introduced into the right gap, a null point is found at 60 cm from left side. When R_1 and R_2 are connected in parallel and introduced into the left gap, a resistance of 3 Ω is introduced into the right-gap to get null point at 40 cm from left end. The product of R_1 R_2 is _____ Ω^2

)

30) Unpolarised light is incident on the boundary between two dielectric media. whose dielectric constants are 2.8 (medium–1) and 6.8 (medium–2), respectively. To satisfy the condition, so that the reflected and refracted rays are perpendicular to each other. the angle of incidence should be $\tan^{-1}\left(1+\frac{10}{\theta}\right)^{\frac{1}{2}}$ value of θ is

(Given for dielectric media. μ_r = 1)

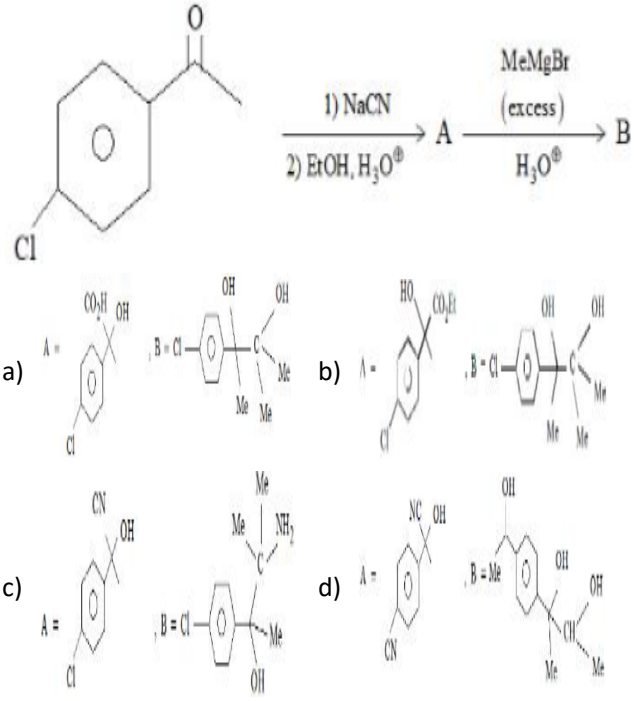
)

CHEMISTRY

31) **The one giving maximum number of isomeric alkenes on dehydrohalogenation reaction is (excluding rearrangement)**

a) 2-Bromopropane
b) 2-Bromo-3, 3-dimethylpentane
c) 1-Bromo-2-methylbutane
d) 2-Bromopentane

32) **Find out the major products from the following reaction sequence.**



a)
b)
c)
d)

33) **A solution of CrO_5 in amyl alcohol has a _____ colour.**

a) Blue
b) Yellow
c) Orange-Red
d) Green

34) **Match List I with List II**

	List I		List II
a.	van't Hoff factor, i	**i.**	Cryoscopic constant
b.	k_f	**ii.**	Isotonic solutions
c.	Solutions with same osmotic pressure	**iii.**	$\frac{Normal\ moral\ mass}{Abnormal\ molar\ mass}$
d.	Azeotropes	**iv.**	Solutions with same composition of vapour above it

Choose the correct answer from the options given below:

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

35) **The set of correct statements is:**

(i) Manganese exhibits +7 oxidation state in its oxide.

(ii) Ruthenium and Osmium exhibit +8 oxidation in their oxides.

(iii) Sc shows +4 oxidation state which is oxidizing in nature.

(iv) Cr shows oxidising nature in +6 oxidation state.

a) (ii) and (iii)
b) (i), (ii) and (iv)
c) (i) and (iii)
d) (ii), (iii) and (iv)

36) Given below are two statements:

Statement I : The decrease in first ionization enthalpy from B to Al is much larger then that from Al to Ga.

Statement II: The d orbitals in Ga are completely filled.

In the light of the above statements, choose the most appropriate answer from the options given below

a) Both the statements I and II are incorrect
b) Both the statements I and II are correct
c) Statement I is correct but statement II is incorrect
d) Statement I is incorrect but statement II is correct

37) **Correct order of spin only magnetic moment of the following complex ions is:**

(Given At no. Fe: 26, Co:27)

a) $[CoF_6]^{3-}$ $[FeF_6]^{3-}$ > $[Co(C_2O_4)_3]^{3-}$
b) $[FeF_6]^{3-}$ > $[CoF_6]^{3-}$ > $[Co(C_2O_4)_3]^{3-}$
c) $[Co(C_2O_4)_3]^{3-}$ > $[CoF_4]^{3-}$ >$[FeF_6]^{3-}$
d) $[FeF_6]^{3-}$ > $[Co(C_2O_4)_3]^{3-}$ >$[CoF_6]^{3-}$

38) **According to MO theory the bond orders for O_2^{2-}, CO and NO^+ respectively, are**

a) 1, 3 and 3
b) 1, 3 and 2
c) 1, 2 and 3
d) 2, 3 and 3

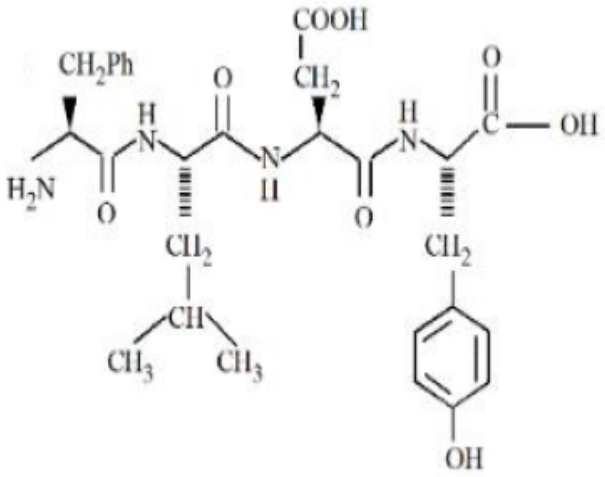
39) **A doctor prescribed the drug Equanil to a patient. The patient was likely to have symptoms of which disease?**

a) Anxiety and stress
b) Depression and hypertension
c) Stomach ulcers
d) Hyperacidity

40) **The concentration of dissolved Oxygen in water for growth of fish should be more than X ppm and Biochemical Oxygen Demand in clean water should be less than Y ppm. X and Y in ppm are, respectively.**

a) X-6, Y-5 b) X-6, Y-12
c) X-4, Y-15 d) X-4, Y-8

41) **Following tetrapeptide can be represented as**



(F, L, D, Y, I, Q, P are one letter codes for amino acids)

a) YQLF b) PLDY
c) FIQY d) FLDY

42) **Match List I and List II**

	List I		List II
A.	Osmosis	I.	Solvent molecules pass through semi permeable membrane towards solvent side.
B.	Reverse osmosis	II.	Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes
C.	Electro osmosis	III.	Solvent molecules pass through semi permeable membrane towards solution side
D.	Electrophoresis	IV.	Dispersion medium moves in an electric field.

Choose the correct answer from the options given below:

a) A-I, B-III, C-II, D-IV b) A-I, B-III, C-IV, D-II
c) A-III, B-I, C-II, D-IV d) A-III, B-I, C-IV, D-II

43) **An indicator 'X' is used for studying the effect of variation in concentration of iodide on the rate of reaction of iodide ion with H_2O_2 at room temp. The indicator 'X' forms blue colored complex with compound 'A' present in the solution. The indicator 'X' and compound A respectively are**

a) Methyl orange and H_2O_2 b) Starch and iodine
c) Starch and H_2O_2 d) Methyl orange and iodine

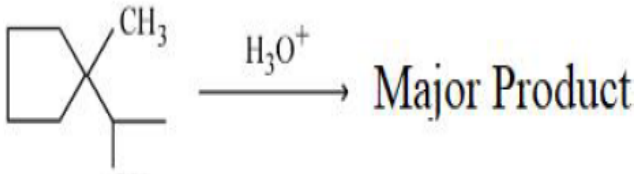
44) **Reaction of propanamide with Br_2/KOH(aq) produces:**

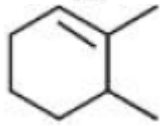
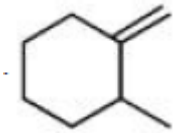
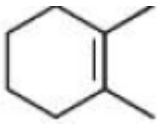
a) Ethylnitrile b) Ethylamine
c) Propylamine d) Propanenitrile

45) **When a hydrocarbon A undergoes combustion in the presence of air, it requirs 9.5 equivalents of oxygen and produces 3 equivalents of water. What is the molecular formula of A?**

a) C_9H_9 b) C_6H_6
c) C_9H_6 d) C_8H_6

46) **Find out the major product for the following reaction.**



a) 
b) 
c) 
d) 

47) **The major component of which of the following ore is sulphide based mineral?**

a) Calamine b) Siderite
c) Sphalerite d) Malachite

48) Given below are two statements:

Statement I: Nickel is being used as the catalyst for producing syn gas and edible fats.

Statement II: Silicon forms both electron rich and electron deficient hydrides. In the light of the above statements, choose the most appropriate answer from the options given below:

a) Statement I is incorrect but statement II is correct
b) Both the statements I and II are incorrect
c) Both the statements I and II are correct
d) Statement I is correct but statement II is incorrect

49) **Match List I with List II**

	List I		**List II**
A.	Elastomeric polymer	I.	Urea formaldehyde resin
B.	Fibre Polymer	II.	Polystyrene
C.	Thermosetting Polymer	III.	Polyester
D.	Thermoplastic Polymer	IV.	Neoprene

Choose the correct answer from the options given below:

a) A-II, B-I, C-IV, D-III b) A-IV, B-I, C-III, D-II
c) A-II, B-III, C-I, D-IV d) A-IV, B-III, C-I, D-II

50) **Which of the following relations are correct?**
(A) $\Delta U = q + p\Delta V$
(B) $\Delta G = \Delta H - T\Delta S$
(C) $\Delta S = \frac{q_{rev}}{T}$
(D) $\Delta H = \Delta U - \Delta nRT$

Choose the most appropriate answer from the options given below :

a) A and B Only b) C and D Only
c) B and D Only d) B and C Only

51) For conversion of compound A → B, the rate constant of the reaction was found to be 4.6×10^{-5} L mol^{-1} s^{-1}. The order of the reaction is
)

52) When 0.01 mol of an organic compound containing 60% carbon was burnt completely, 4.4 g of CO_2 was produced. The molar mass of compound _____ g mol^{-1}. (Nearest integer).
)

53) **Total number of acidic oxides among N_2O_3, NO_2, N_2O, Cl_2O_7, SO_2, CO, CaO, Na_2O and NO is**
)

54) The volume of HCl, containing 73 g L^{-1}, required to completely neutralise NaOH obtained by reacting 0.69 g of metallic sodium with water, is _____ mL (nearest integers)
(Given: molar Masses of Na, Cl, O, H, are 23, 35.5, 16 and 1 g mol^{-1} respectively)
)

55) At 298 K

N_2 (g) + 3H_2 (g) ⇌ 2NH_3 (g), $K_1 = 4\times 10^5$

N_2 (g) + O_2 (g) ⇌ 2NO (g), $K_2 = 1.6 \times 10^{12}$

$H_2\left(g\right) + \frac{1}{2}O_2\left(g\right)$ ⇌ H_2O (g), $K_3 = 1.0 \times 10^{-13}$

Based on above equilibria, the equilibrium constant of the reaction,

2NH_3 (g) + O_2(g) → 2NO(g) + 3H_2O (g) is ____ × 10^{-33} (Nearest integer).
)

56) Assume that the radius of the first Bohr orbit of hydrogen atom is 0.6 Å. The radius of the third Bohr orbit of He^+ is _____ picometer. (Nearest Integer)
)

57) On heating, $LiNO_3$ gives how many compounds among the following?

Li_2O, N_2, O_2, $LiNO_2$, NO_2
)

58) The equilibrium constant for the reaction

Zn(s) + Sn^{2+} (aq) ⇌ Zn^{2+} (aq) + Sn(s) in 1×10^{20} at 298 K. The magnitude of standard potential of Sn/Sn^{2+} if $E^{\theta}_{Zn^{2+}/Zn} = -0.76\ V$ is _____ × 10^{-2} V.

(Nearest integer).
Given : $\frac{2.303\ RT}{F} = 0.059\ V$
)

59) The denticity of the ligand present in the Fehling's reagent is
)

60) A metal M forms hexagonal close-packed structure. The total number of voids in 0.02 mol of it is _____ × 10^{21} (Nearest integer).

(Given $N_A = 6.02 \times 10^{23}$)
)

MATHEMATICS

61) **The number of 3 digit numbers, that are divisible by either 3 or 4 but not divisible by 48, is**

a) 432 b) 507
c) 472 d) 400

62) **Let S = {w_1, w_2, ...} be the sample space associated to a random experiment. Let $P\left(w_n\right) = \frac{P(W_{n-1})}{2}$, $n \geq 2$. Let A = {2k + 3ℓ : k, $\ell \in$ N} and B = {w_n : n $\in$ A}. Then P(B) is**

a) $\frac{1}{32}$ b) $\frac{3}{32}$
c) $\frac{1}{16}$ d) $\frac{3}{64}$

63) **Let $\vec{a} = 4\hat{i} + 3\hat{j}$ and $\vec{b} = 3\hat{i} - 4\hat{j} + 5\hat{k}$. If $\vec{c}$ is a vector such that $\vec{c} \cdot \left(\vec{a} \times \vec{b}\right) + 25 = 0$, $\vec{c} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) = 4$, and projection of $\vec{c}$ on $\vec{a}$ is 1, then the projection of $\vec{c}$ on $\vec{b}$ equals**

a) $\frac{3}{\sqrt{2}}$ b) $\frac{5}{\sqrt{2}}$
c) $\frac{1}{5}$ d) $\frac{1}{\sqrt{2}}$

64) **Let K be the sum of the coefficients of the odd powers of x in the expansion of $(1 + x)^{99}$. Let a be the middle term in the expansion of $\left(2 + \frac{1}{\sqrt{2}}\right)^{200}$. If $\frac{^{200}C_{99}K}{a} = \frac{2^1m}{n}$, where m and n are odd numbers, then the ordered pair (l, n) is equal to**

a) (51, 101) b) (50, 51)
c) (51, 99) d) (50, 101)

65) **The value of the integral $\int_1^2 \left(\frac{t^4+1}{t^6+1}\right)dt$ is**

a) $\tan^{-1} 2 + \frac{1}{3}\tan^{-1} 8 - \frac{\pi}{3}$
b) $\tan^{-1} \frac{1}{2} - \frac{1}{3}\tan^{-1} 8 + \frac{\pi}{3}$
c) $\tan^{-1} \frac{1}{2} + \frac{1}{3}\tan^{-1} 8 - \frac{\pi}{3}$
d) $\tan^{-1} 2 - \frac{1}{3}\tan^{-1} 8 + \frac{\pi}{3}$

66) **Let y = y(x) be the solution of the differential equation**

$x \log_e x \frac{dy}{dx} + y = x^2 \log_e x$, **(x > 1). If y(2) = 2, then y(e) is equal to**

a) $\frac{4+e^2}{4}$ b) $\frac{1+e^2}{4}$

c) $\frac{2+e^2}{2}$ d) $\frac{1+e^2}{2}$

67) **The set of all values of λ for which the equation $\cos^2 2x - 2\sin^4 x - 2\cos^2 x = \lambda$ has a real solution x, is**

a) $\left[-1, -\frac{1}{2}\right]$ b) $[-2, -1]$

c) $\left[-2, -\frac{3}{2}\right]$ d) $\left[-\frac{3}{2}, -1\right]$

68) **The letters of the word OUGHT are written in all possible ways and these words are arranged as in a dictionary, in a series. Then the serial number of the word TOUGH is**

a) 89 b) 79

c) 84 d) 86

69) **The plane 2x – y + z = 4 intersects the line segment joining the points A(a, –2, 4) and B (2, b, –3) at the point C in the ratio 2 : 1 and the distance of the point C from the origin is $\sqrt{5}$. If ab < 0 and P is the point (a – b, b, 2b – a) then CP^2 is equal to**

a) $\frac{17}{3}$ b) $\frac{16}{3}$

c) $\frac{97}{3}$ d) $\frac{73}{3}$

70) **The shortest distance between the lines**

$\frac{x-1}{2} = \frac{y+8}{-7} = \frac{z-4}{5}$ **and** $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-6}{-3}$ **is**

a) $2\sqrt{3}$ b) $4\sqrt{3}$

c) $3\sqrt{3}$ d) $5\sqrt{3}$

71) **Let f and g be twice differentiable functions on R. such that**

f" (x) =g" (x) + 6x

f'(1) = 4g'(1) – 3 = 9

f(2) = 3g (2) = 12.

Then which of the following is NOT true?

a) $|f'(x) - g'(x)| < 6 \Rightarrow -1 < x < 1$

b) $g(-2) - f(-2) = 20$

c) There exists $x_0 \in (1, 3/2)$ such that $f(x_0) = g(x_0)$

d) If $-1 < x < 2$, then $|f(x) - g(x)| < 8$

72) **The area of the region**

$A = \{(x, y) : |\cos x - \sin x| \le y \le \sin x, 0 \le x \le \frac{\pi}{2}\}$ **is**

a) $\frac{3}{\sqrt{5}} - \frac{3}{\sqrt{2}} + 1$ b) $1 - \frac{3}{\sqrt{2}} + \frac{4}{\sqrt{5}}$

c) $\sqrt{5} + 2\sqrt{2} - 4.5$ d) $\sqrt{5} - 2\sqrt{2} + 1$

73) **If** $\vec{a} = \hat{i} + 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j} + \hat{k}$, $\vec{c} = 7\hat{i} - 2\hat{j} + 4\hat{k}$, $\vec{r} \times \vec{b} + \vec{b} \times \vec{c} = \vec{0}$ **and** $\vec{r} \cdot \vec{a} = 0$**. Then** $\vec{r} \cdot \vec{c}$ **is equal to**

a) 32 b) 36

c) 34 d) 30

74) **The statement B = ((~A) ∨ B) is equivalent to:**

a) $B \Rightarrow ((\sim A) \Rightarrow B)$ b) $A \Rightarrow ((\sim A) \Rightarrow B)$

c) $A \Rightarrow (A \Leftrightarrow B)$ d) $B \Rightarrow (A \Rightarrow B)$

75) **Let R be a relation defined on N as a R b if 2a + 3b is a multiple of 5, a, b ∈ N. Then R is**

a) an equivalence relation b) not reflexive

c) transitive but not symmetric d) symmetric but not transitive

76) **If the lines** $\frac{x-1}{1} = \frac{y-2}{3} = \frac{z+3}{1}$ **and** $\frac{x-a}{2} = \frac{y+2}{3} = \frac{z-3}{1}$ **intersect at the point P, then the distance of the point P from the plane z = a is :**

a) 28 b) 22

c) 16 d) 10

77) The value of the integral $\int_{1/2}^{2} \frac{\tan^{-1} x}{x} dx$ is equal to

a) $\frac{\pi}{4}\log_e 2$ b) $\frac{\pi}{2}\log_e 2$

c) $\frac{1}{2}\log_e 2$ d) $\pi \log_e 2$

78) **The set of all vales of t ∈ R, for which the matrix**

$$\begin{bmatrix} e^t & e^{-t}(\sin t - 2\cos t) & e^{-1}(-2\sin t - \cos t) \\ e^t & e^{-t}(2\sin t + \cos t) & e^{-t}(\sin t - 2\cos t) \\ e^t & e^{-t}\cos t & e^{-t}\sin t \end{bmatrix}$$

is invertible, is

a) R b) $\left\{\left(2k+1\right)\frac{\pi}{2}, k \in Z\right\}$

c) $\left\{k\pi + \frac{\pi}{2}, k \in Z\right\}$ d) {k π, k ∈ Z}

79) **Consider a function f : IN → IR, satisfying**

f(1) + 2f(2) + 3f(3) + ... + xf(x) = x(x + 1)f(x); x ≥ 2 with f(1) = 1.

Then $\frac{1}{f(2022)} + \frac{1}{f(2028)}$ is equal to

a) 8200 b) 8000

c) 8400 d) 8100

80) **If the tangent at a point P on the parabola $y^2 = 3x$ is parallel to the line x + 2y = 1 and the tangents at the points Q and R on the ellipse $\frac{x^2}{4} + \frac{y^2}{1} = 1$ are perpendicular to the line x – y = 2, then the area of the triangle PQR is:**

a) $\frac{3}{2}\sqrt{5}$ b) $5\sqrt{3}$

c) $3\sqrt{5}$ d) $\frac{9}{\sqrt{5}}$

81) Let $\{a_k\}$ and $\{b_k\}$, k ∈ N, be two G.P.s with common ratios r_1 and r_2 respectively such that $a_1 = b_1 = 4$ and $r_1 < r_2$. Let $c_k = a_k + b_k$, k ∈ N. If $c_2 = 5$ and $c_3 = \frac{13}{4}$ then $\sum_{k=1}^{\infty} c_k - \left(12a_6 + 8b_4\right)$ is equal to

)

82) **The total number of 4-digit numbers whose greatest common divisor with 54 is 2, is**

)

83) **A triangle is formed by the tangents at the point (2, 2) on the curves $y^2 = 2x$ and $x^2 + y^2 = 4x$, and the line x + y + 2 = 0. If r is the radius of its circumcircle, then r^2 is equal to**

)

84) Let α = 8 – 14i, $A = \left\{z \in C : \frac{\alpha z - \bar{\alpha}\,\bar{z}}{z^2 - (\bar{z})^2 - 112i}\right\}$ and B = {z ∈ C : |z + 3i| = 4}. Then $\sum_{z \in A \cap B}\left(Rez - Im\ z\right)$ is equal to

)

85) Let $a_1 = b_1 = 1$ and $a_n = a_{n-1} + (n - 1)$, $b_n = n_n - 1 + a_n - 1$, ∀ n ≥ 2. If $S = \sum_{n=1}^{10} \frac{b_n}{2^n}$ and $T = \sum_{n=1}^{8} \frac{n}{2^{n-1}}$, then 2^7 (2S – T) is equal to

)

86) Let X = {11, 12, 13, ..., 40, 41} and Y = {61, 62, 63, ..., 90, 91} be the two sets of observations. If $\bar{x}$ and $\bar{y}$ are their respective means and σ^2 is the variance of all the observations in X ∪ Y, then $\left|\bar{x} + \bar{y} - \sigma^2\right|$ is equal to _____.

)

87) Let A be a symmetric matrix such that |A| = 2 and $\begin{bmatrix} 2 & 1 \\ 3 & \frac{3}{2} \end{bmatrix} A - \begin{bmatrix} 1 & 2 \\ \alpha & \beta \end{bmatrix}$. If the sum of the diagonal elements of A is S, then is equal to

___

)

88) If the equation of the normal to the curve $y = \frac{x-a}{(x+b)(x-2)}$ at the point (1, –3) is

x – 4y = 13, then the value of a +b is equal to

)

89) A circle with centre (2, 3) and radius 4 intersects the line x + y = 3 at the points P and Q. If the tangents at P and Q intersect at the point S (α, β), then 4α – 7β is equal to

)

90) Let $\alpha_1\ \alpha_2, ..., \alpha_7$ be the roots of the equation $x^7 + 3x^5 - 13x^3 - 15x = 0$ and $|\alpha_1| \geq |\alpha_2| \geq ... \geq |\alpha_7|$. Then $\alpha_1\ \alpha_2 - \alpha_3\ \alpha_4 + \alpha_5\ \alpha_6$ is equal to

)