SATISH SCIENCE ACADEMY
DHANORI PUNE - 411015

Mhtcet pcm 4
ENTRANCE EXAM - MHT - CET

Time Allowed: 3 hours **Maximum Marks :** 200

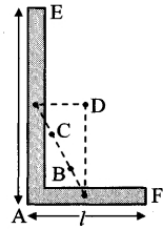
General Instructions:

- All questions are compulsory.
- There are two sections.
- Section A has 100 questions from Physics and Chemistry.
- Section B has 50 questions from Mathematics.

Section - A (Physics)

1) A boy playing on the roof of a 10 m high building throws a ball with a speed of 10 ms^{-1} at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground? (g = 10 ms^{-2}, sin 30° = $\frac{1}{2}$, cos 30° = $\frac{\sqrt{3}}{2}$) **[1]**
   a) 2.60 m b) 8.66 m
   c) 5.20 m d) 4.33 m

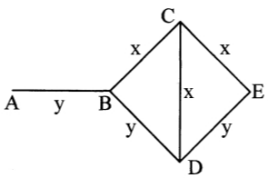
2) A uniform metal strip is bent into an L - shape as shown. The centre of mass of the strip is likely to be at



[1]
   a) Point B b) Point A
   c) Point C d) Point D

3) If change in the value of g at a depth d below the surface of the earth is equal to that on the surface of the earth at latitude of angleϕ , then **[1]**
   a) $\phi = \cos^{-1}\left[\sqrt{\frac{R\omega}{gd}}\right]$
   b) $\phi = \cos^{-1}\left[\frac{gd}{R\omega}\right]$
   c) $\phi = \cos^{-1}\left[\frac{\sqrt{d}}{R^2\omega^2}\right]$
   d) $\phi = \cos^{-1}\left[\frac{\sqrt{gd}}{R\omega}\right]$

4) Three rods of material x and three roads of material y are connected as shown in figure. All rods are indentical in length and cross - sectional area. If end A is maintained at 120 °C, E at 20 °C, thermal conductivity of x is 0.92 cal/s cm °C and that of y is 0.46 cal/s cm °C, then the temperature of junctions B, C, D respectively are



[1]
   a) 60 °C, 40 °C, 40 °C b) 20 °C, 30 °C, 40 °C
   c) 40 °C, 60 °C, 30 °C d) 30 °C, 20 °C, 20 °C

5) For propagation of sound waves medium should be _____. **[1]**
   a) Chemically ionized b) Denser
   c) Elastic d) Plastic

6) A prism of angle 4° gives a deviation of 2.4°. The refractive index of the material of the prism is **[1]**
   a) 1.8 b) 1.6
   c) 1.5 d) 1.55

7) When a ray of monochromatic light enters from rarer medium to denser medium obliquely, the angle of incidence i and angle of refraction r is related as **[1]**
   a) I > r b) I = r
   c) I≤ r d) I < r

8) The angle between the two - plane rectangular refracting surface is called _____. **[1]**
   a) Dispersion angle
   b) Angle of refraction
   c) Refracting angle of the prism
   d) Reflecting angle of the prism

9) For the following reaction, which is correct?
$_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_{2}He^{4}$ **[1]**
   a) Heat is lost.
   b) Heat is gained.
   c) Net charge is conserved.
   d) Net momentum is conserved.

10) The moment of inertia of a uniform circular disc of mass M and radius R about any of its diameters is$\frac{1}{4}$ MR^2. What is the moment of inertia of the disc about an axis passing through its centre and normal to the disc? **[1]**
   a) $\frac{1}{2}$ MR^2 b) MR^2
   c) 2 MR^2 d) $\frac{3}{2}$ MR^2

11) If the length of simple pendulum is increased by 300%, then the time period will be increased by **[1]**
   a) 200% b) 100%
   c) 300% d) 400%

12) The velocity of a particle executing a simple harmonic motion is 13 ms^{-1}, when its distance from the equilibrium position (Q) is 3 m and its velocity is 12 ms^{-1}, when it is 5 m away from Q. The frequency of the simple harmonic motion is **[1]**
   a) $\frac{5}{8\pi}$ b) $\frac{8\pi}{5}$
   c) $\frac{8}{5\pi}$ d) $\frac{5\pi}{8}$

13) Time period of a pendulum on earth surface is T_1. It is arranged on earth surface at a height R and thus its time period is T_2. What is the ratio of T_1 and T_2? **[1]**
   a) 0.2 b) 0.8
   c) 1 d) 0.5

14) A sinusoidal A.C. current flows through a resistor of resistance R. If the peak current is I_p, then the power dissipated is **[1]**

a) $\frac{1}{\pi}I_p^2R$
b) $\frac{4}{\pi}I_p^2R$
c) $I_p^2R\cos\theta$
d) $\frac{1}{2}I_p^2R$

15) If T is the surface tension of a soap solution, the amount of work done in doubling the radius of a soap bubble of radius r is **[1]**

a) $24\pi\ r^2T$ b) $16\pi\ r^2T$
c) $32\pi\ r^2T$ d) $8\pi\ r^2T$

16) A note is _____. **[1]**

a) Pure sine vibration
b) Irregular disturbance
c) Pure tan vibration
d) Straight motion

17) A vibrating string of certain length l under a tension T resonates with a mode corresponding to the first overtone (third harmonic) of an air column of length 75 cm inside a tube closed at one end. The string also generates 4 beats per second when excited along with a tuning fork of frequency n. Now when the tension of the string is slightly increased, the number of beats reduces to 2 per second. Assuming the velocity of sound in air to be 340 m/s, the frequency n of the tuning fork in Hz is **[1]**

a) 117.3 b) 336
c) 109.3 d) 344

18) What is nature of waves on stretched sonometer wire? **[1]**

a) Transverse progressive polarised.
b) Transverse stationary polarised.
c) Longitudinal progressive polarised.
d) Unpolarised.

19) Two containers are filled; each with a different gas. The two containers are at the same temperature. If the molecular weights of the two gases are M_A and M_B, then the average momenta (in magnitude) of the molecules are related as **[1]**

a) $p_A = \left(\frac{M_B}{M_A}\right) p_B$
b) $p_A = \left(\frac{M_A}{M_B}\right)^{\frac{1}{2}} p_B$
c) $P_A = p_B$
d) $p_A = \left(\frac{M_B}{M_A}\right)^{\frac{1}{2}} p_B$

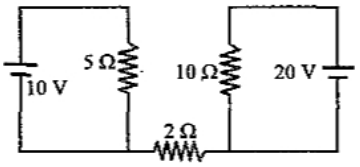
20) The distance between the first and the sixth minima in the diffraction pattern of a single slit is 0.5 mm. The screen is 0.5 m away from the slit. If the wavelength of light used is $5000\mathring{A}$, then the slit width will be **[1]**

a) 2.5 mm b) 1.25 mm
c) 1.0 mm d) 5 mm

21) In a metrebridge experiment, when a nichrome wire is in the right gap, the balancing length is 60 cm. When the nichrome wire is uniformly stretched to increase its length by 20% and again connected in the right gap balancing length is nearly **[1]**

a) 31 cm b) 51 cm
c) 41 cm d) 61 cm

22) Find out the value of current through 2Ω resistance for the given circuit



[1]

a) 5 A b) 2 A
c) 4 A d) Zero

23) A galvanometer of resistance 50Ω gives a full scale deflection for a current 5×10^{-4} A. The resistance that should be connected in series with the galvanometer to read 3 V is **[1]**

a) 5059Ω b) 5050Ω
c) 595Ω d) 5950Ω

24) A potentiometer wire is 10 m long and has a resistance of 2Ω /m. It is connected in series with a battery of e.m.f. 3 V and a resistance of 10 Ω . The potential gradient along the wire in V/m is **[1]**

a) 0.1 b) 0.02
c) 0.01 d) 0.2

25) According to right hand thumb rule, if current is directed in upward direction then the direction of magnetic induction is _____. **[1]**

a) Same as current
b) Opposite to that of current
c) Clockwise
d) Anticlockwise

26) In a cyclotron a charged particle **[1]**

a) Undergoes acceleration all the time.
b) Speeds up between the dees because of the magnetic field.
c) Speeds up in dee.
d) Slows down within a dee and speeds up between dees.

27) Magnetic fields at two points on the axis of a circular coil at a distance of 0.05 m and 0.2 m from the centre are in the ratio 8 : 1. The radius of the coil is **[1]**

a) 0.1 m b) 0.15 m
c) 0.2 m d) 1.0 m

28) If the current flowing in a circular loop is in anticlockwise direction then the magnetic induction will be **[1]**

a) Along the direction of current.
b) Opposite to the direction of current.
c) Directed inwards.
d) Directed outwards.

29) A thin bar magnet oscillates with a time period T. If it is cut into two equal pieces along its axis, time period of oscillation of each piece is **[1]**

a) T b) $\frac{T}{2}$
c) $\frac{T}{4}$ d) 2T

30) Magnetization of a sample is **[1]**

a) Volume of sample per unit magnetic moment
b) Ratio of magnetic moment and pole strength
c) Net magnetic moment per unit volume
d) Ratio of pole strength to magnetic moment

31) In a hydrogen atom, an electron of charge 'e' revolves in a orbit of radius 'r' with speed 'v'. Then magnetic moment associated with electron is **[1]**

a) 2evr
b) Evr
c) $\frac{evr}{3}$
d) $\frac{evr}{2}$

32) A magnetic needle of magnetic moment 6.7×10^{-2} Am^2 and moment of inertia 7.5×10^{-6} kg m^2 is performing simple harmonic oscillations in a magnetic field of 0.01 T. Time taken for 10 complete oscillations is **[1]**
a) 8.89 s
b) 6.65 s
c) 8.76 s
d) 6.98 s

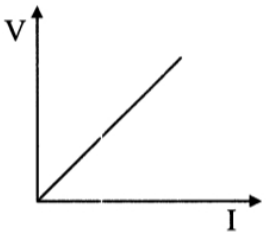
33) If in a galvanometer the coil is wound on a bad conductor, the eddy current will be **[1]**
a) 50% of the actual value
b) Minimum
c) Zero
d) Maximum

34) A coil of effective area 2 m^2 is rotated so as to cut a magnetic field of induction 7×10^{-5} Wb/m^2. If the coil makes 100 revolutions/s, then the maximum e.m.f. induced in the coil is **[1]**
a) 88 m V
b) 44 m V
c) 200 m V
d) 22 m V

35) Induction coil is an instrument based on the principle of **[1]**
a) Mutual induction.
b) Electromagnetic induction.
c) Self induction.
d) Induction furnace.

36) A metallic surface is illuminated by a monochromatic light of wavelengthλ . The potential difference required to stop the ejection of electrons is $3V_0$. When the same surface is illuminated by the light of wavelength 2λ , then the potential difference required to stop the ejection of electrons is V_0. Then for emission of photoelectrons, the threshold wavelength for the metal surface will be **[1]**
a) 6λ
b) 8λ
c) 4λ /3
d) 4λ

37) The graph between stopping potential and intensity of light in photoelectric effect is **[1]**

a)


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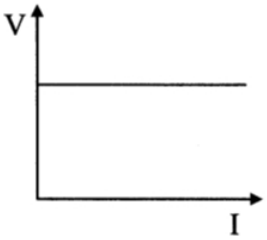

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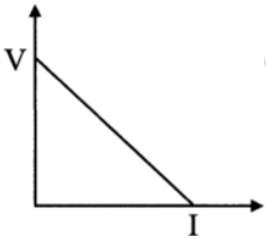

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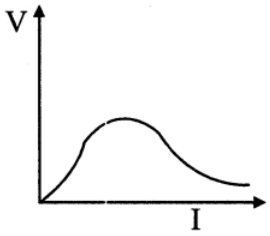


38) Speed of photons in photoelectric emission is **[1]**
a) One third of light speed.
b) Same as light.
c) Greater than light speed.
d) One - fourth of light speed.

39) Electrons in hydrogen atom jump from orbit corresponding to n =∞ to n = 5. The energy of the emitted photon is **[1]**
a) 0.27 eV
b) 3.4 eV
c) 0.38 eV
d) 0.54 eV

40) The wavelength of emitted radiation in terms of R (the Rydberg constant) is$\lambda = \frac{36}{5R}$. The electron jumps from **[1]**
a) 4^{th} orbit to 3^{rd} orbit
b) 3^{rd} orbit to 2^{nd} orbit
c) 3^{rd} orbit to 1^{st} orbit
d) 4^{th} orbit to 2^{nd} orbit

41) An electron in first orbit of hydrogen moves in circular orbit of radius r with velocity v. The current through loop is **[1]**
a) Evr
b) $\frac{ev}{2\pi r}$
c) 3 ev
d) $\frac{2\pi ev}{r}$

42) An atom consists of a tiny particle named nucleus whose size is _____ the size of the atom. **[1]**
a) 10^{15} times smaller than
b) 100 times larger than
c) 10 times larger than
d) 100000 times smaller than

43) What is the wavelength of light for the least energetic photon emitted in the Lyman series of the hydrogen spectrum?
(Take hc = 1240 eV nm) **[1]**
a) 122 nm
b) 82 nm
c) 102 nm
d) 150 nm

44) When the electron in hydrogen atom is excited from the 4^{th} stationary orbit to the 5^{th} stationary orbit, the change in the angular momentum of the electron in joule - second is (h = 6.64×10^{-34} Js) **[1]**
a) 4.16×10^{-34}
b) 3.32×10^{-34}
c) 1.05×10^{-34}
d) 2.08×10^{-34}

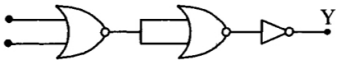
45) Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atom in the ground state is excited by monochromatic radiation of photon energy 12.1 eV. The number of spectral lines emitted by hydrogen atoms according to Bohr's theory will be **[1]**
a) 1
b) 2
c) 3
d) 4

46) When a hydrogen atom is excited from ground state to first excited state then
i. Its kinetic energy increases by 10.2 eV.

ii. Its kinetic energy decreases by 20.4 eV.
iii. Its potential energy decreases by 20.4 eV.
iv. Its angular momentum increases by 1.05×10^{-34} J - s.

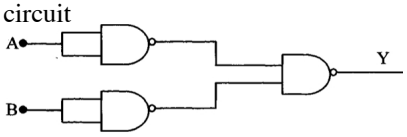
[1]
a) Option (a) b) Option (c)
c) Option (d) d) Option (b)

47) The given electrical network is equivalent to



[1]
a) AND gate b) NOR gate
c) NOT gate d) OR gate

48) Identify the logic operation carried out by the following circuit



[1]
a) AND b) OR
c) NOR d) NAND

49) AC signal is preferred over DC signal because
i. Generation of AC at a power station is more cost effective than producing DC power.
ii. The transmission of AC power is also more economic than transmitting DC power.
iii. Many electronic gadgets require an AC supply.
iv. Both generation of AC at a power station is more cost effective than producing DC power and the transmission of AC power is also more economic than transmitting DC power.

[1]
a) Option (c) b) Option (d)
c) Option (a) d) Option (b)

50) A Zener diode [1]

a) Has sharp breakdown at low reverse voltage.
b) Has negative temperature coefficient of resistance.
c) Works only in forward bias.
d) Rectifies Zener voltage.

Section - A (Chemistry)

51) For practical purpose, the average atomic mass of oxygen (which is an isotopic mixture of ^{16}O, ^{17}O and ^{18}O) is assumed to be equal to _____. [1]
a) 16.0 u b) 15.0 u
c) 18.0 u d) 17.0 u

52) The mass of a proton is equal to _____. [1]
a) 1.672 u b) 0.0055 u
c) 1.00727 u d) 1.6000 u

53) Which of the following is INCORRECT regarding balancing equations of redox reactions?
i. Balancing of equations of redox reactions by oxidation number method involves the principle that net change in the total oxidation numbers is zero.
ii. While balancing of equations of redox reactions by ion - electron method, the overall reaction is split into two half reactions.
iii. The equations are balanced with respect to both, atoms as well as charges.
iv. In balancing of equations by oxidation number method, the first step involves writing the unbalanced net equation and balancing all the atoms present in it.

[1]
a) Option (A) b) Option (D)
c) Option (B) d) Option (C)

54) i. $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$
ii. $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$
The role of hydrogen peroxide in the above reactions is respectively____. [1]

a) Reducing in (i) and oxidizing in (ii)
b) Reducing in (i) and (ii)
c) Oxidizing in (i) and (ii)
d) Oxidizing in (i) and reducing in (ii)

55) The volume occupied by 2 mole of an ideal gas at 3×10^5 N m^{-2} pressure and 300 K temperature (R = 8.314 J K^{-1} mol^{-1}) is _____. [1]
a) 18.6 dm^3 b) 1.66 dm^3
c) 16.6 dm^3 d) 32.2 dm^3

56) Choose the CORRECT statement. [1]

a) Colloidal system is homogeneous.
b) Lyophobic colloid can be coagulated by persistent dialysis.
c) Lyophilic colloids are irreversible.
d) Detergent is an example of multimolecular colloid.

57) Number of σ and π bonds present in but - 1 - en - 3 - yne respectively are _____. [1]
a) $6\sigma, 2\pi$ b) $8\sigma, 3\pi$
c) $7\sigma, 3\pi$ d) $5\sigma, 2\pi$

58) The minimum number of carbon atoms necessary for an alkane to form a branched structure is _____. [1]
a) 6 b) 9
c) 4 d) 3

59) Resonance will NOT be shown by _____. [1]
a) Buta - 1,3 - diene b) Cyclohexane
c) Benzaldehyde d) Nitrobenzene

60) Solid SO_2 is a/an _____ crystal. [1]
a) Ionic b) Amorphous
c) Covalent network d) Molecular

61) Which of these species will have a non - zero magnetic moment? [1]
a) Ar b) Mg
c) Na^+ d) F^-

62) The elevation in the boiling point of a solution of 13.44 g of $CuCl_2$ in 1 kg of water will be _____ K. (Molecular mass of $CuCl_2$ = 134.4 and K_b = 0.52 K m^{-1}) [1]
a) 0.16 b) 0.2
c) 0.1 d) 0.05

63) Which of the following is INCORRECT for supersaturated solution? [1]

a) The supersaturated solution changes to saturated solution upon precipitation.
b) A supersaturated solution contains greater than the equilibrium amount of solute in a given amount of solvent.
c) Supersaturated solutions are very stable.
d) The precipitation occurs by the addition of a tiny crystal of solute.

64) The intensive property among the following quantities is _____. [1]

a) Volume
b) Mass
c) Density
d) Heat capacity

65) TheΔ S for the vaporization of 1 mol of water is 88.3 J/mol K. The value of Δ S for the condensation of 1 mol of water vapour will be _____. **[1]**

a) $(88.3)^2$ J/mol K
b) - 88.3 J/mol K
c) 88.3 J/mol K
d) $\frac{1}{88.3}$ J/mol K

66) During electrolysis of a solution of $AgNO_3$, 9650 coulombs of charge pass through the electroplating bath, and the mass of silver deposited in the cathode will be _____. **[1]**

a) 21.6 g
b) 108 g
c) 10.8 g
d) 1.08 g

67) Which of the following is INCORRECT?

i. Electrolytic conductivity decreases with a decrease in the concentration of the solution.
ii. Molar conductivity decreases with a decrease in the concentration of solution.
iii. Molar conductivity of electrolytes increases rapidly on dilution.
iv. Molar conductivity of strong electrolytes varies linearly with square root of concentration.

[1]

a) Option (A)
b) Option (C)
c) Option (D)
d) Option (B)

68) The plot between reactant concentration versus time for a zero order reaction is represented by: **[1]**

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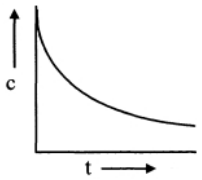

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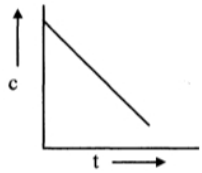

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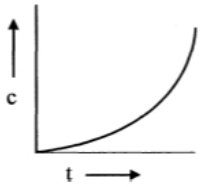

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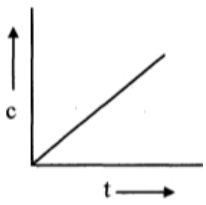


69) Number of reactant molecules participating in a chemical reaction is called _____. **[1]**

a) Molecularity
b) Decay constant
c) Order
d) Rate law

70) Which of the following is a strong electrolyte? **[1]**

a) HCl
b) H_2S
c) H_2CO_3
d) HF

71) K_{sp} for $Cr(OH)_3$ is 2.7×10^{-31}. What is its solubility in mol dm^{-3}? **[1]**

a) 8×10^{-8}
b) 0.18×10^{-8}
c) 1×10^{-8}
d) 1.1×10^{-8}

72) In the reaction $B(OH)_3 + 2H_2O \longrightarrow [B(OH)_4]^- + H_3O^+$ $B(OH)_3$functions as _____. **[1]**

a) Protonic acid
b) Bronsted acid
c) Lewis acid
d) Lewis base

73) _____ is a decay product of radium. **[1]**

a) Xenon
b) Helium
c) Radon
d) Polonium

74) Hexahalides of group 16 elements undergo _____. **[1]**

a) Sp^3
b) $Sp^3 d^2$
c) $Sp^3 d$
d) Dsp^3

75) Which of the following group 16 element is present in galena and zinc blende? **[1]**

a) Selenium
b) Sulphur
c) Oxygen
d) Tellurium

76) The electronic configuration of manganese (Z = 25) is _____. **[1]**

a) $[Ar]3d^6\ 4s^1$
b) $[Ar]3d^5\ 4s^2$
c) $[Ar]3d^5\ 4s^1$
d) $[Ar]3d^4\ 4s^2$

77) Which of the following lanthanoid ions is diamagnetic? (Atomic number.: Ce = 58, Sm = 62, Eu = 63, Yb = 70) **[1]**

a) Ce^{2+}
b) Eu^{2+}
c) Yb^{2+}
d) Sm^{2+}

78) $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits _____.

i. Ionization isomerism, geometrical isomerism, and optical isomerism
ii. Linkage isomerism, geometrical isomerism, and optical isomerism
iii. Linkage isomerism, ionization isomerism, and optical isomerism
iv. Linkage isomerism, geometrical isomerism, and ionization isomerism

[1]

a) Option (b)
b) Option (d)
c) Option (c)
d) Option (a)

79) The coordination number and the oxidation state of the element 'E' in the complex $[E(en)_2(C_2O_4)]NO_2$ (where (en) is ethylenediamine) are, respectively _____. **[1]**

a) 4 and 2
b) 6 and 3
c) 6 and 2
d) 4 and 3

80) Ammonia molecule and oxalate ion have _____ coordination sites respectively. **[1]**

a) Three, two
b) One, three
c) Two, one
d) One, two

81) Both methane and ethane can be prepared in one step from _____. **[1]**

a) CH_3OH
b) CH_3Br
c) CH_3CH_2OH
d) C_2H_4

82) Which one of the following compounds most readily undergoes substitution by S_N2 mechanism? **[1]**

a) $CH_3 - CH_2 - Cl$

b) $CH_3 - \underset{\underset{C_2H_5}{|}}{\overset{\overset{CH_3}{|}}{C}} - Cl$

c) $(CH_3)_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{Cl}{|}}{CH}} - C - H$

d) $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - Cl$

83) Arenes on treatment with chlorine in presence of ferric chloride as a catalyst undergo what type of reaction? [1]

a) Electrophilic addition
b) Electrophilic substitution
c) Nucleophilic addition
d) Nucleophilic substitution

84) _____ is used as an ingredient in mouthwashes. [1]
a) Methanol b) Propanol
c) Phenol d) Butanol

85) - CH_2OH is the functional group of _____. [1]
a) Quaternary alcohols b) Tertiary alcohols
c) Primary alcohols d) Secondary alcohols

86) Which of the following is tertiary alcohol? [1]

a) $CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - OH$

b) $CH_3 - \underset{\underset{CH_2}{|}}{\overset{\overset{CH_3}{|}}{CH_2}} - CH_2OH$

c) $\underset{\underset{CH_2-OH}{|}}{\overset{\overset{CH_3}{|}}{CH}} - OH$

d) CH_3 - CH_2 - OH

87) Methanal is a ____ at room temperature. [1]
a) Liquid b) Gas
c) Semi - solid d) Solid

88) The reaction between a carboxylic acid and alcohol in presence of cone. H_2SO_4 will give a/an _____. [1]
a) Alkane b) Acid anhydride
c) Ester d) Secondary alcohol

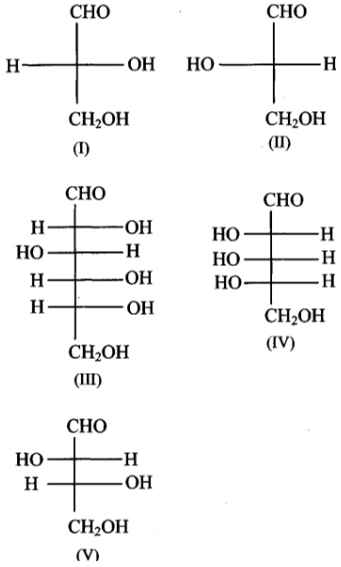
89) Which of the following compounds will NOT give the positive test for Tollens' reagent?
i. Propanone
ii. Propanal
iii. Ethanal
iv. Both Propanal and Ethanal
[1]
a) Option (a) b) Option (b)
c) Option (c) d) Option (d)

90) When all the three hydrogen atoms of the ammonia molecule are replaced by aryl groups, then the corresponding amine obtained is _____ amine. [1]
a) A tertiary aromatic b) A secondary aromatic
c) A primary aliphatic d) A tertiary aliphatic

91) The reaction in which - C=N group is converted into - CH_2NH_2 group is called _____. [1]
a) Hofmann alkylation b) Mendius reaction
c) Hofmann degradation d) Hofmann elimination

92) Common name of N,N - dimethylbenzenamine _____. [1]
a) Diphenylamine b) N,N - dimethylaniline
c) Benzylamine d) Methylphenylamine

93) Which of the following compounds represents D - configuration?



[1]
a) I, III, V b) I, V
c) II, III, V d) II, IV

94) The number of sp^3 and sp^2 hybridized C - atoms in the open chain structure of glucose are respectively _____. [1]
a) 5 and 1 b) 4 and 2
c) 1 and 5 d) 2 and 4

95) Which polymer from the following is prepared from cyclic monomer? [1]
a) Nylon 6,6 b) Nylon 6
c) Orlon d) Terylene

96) Based on intermolecular forces, polymers are classified as: [1]

a) Elastomers, fibers, thermoplastic polymers and thermosetting polymers
b) Linear, branched chain and cross - linked polymers
c) Addition, condensation and ring opening polymers
d) Homopolymers and copolymers

97) The total number of carbon atoms present in the starting materials used for nylon 6,6 are _____. [1]
a) 6 b) 8
c) 10 d) 12

98) Which of the following instruments can be employed for the preliminary confirmation of the formation of nanoparticles? [1]

a) Fourier Transform Infrared Spectrophotometer
b) X - ray diffractometer
c) UV - visible spectrophotometer
d) Transmission Electron Microscope

99) _____ can be categorised as benign solvent. [1]
a) Carbon tetrachloride b) Dichloromethane
c) Water d) Chloroform

100) Identify the reactions from the following which involve the protection and deprotection of functional groups. [1]

a) M - Hydroxybenzaldehyde to m - hydroxybenzoic acid
b) All of these
c) Aniline to p - nitroaniline
d) Aniline to p - bromoaniline

Section - B (Mathematics)

101) The value of cos 105° + sin 105° is [2]

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

102) If the lines ax + 2y + 1 = 0, bx + 3y + 1 = 0 and cx + 4y + 1 = 0 are concurrent, then a, b, c are in **[2]**
a) H. P. b) H.M.
c) A.P. d) G. P.

103) The equation $(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$ represents a circle whose centre is **[2]**
a) $\left(\frac{x_1-x_2}{2}, \frac{y_1-y_2}{2}\right)$
b) $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
c) (x_1, y_2)
d) (x_2, y_2)

104) The S.D. and C.V. for the data 75, 78, 80, 86, 91, 88, 83 is **[2]**
a) 4.98 and 5.67 b) 5.29 and 6.37
c) 5.29 and 5.67 d) 4.98 and 6.37

105) In a certain town, 60% of the families own a car, 30% own a house and 20% own both a car and a house. If a family is randomly chosen, what is the probability that this family owns a car or a house but not both? **[2]**
a) 0.5 b) 0.9
c) 0.1 d) 0.7

106) Ifω ($\neq$ 1) is a cube root of unity and $(1 + \omega)^7 = A + B\omega$, then A and B are respectively, the numbers **[2]**
a) 0, 1 b) - 1, 1
c) 1, 0 d) 1, 1

107) There are 7 greeting cards, each of a different colour and 7 envelopes of same 7 colours as that of the cards. The number of ways in which the cards can be put in envelopes, so that exactly 4 of the cards go into envelopes of respective colour is **[2]**
a) $3!{}^4C_4$ b) $2\cdot {}^7C_3$
c) ${}^7C_3$ d) $3!{}^7C_3{}^4C_3$

108) If $f(x) = \cos\left[\pi^2\right] x + \cos\left[-\pi^2\right] x$, then **[2]**
a) $f\left(\frac{\pi}{2}\right) = -1$
b) $f(\pi) = 1$
c) $f(-\pi) = 2$
d) $f\left(\frac{\pi}{4}\right) = 2$

109) Which of the following is a statement in logic?
i. Go away
ii. How beautiful!
iii. X > 5
iv. 2 = 3
[2]
a) Option (i) b) Option (iv)
c) Option (iii) d) Option (ii)

110) If $P = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, $Q = \begin{bmatrix} 1 & -2 & -3 \\ -3 & 1 & 9 \\ 0 & 0 & -5 \end{bmatrix}$ then $(PQ)^{-1}$ equals to **[2]**
a) Zero matrix b) Diag [- 5, - 5, - 5]
c) $-\frac{1}{5} I_3$ d) I_3

111) If $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$, then M_{21}= **[2]**
a) 1 b) 3
c) 2 d) - 1

112) If $A = [a_{ij}]_{2\times 2}$, where $a_{ij} = \begin{cases} i + j, & \text{if } i \neq j \\ i^2 - 2j, & \text{if } i = j \end{cases}$ then A^{-1} is equal to **[2]**
a) $\frac{1}{9}\begin{bmatrix} 4 & 1 \\ -1 & 2 \end{bmatrix}$
b) $\frac{1}{9}\begin{bmatrix} 1 & 3 \\ 3 & 0 \end{bmatrix}$
c) $\frac{1}{9}\begin{bmatrix} 0 & -3 \\ -3 & -1 \end{bmatrix}$
d) $\frac{1}{9}\begin{bmatrix} 0 & 3 \\ 3 & 1 \end{bmatrix}$

113) If $5\cos 2\theta + 2\cos^2\frac{\theta}{2} + 1 = 0$, $-\pi < \theta < \pi$, then θ = **[2]**
a) $\frac{\pi}{3}, \pi - \cos^{-1}\frac{3}{5}$
b) $\frac{\pi}{3}$
c) $\cos^{-1}\frac{3}{5}$
d) $\frac{\pi}{3}, \cos^{-1}\frac{3}{5}$

114) If $\sin^2 x - 2\cos x + \frac{1}{4} = 0$, then x has value **[2]**
a) $2n\pi + \frac{\pi}{6}$
b) $2n\pi + \frac{\pi}{4}$
c) $2n\pi \pm \frac{\pi}{3}$
d) $2n\pi + \frac{\pi}{12}$

115) If $\sin\left(\sin^{-1}\frac{1}{5} + \cos^{-1}x\right) = 1$, then x is equal to **[2]**
a) $\frac{1}{5}$ b) $\frac{4}{5}$
c) 0 d) 1

116) If in a triangle the angles are in A. P. and b : c = $\sqrt{3} : \sqrt{2}$, then $\angle$ A is equal to **[2]**
a) 60° b) 30°
c) 75° d) 15°

117) If $\frac{1-\tan^2\theta}{\sec^2\theta} = \frac{1}{2}$, then the general value of θ is **[2]**
a) $N\pi + \frac{\pi}{6}$
b) $N\pi + \frac{\pi}{3}$
c) $2n\pi \pm \frac{\pi}{6}$
d) $N\pi \pm \frac{\pi}{6}$

118) $\int_0^{\frac{2}{3}} \frac{dx}{4+9x^2}$ = **[2]**
a) $\frac{\pi}{4}$ b) $\frac{\pi}{12}$
c) 0 d) $\frac{\pi}{24}$

119) $\int_0^{\frac{\pi}{2}} \cos^6 x \, dx$ = **[2]**
a) $\frac{5}{32}$ b) $\frac{5}{16}$
c) $\frac{5\pi}{16}$ d) $\frac{5\pi}{32}$

120) $\int_0^1 (1-x)^9 \, dx$ = **[2]**
a) 1 b) $\frac{11}{10}$
c) 2 d) $\frac{1}{10}$

121) $\int_a^b \frac{\log x}{x} \, dx$ = **[2]**
a) $\frac{1}{2}\log(ab)\log\left(\frac{a}{b}\right)$
b) $\text{Log}\left(\frac{\log b}{\log a}\right)$
c) $\text{Log}(ab)\log\left(\frac{b}{a}\right)$
d) $\frac{1}{2}\log(ab)\log\left(\frac{b}{a}\right)$

122) $\int_0^{\frac{\pi}{4}} \sec x \log(\sec x + \tan x) \, dx$ = **[2]**
a) $[\log(\sqrt{2}-1)]^2$
b) $[\log(1+\sqrt{2})]^2$
c) $\frac{1}{2}[\log(\sqrt{2}-1)]^2$
d) $\frac{1}{2}[\log(1+\sqrt{2})]^2$

123) The position vector of the point which divides internally in the ratio 2 : 3, the join of the points$2\vec{a} - 3\vec{b}$ and $3\vec{a} - 2\vec{b}$, is **[2]**
a) $\frac{3}{5}\vec{a} - \frac{2}{5}\vec{b}$
b) $\frac{12}{5}\vec{a} + \frac{13}{5}\vec{b}$

c) $\frac{2}{5}\vec{a} - \frac{3}{5}\vec{b}$
d) $\frac{12}{5}\vec{a} - \frac{13}{5}\vec{b}$

124) The angle between two adjacent sides $\vec{a}$ and $\vec{b}$ of parallelogram is $\frac{\pi}{6}$. If $\vec{a} = (2, -2, 1)$ and $|\vec{b}| = 2|\vec{a}|$, then area of this parallelogram is **[2]**
a) $\frac{3}{4}$ b) $\frac{9}{2}$
c) 18 d) 9

125) If $\vec{a}$, $\vec{b}$, $\vec{c}$ are three non - zero vectors which are pairwise non - collinear. If $\vec{a} + 3\vec{b}$ is collinear with $\vec{c}$ and $\vec{b} + 2\vec{c}$ is collinear with $\vec{a}$, then $\vec{a} + 3\vec{b} + 6\vec{c}$ is **[2]**
a) $\vec{a} + \vec{c}$
b) $\vec{0}$
c) $\vec{a}$
d) $\vec{c}$

126) The vector of magnitude 6 which is equally inclined to the co - ordinate axes is **[2]**
a) $\pm 2\sqrt{3}(\hat{i} + \hat{j} + \hat{k})$
b) $3\sqrt{3}(\hat{i} + \hat{j} + \hat{k})$
c) $\sqrt{3}(\hat{i} + \hat{j} + \hat{k})$
d) $\pm 2(\hat{i} + \hat{j} + \hat{k})$

127) If the slope of one of the lines represented by ax^2 - 6xy + y^2 = 0 is twice the other, then **a** is equal to **[2]**
a) 2 b) 1
c) 8 d) 4

128) The co - ordinates of the foot of perpendicular drawn from point P(1, 0, 3) to the join of points A(4, 7, 1) and B(3, 5, 3) is **[2]**
a) $\left(\frac{5}{3}, \frac{7}{3}, \frac{17}{3}\right)$
b) (5, 7, 1)
c) $\left(\frac{5}{3}, \frac{2}{3}, \frac{7}{3}\right)$
d) $\left(\frac{2}{3}, \frac{5}{3}, \frac{7}{3}\right)$

129) The distance of the point (1, 2, 1) from the line $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{2}$ is **[2]**
a) $\frac{2\sqrt{5}}{3}$ b) $\frac{20}{3}$
c) $\frac{\sqrt{5}}{3}$ d) $\frac{2\sqrt{3}}{5}$

130) The equation of the plane passing through $A(x_1, y_1, z_1)$ and containing the line $\frac{x-x_2}{d_1} = \frac{y-y_2}{d_2} = \frac{z-z_2}{d_3}$ is **[2]**

a) $\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$

b) $\begin{vmatrix} x + x_1 & y + y_1 & z + z_1 \\ x_2 + x_1 & y_2 + y_1 & z_2 + z_1 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$

c) $\begin{vmatrix} x - d_1 & y - d_2 & z - d_3 \\ x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \end{vmatrix} = 0$

d) $\begin{vmatrix} x & y & z \\ x_1 - x_2 & y_1 - y_2 & z_1 - z_2 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$

131) If $y = a^x \cdot b^{2x-1}$, then $\frac{d^2y}{dx^2}$ is **[2]**
a) $Y^2 \cdot \log ab^2$ b) $Y \cdot \log ab^2$
c) Y^2 d) $Y(\log ab^2)^2$

132) If $y = \frac{a^{\cos^{-1} x}}{1 + a^{\cos^{-1} x}}$ and $z = a^{\cos^{-1} x}$, then $\frac{dy}{dz} =$ **[2]**
a) $-\frac{1}{1 + a^{\cos^{-1} x}}$
b) $\frac{1}{1 + a^{\cos^{-1} x}}$
c) $\frac{1}{1 + a^{\cos^{-1} x}}$
d) $\frac{1}{\left(1 + a^{\cos^{-1} x}\right)^2}$

133) If the slope of the tangent to the circle S = x^2+ y^2 - 13 = 0 at (2, 3) is m, then the point $(m, \frac{-1}{m})$ is **[2]**
a) A point on the circle S = 0
b) The centre of the circle S = 0
c) An external point with respect to the circle S = 0
d) An internal point with respect to the circle S = 0

134) The slope of the tangent to the curves $x = 3t^2 + 1$, $y = t^3 - 1$ at t = 1 is **[2]**
a) $\frac{1}{2}$ b) 0
c) - 2 d) 1

135) For which value of x, the function $f(x) = x^2 - 2x$ is decreasing? **[2]**
a) X < 2 b) X < 1
c) X > 2 d) X > 1

136) The function f defined by $f(x) = (x + 2)e^{-x}$ is **[2]**
a) Decreasing in (- 1,∞) and increasing in (- ∞ , - 1)
b) Increasing for all x
c) Decreasing in (- ∞ , 1) and increasing in (- 1, ∞)
d) Decreasing for all x

137) $\int \frac{x^2 - 1}{x^4 + 3x^2 + 1}$ dx (x > 0) is **[2]**
a) Tan $^{-1}$ $\left(x + \frac{1}{x}\right)$ + c
b) Tan $^{-1}$ $\left(x - \frac{1}{x}\right)$ + c
c) Log_e $\left(\frac{x + \frac{1}{x} - 1}{x + \frac{1}{x} + 1}\right)$ + c
d) Log_e $\left(\frac{x - \frac{1}{x} - 1}{x - \frac{1}{x} + 1}\right)$ + c

138) $\int$ $(e^x + e^{-x})^2$ $(e^x - e^{-x})$ dx is equal to **[2]**
a) $\frac{1}{2}$ $(e^x + e^{-x})^2$ + c
b) $\frac{1}{2}$ $(e^x - e^{-x})^2$ + c
c) $\frac{1}{3}$ $(e^x + e^{-x})^3$ + c
d) E^x + c

139) The value of $\sqrt{2}\int \frac{\sin x}{\sin\left(x - \frac{\pi}{4}\right)} dx$ is **[2]**
a) X + log |cos (x - $\frac{\pi}{4}$)| + c
b) X - log |cos (x - $\frac{\pi}{4}$)| + c
c) X + log |sin (x - $\frac{\pi}{4}$)| + c
d) X - log |sin (x - $\frac{\pi}{4}$)| + c

140) $\int$ log (x + 1) dx = **[2]**
a) (x - 1) log (x + 1) + x + c
b) (x - 1) log (x + 1) - x + c
c) (x + 1) log (x + 1) - x + c
d) (x + 1) log (x + 1) + x + c

141) Area of the region bounded by rays |x| + y = 1 and X - axis is **[2]**
a) $\frac{1}{4}$ b) $\frac{1}{2}$
c) 2 d) 1

142) The area bounded by the curves y^2 - x = 0 and y - x^2 = 0 is **[2]**
a) $\frac{5}{3}$ b) $\frac{7}{3}$
c) 1 d) $\frac{1}{3}$

143) The solution of the differential equation $\frac{dy}{dx}$ + y cot x = 2 cos x is **[2]**
a) Y sin x + cos 2x = 2c
b) 2y sin x + cos x = c
c) Y sin x + cos x = c
d) 2y sin x + cos 2x = c

144) Integrating factor of differential equation cos x$\frac{dy}{dx}$ + y sin x = 1 is **[2]**

a) Sin x
b) Sec x
c) Tan x
d) Cos x

145) The solution of the differential equation$x \log x \frac{\mathrm{d}y}{\mathrm{d}x} + y = 2 \log x$ is **[2]**

a) Y = log x + c
b) Y = x log x + c
c) Y log x = (log x)^2 + c
d) Y = log x^2 + c

146) The order and degree of the differential equation$\left(\frac{\mathrm{d}^2y}{\mathrm{d}x^2}\right)^{\frac{1}{3}} + \left(x + \frac{\mathrm{d}y}{\mathrm{d}x}\right)^{\frac{1}{2}}$ = 0 are **[2]**

a) O =$\frac{1}{3}$, D = 2
b) O = 2, D =$\frac{1}{3}$
c) O = 2, D = 2
d) O = 2, D = 3

147) If the probability density function of a random variable X is f(x) =$\frac{x}{2}$ in 0 ≤ x ≤ 2, then P(X > 1.5 ∣ X > 1) is equal to **[2]**

a) $\frac{21}{64}$
b) $\frac{3}{4}$
c) $\frac{7}{12}$
d) $\frac{7}{16}$

148) The probability distribution of a r.v. X is

X = x	- 2	- 1	0	1	2
P(X = x)	0.2	0.3	0.15	0.25	0.1

Then F (- 1) = **[2]**

a) 0.5
b) 0.7
c) 1
d) 0.9

149) The mean and variance of a binomial distribution are 4 and 3 respectively, then the probability of getting exactly six successes in this distribution is **[2]**

a) $^{16}C_6 \left(\frac{1}{4}\right)^6 \left(\frac{3}{4}\right)^{10}$
b) $^{12}C_6 \left(\frac{1}{4}\right)^{10} \left(\frac{3}{4}\right)^6$
c) $^{16}C_6 \left(\frac{1}{4}\right)^{10} \left(\frac{3}{4}\right)^6$
d) $^{12}C_6 \left(\frac{1}{4}\right)^6 \left(\frac{3}{4}\right)^6$

150) The mean and variance of a random variable X having a binomial distribution are 6 and 3 respectively. The probability of variable X less than 2 is **[2]**

a) $\frac{13}{4096}$
b) $\frac{15}{4096}$
c) $\frac{13}{2048}$
d) $\frac{25}{2048}$