SATISH SCIENCE ACADEMY
DHANORI PUNE - 411015

Mhtcet pcm 5
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) The horizontal distance x and the vertical height y of a projectile at a time t are given by x = at and y = bt^2 + ct where a, b and c are constants. The magnitude of the velocity of the projectile 1 second after it is fired is **[1]**

a) $\left[a^2+(2b+c)^2\right]^{\frac{1}{2}}$
b) $\left[2a^2+(b+c)^2\right]^{\frac{1}{2}}$
c) $\left[a^2+(b+2c)^2\right]^{\frac{1}{2}}$
d) $\left[2a^2+(2b+c)^2\right]^{\frac{1}{2}}$

2) Force applied to open or close a water tap is an example of _____. **[1]**

a) Application of Newton's law of motion
b) Couple
c) Conservation of momentum
d) Elastic collision

3) Two identical solid copper spheres of radius R placed in contact with each other. The gravitational attraction between them is proportional to **[1]**

a) R^{-4} b) R^4
c) R^2 d) R^{-2}

4) When water is heated from 0 °C to 10 °C its density **[1]**

a) Decreases.
b) First increases and then decreases.
c) Does not change.
d) Increases.

5) Progressive wave with doubly periodic means **[1]**

a) Repetition after equal interval of time.
b) Repetition in medium without inertia.
c) Repetition at equal distance.
d) The wave which repeats itself at equal distance in equal interval of time.

6) The magnifying power of simple microscope, when image is formed at DDV, is (where f is its focal length) **[1]**

a) $(1-\frac{D}{f})$ b) $(1+\frac{D}{f})$
c) $\frac{D}{f}$ d) $\frac{f}{D}$

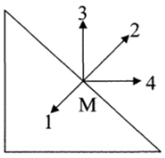
7) A person wants a real image of his own, 3 times enlarged. Where should he stand in front of a concave mirror of radius of curvature 30 cm? **[1]**

a) 20 cm b) 10 cm
c) 90 cm d) 30 cm

8) An equiconvex lens has power P. It is cut into two symmetrical halves by a plane containing the principal axis. The power of one part will be, **[1]**

a) $\frac{P}{4}$ b) 0
c) $\frac{P}{2}$ d) P

9) Three identical point charges, as shown are placed at the vertices of an isosceles right angled triangle. Which of the numbered vectors coincides in direction with the electric field at the mid - point M of the hypotenuse?



[1]

a) 2 b) 3
c) 1 d) 4

10) A light rod of length l has two masses m_1 and m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is **[1]**

a) $\frac{m_1+m_2}{m_1\ m_2}l$
b) $\sqrt{m_1\ m_2}l^2$
c) $\frac{m_1\ m_2}{m_1+m_2}l^2$
d) $(m_1 + m_2)\ l^2$

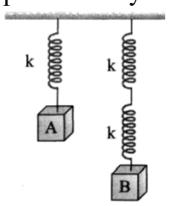
11) The velocity of a particle performing linear S.H.M. at mean position is v_0. What will be its velocity at the mean position when its amplitude is doubled and time period reduced to $\frac{1}{3}$? **[1]**

a) V_0 b) $6v_0$
c) $2v_0$ d) $4v_0$

12) The periodic time of a body executing simple harmonic motion is 3 s. After how much interval from time t = 0 will its displacement be half of its amplitude? **[1]**

a) $\frac{1}{8}$ s b) $\frac{1}{3}$ s
c) $\frac{1}{4}$ s d) $\frac{1}{6}$ s

13) The springs shown are identical. When A = 4 kg, the elongation of spring is 1 cm. If B = 6 kg, the elongation produced by it is



[1]

a) 3 cm b) 4 cm
c) 1 cm d) 2 cm

14) An inductor 20 mH, a capacitor 50μ F and a resistor 40 Ω are connected in series across a source of emf V =

10 sin 340t. The power loss in A.C. circuit is **[1]**

a) 0.67 W b) 0.51 W
c) 0.89 W d) 0.76 W

15) In streamline flow, the velocity of a liquid at a given point is **[1]**

a) Constant in magnitude only.
b) Always constant in magnitude and direction.
c) Not constant in direction but constant in magnitude.
d) Constant in direction but not constant in magnitude.

16) When the length of the vibrating segment of a sonometer wire is increased by 1%, the percentage change in its frequency is **[1]**

a) $\frac{100}{101}$ b) 2
c) 1 d) $\frac{99}{100}$

17) A source of unknown frequency gives 4 beats/s, when sounded with a source of known frequency 250 Hz. The second harmonic of the source of unknown frequency gives five beats per second, when sounded with a source of frequency 513 Hz. The unknown frequency is **[1]**

a) 246 Hz b) 254 Hz
c) 240 Hz d) 260 Hz

18) Air is blown at the mouth of an open tube of length 25 cm and diameter 2 cm. If the velocity of sound in air is 330 ms^{-1}, then emitted frequencies are (in Hz) **[1]**

a) 330, 990, 169 b) 660, 1000, 3300
c) 660, 1320, 2640 d) 302, 664, 1320

19) The rate of emission of electromagnetic energy by any body does not depend on **[1]**

a) Its power of absorption of radiation.
b) Area of its surface.
c) Its temperature.
d) Its mass.

20) A double - slit apparatus is immersed in liquid of refractive indexμ_m . The distance between the slits is d and distance between plane of slits and screen as D (D » d). The slits are illuminated by parallel beam of wavelength λ' . The smallest thickness of a sheet of refractive index μ_p to bring adjacent minima on the axis is, **[1]**

a) $\frac{(\mu_p-\mu_m)\lambda'}{2}$
b) $\frac{\lambda'}{(\mu_p-\mu_m)}$
c) $(\mu_p - \mu_m)\,\lambda'$
d) $\frac{\lambda'}{2(\mu_p-\mu_m)}$

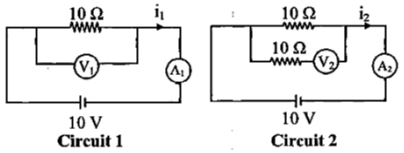
21) An ammeter should have very low resistance, so that it may **[1]**

a) Not burn out.
b) Not change the value of the current.
c) Have better stability.
d) Show large deflection.

22) When a resistance of 100Ω is connected in series with a galvanometer of resistance R, its range is V. To double its range, a resistance of 1000 ohm is connected in series. Find R **[1]**

a) 700Ω b) 900Ω
c) 800Ω d) 100Ω

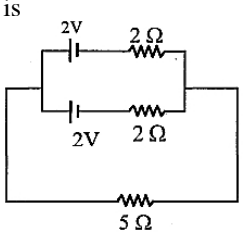
23) In the circuits shown below, the readings of the voltmeters and the ammeters will be:



[1]

a) $V_2 > V_1$ and $i_1 = i_2$ b) $V_1 = V_2$ and $i_1 > i_2$
c) $V_2 > V_1$ and $i_1 > i_2$ d) $V_1 = V_2$ and $i_1 = i_2$

24) In the circuit shown, the current through the 5Ω resistor is



[1]

a) $\frac{8}{3}$ A b) $\frac{4}{13}$ A
c) $\frac{1}{3}$ A d) $\frac{9}{13}$ A

25) A proton is moving perpendicular to a uniform magnetic field of 2.5 tesla with 2 MeV kinetic energy. The force on proton is _____ N. (Mass of proton = 1.6×10^{-27} kg, charge of proton = 1.6×10^{-19} C) **[1]**

a) 3×10^{-11} b) 3×10^{-10}
c) 8×10^{-11} d) 8×10^{-12}

26) Two long parallel wires carrying equal current separated by 1 m, exert a force of 2×10^{-7} N/m on one another. The current flowing through them is **[1]**

a) 2.0×10^{-1} A b) 2.0 A
c) 1.0×10^{-7} A d) 1.0 A

27) Three long straight wires of length L are connected parallel to each other across a battery of negligible internal resistance. The ratio of their resistance are 3 : 4 : 5. What is the ratio of distances of middle wire from the others if the net force experienced by it is zero? **[1]**

a) 2 : 3 b) 3 : 1
c) 4 : 3 d) 5 : 3

28) A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross - section. The ratio of the magnetic fields B and B' at radial distances $\frac{a}{2}$ and 2a respectively, from the axis of the wire is **[1]**

a) 1 b) $\frac{1}{2}$
c) 4 d) $\frac{1}{4}$

29) The space within a current carrying toroid is filled with tungsten of susceptibility 4.6×10^{-5}. The percentage increase in the magnetic field is **[1]**

a) 2.3×10^{-3} b) 6.9×10^{-3}
c) 4.6×10^{-3} d) 9.2×10^{-3}

30) Magnetic susceptibility for a paramagnetic and diamagnetic materials is respectively **[1]**

a) Small, positive and small, positive
b) Large, negative and large, positive
c) Small, positive and small, negative
d) Large, positive and small, negative

31) Magnetic material can be easily magnetized if magnetic susceptibility is **[1]**

a) Very low and positive.
b) Very high and positive.
c) Very low and negative.

d) Very high and negative.

32) Electromagnets are made of soft iron because soft iron has **[1]**

a) High susceptibility and high retentivity.
b) Low susceptibility and high retentivity.
c) Low susceptibility and low retentivity.
d) High susceptibility and low retentivity.

33) A 50 mH coil carries a current of 2 ampere. The energy stored in joules is **[1]**

a) 0.1 b) 1
c) 0.5 d) 0.05

34) In a coil, L = 5 H, current changes at the rate of 2 ampere per second. The e.m.f. induced **[1]**

a) - 5 V b) - 10 V
c) 20 V d) 2.5 V

35) Two coils P and Q are kept near each other. When no current flows through coil P and current increases in coil Q at the rate 10 A/s, the e.m.f. in coil P is 15 mV. When coil Q carries no current and current of 1.8 A flows through coil P, the magnetic flux linked with the coil Q is **[1]**

a) 2.7 mWb b) 1.4 mWb
c) 2.9 mWb d) 2.2 mWb

36) The de - Broglie wavelength of an electron is 66 nm. The velocity of the electron is
[h = 6.6 $\times$ 10^{-34} kg m^2 s^{-1}, m = 9.0 $\times$ 10^{-31} kg]**[1]**

a) 1.1$\times$ 10^3 ms^{-1}
b) 1.84$\times$ 10^{-4} ms^{-1}
c) 1.1$\times$ 10^4 ms^{-1}
d) 5.4$\times$ 10^3 ms^{-1}

37) When potential difference of 9V is applied between the two plates, electron accelerate between the plates with velocity **[1]**

a) 1.8$\times$ 10^6 m/s b) 1.8$\times$ 10^{-6} m/s
c) 1.8$\times$ 10^{-4} m/s d) 1.8$\times$ 10^4 m/s

38) If the energy of photons corresponding to wavelength of 6000$\overset{o}{A}$ is 3.2 $\times$ 10^{-19} J. The photon energy for wavelength of 4000 $\overset{o}{A}$ will be _____. **[1]**

a) 1.11$\times$ 10^{-19} J b) 4.44$\times$ 10^{-19} J
c) 4.80$\times$ 10^{-19} J d) 2.22$\times$ 10^{-19} J

39) What will be ratio of radii of Li^7 nucleus to Fe^{56} nucleus? **[1]**

a) 1 : 6 b) 1 : 3
c) 1 : 2 d) 1 : 8

40) Relation between nuclear radius r and mass number A is given by **[1]**

a) R = $r_0 A^{\frac{1}{3}}$ b) R = $r_0 A^3$
c) R = $r_0 A^{\frac{-1}{3}}$ d) R = $r_0 A$

41) In Bohr's model of hydrogen atom, the period of revolution of the electron in any orbit is proportional to **[1]**

a) Square of the quantum number
b) The quantum number
c) Square root of the quantum number
d) Cube of the quantum number

42) The ratio of the largest to shortest wavelengths in Lyman series of hydrogen spectra is **[1]**

a) $\frac{9}{5}$ b) $\frac{17}{6}$
c) $\frac{25}{9}$ d) $\frac{4}{3}$

43) According to Dalton's theory of atomic structure
i. Matter is made up of indestructible particles
ii. Atoms can combine with other atoms to form new substances.
iii. Atoms of a given element are identical
iv. All of these
[1]

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

44) The ionization energy of hydrogen is 13.6 eV. The energy of the photon released when an electron jumps from the first excited state (n = 2) to the ground state of a hydrogen atom is **[1]**

a) 3.4 eV b) 10.2 eV
c) 4.53 eV d) 13.6 eV

45) In radioactive reaction
$^{A}_{Z}X \rightarrow {}^{A}_{Z+1}X_1 \rightarrow {}^{A}_{Z+2}X_2 \rightarrow {}^{A-4}_{Z} X_3 \rightarrow {}^{A-4}_{Z+1}X_4$
successive emission of particles is **[1]**

a) $\beta^-, \beta^-, \alpha, \alpha$
b) $\beta^-, \beta^-, \beta^+, \alpha$
c) $\beta^-, \beta^-, \beta^-, \alpha$
d) $\beta^-, \beta^-, \alpha, \beta^-$

46) In Bohr's atomic model, the lowest orbit corresponds to **[1]**

a) Maximum energy b) Zero energy
c) Minimum energy d) Infinite energy

47) Ripple frequency at the output of bridge rectifier when the transformer primary is connected to A.C. mains supply is **[1]**

a) 25 Hz b) 50 Hz
c) 75 Hz d) 100 Hz

48) When n - p - n transistor is used as an amplifier, **[1]**

a) Holes move from emitter to base.
b) Electrons move from collector to base.
c) Holes move from base to collector.
d) Electrons move from base to collector.

49) In CE NPN transistor 10^{10} electrons enter the emitter in 10^{-6} s when it is connected to battery. About 5% electrons recombine with holes in the base. The current gain of the transistor is _____. (e = 1.6 $\times$ 10^{-19} C) **[1]**

a) 19 b) 0.95
c) 0.98 d) 49

50) Which of the following diode emits red and yellow light? **[1]**

a) Ga - P b) Ga - As - P
c) Ga - As d) As - P

Section - A (Chemistry)

51) The mass of sulphur dioxide produced by burning 16 g of sulphur in excess of oxygen in contact process is _____ g. (Average atomic mass: S = 32 u, O = 16 u). **[1]**

a) 64 b) 16
c) 32 d) 128

52) The possible values of m_l for an electron with l = 1 are _____. **[1]**

a) - 2, - 1, 0, +1, +2 b) - 1, 0
c) 0, +1 d) - 1, 0, +1

53) Reducing agent is a substance, which can _____. **[1]**
a) Donate oxygen(s) b) Accept proton(s)
c) Donate electron(s) d) Accept electron(s)

54) Group 1 and group 2 elements are placed at the _____ of the long form of the modem periodic table. **[1]**
a) Bottom b) Left
c) Middle d) Right

55) For one mole of an ideal gas, the slope of the V versus T curve at a constant pressure of 2 atm is X lit mol^{-1} K^{-1}. The value of the ideal universal gas constant **R** in terms of X is _____. **[1]**
a) X lit atm mol^{-1} K^{-1}
b) 2X lit atm mol^{-1} K^{-1}
c) 2X atm lit^{-1} mol^{-1} K^{-1}
d) $\frac{X}{2}$ lit atm mol^{-1} K^{-1}

56) Which property of the colloidal solution is independent of charge on the colloidal particles? **[1]**
a) Tyndall effect b) Electroosmosis
c) Coagulation d) Electrophoresis

57) The CORRECT order of reactivity of halogen acids towards alkenes in a hydrohalogenation reaction is _____. **[1]**
a) HCl < HI < HBr b) HI > HBr > HCl
c) HBr > HI > HCl d) HCl > HI > HBr

58) What is the electrophile when RCl + $AlCl_3$ are used in Friedel Craft's reaction? **[1]**
a) $AlCl_4^-$ b) $AlCl_2^+$
c) R^+ d) Cl^+

59) Carbanion contains _____ electrons in the valence shell. **[1]**
a) Eight b) Six
c) Ten d) Five

60) Find the CORRECT match.
i. Metallic glass: Crystalline solid
ii. Sodium: Insulator
iii. Solid O_2: Covalent network solid
iv. Silicon: Semiconductor
[1]
a) Option (d) b) Option (b)
c) Option (a) d) Option (c)

61) Crystals of covalent compounds always have _____.
i. Atoms as their structural units
ii. Molecules as structural units
iii. Ions held together by electrostatic forces
iv. High melting points
[1]
a) Option (d) b) Option (a)
c) Option (c) d) Option (b)

62) At 100 °C, the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If K_b = 0.52, the boiling point of this solution will be _____. **[1]**
a) 101 °C b) 100 °C
c) 102 °C d) 103 °C

63) The freezing point of a solution containing 4.8 g of a compound in 60 g of benzene is 4.48 °C. What is the molar mass of the compound? (K_f = 5.1 K m^{-1}, freezing point of benzene = 5.5 °C) **[1]**
a) 200 g mol^{-1} b) 400 g mol^{-1}
c) 300 g mol^{-1} d) 100 g mol^{-1}

64) The unit of entropy is _____. **[1]**
a) $J^{-1}K$ b) $J\ K^{-1}$
c) J K d) $J^{-1}\ K^{-1}$

65) In the reactions, $S + \frac{3}{2}\ O_2 \rightarrow\ SO_3$ + 2x kJ and $SO_2 + \frac{1}{2}\ O_2 \rightarrow\ SO_3$ + y kJ
Heat of formation of SO_2 is _____. **[1]**
a) X - y b) Y - 2x
c) 2x + y d) 2x - y

66) Which of the following is a nonelectrolyte? **[1]**
a) Acetic acid b) Sucrose
c) Hydrochloric acid d) Potassium chloride

67) The standard emf of a galvanic cell involving cell reaction with n = 2 was found to be 0.295 V at 25°C. The equilibrium constant of the reaction would be _____. **[1]**
a) $2\times\ 10^{11}$ b) $1\times\ 10^{2}$
c) $1\times\ 10^{10}$ d) $4\times\ 10^{12}$

68) In the synthesis of ammonia from nitrogen and hydrogen gases, if $6\times\ 10^{-2}$ mol L^{-1} of hydrogen disappears in 10 minutes, the amount of ammonia formed during this time interval is _____ mol L^{-1}. **[1]**
a) $4\times\ 10^{-2}$ b) $3.6\times\ 10^{-2}$
c) $1.2\times\ 10^{-3}$ d) $1.8\times\ 10^{-2}$

69) Catalytic decomposition of phosphine on hot tungsten at high pressure is _____ reaction. **[1]**
a) 1^{st} order b) Pseudo 1^{st} order
c) Zero order d) 2^{nd} order

70) Acidic nature of NH_4Cl is due to _____. **[1]**
a) Reaction of anion with water
b) Reaction of cation with water
c) Reaction of cation and anion with water
d) No reaction

71) According to the Arrhenius theory, acid is a substance that _____. **[1]**
a) Contains OH group
b) Gives OH^- ions in aqueous solution
c) Gives H^+ ions in aqueous solution
d) Accepts an electron pair

72) Which of the following forms a basic buffer solution? **[1]**
a) Ammonium hydroxide and sodium sulphate
b) Ammonium hydroxide and ammonium chloride
c) Sodium hydroxide and ammonium chloride
d) Acetic acid and sodium acetate

73) Identify! the CORRECT statement from the following.
i. O_3 and SO_2 molecules have different shapes.
ii. The molecular formula of pyrosulphuric acid is $H_2S_2O_8$.
iii. V_2O_5acts as a catalyst in contact process.
iv. In the presence of moisture, SO_2 acts as an oxidising agent.
[1]
a) Option (b) b) Option (a)
c) Option (d) d) Option (c)

74) Elements of group 16 are called chalcogens because _____.
i. These elements, particularly sulphur and oxygen, are present in many metallic ores
ii. A large number of acids contain these elements, particularly sulphur and oxygen
iii. These elements mainly form anions
iv. These elements exist in different allotropic forms
[1]

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

75) Which among the following halogen does NOT form polyhalite ion? **[1]**
a) Br b) I
c) F d) Cl

76) Manganese shows oxidation states from _____. **[1]**
a) +4 to +7 b) +2 to +7
c) +1 to +6 d) +2 to +5

77) When neutral or faintly alkaline $KMnO_4$ is treated with potassium iodide, the iodide ion is converted into **X**. **X** is _____. **[1]**
a) IO_3^- b) I_2
c) IO^- d) IO_4^-

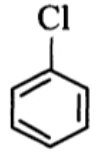
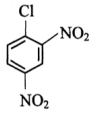
78) The ionization isomer of $[Co(NH_3)_3\ H_2OBr]SO_4$ is: **[1]**
a) $[Co(NH_3)_3BrSO_4]\cdot\ NH_3$
b) $[Co(NH_2)_2BrSO2]\cdot\ NH4$
c) $[Co(NH_3)_4(H_2O)SO_4]Br$
d) $[Co(NH_3)_3BrSO_4]\cdot\ H_2O$

79) The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3, and L_4 absorb wavelengths in the region of red, green, yellow, and blue respectively. The increasing order of ligand strength of the four ligands is _____. **[1]**
a) $L_4 < L_3 < L_2 < L_1$ b) $L_1 < L_3 < L_2 < L_4$
c) $L_3 < L_2 < L_4 < L_1$ d) $L_1 < L_2 < L_4 < L_3$

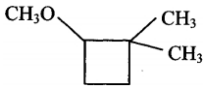
80) Which of the following complexes is heteroleptic? **[1]**
a) $K_3[Fe(CN)_6]$ b) $[CO(NH_3)_6]Cl_3$
c) $[NiCl_4\ ]^{2-}$ d) $[Pt(Cl)_2(NH_3)_2]$

81) In the following sequence of reaction:
CH_3 - CH_2 - CH_2 - I $\xrightarrow{Alc.KOH}$ (A) $\xrightarrow{Br_2}$ (B) $\xrightarrow{NaNH_2/NH_3}$ (C)
The product **C** is _____. **[1]**
a) Amine b) Alkyne
c) Alkanol d) Alkene

82) Which one of the following is most reactive towards nucleophilic substitution reaction? **[1]**
a) Cl - CH_2 - CH = CH_2 b) C_6H_5 - Cl
c) H_3C - CH_2 - Cl d) H_3C - CH_2 - CH_2 - Cl

83) Which of the following will undergo nucleophilic substitution most readily? **[1]**
a) 
b) 
c) 
d) 

84) In bromination of phenol carried out using Br_2 in CCl_4, o - Bromophenol is minor product due to _____. **[1]**
a) Hydrogen bonding
b) Steric attraction between - OH and - Br
c) Steric repulsion between - OH and - Br
d) Low reactivity of bromine

85) IUPAC name of the following compound is _____.

[1]
a) 2 - methoxy - 1,1 - dimethylcyclobutane
b) 1,1 - dimethyl - 2 - methoxycyclobutane
c) 1 - methoxy - 2,2 - dimethylcyclobutane
d) 2,2 - dimethyl - 1 - methoxy cyclobutane

86) Propan - 2 - ol on oxidation forms a ketone with _____. **[1]**
a) One carbon atom more
b) Two carbon atoms less
c) Same number of carbon atoms
d) One carbon atom less

87) Crossed aldol condensation product of benzaldehyde and 'Y' is 4 - phenylbut - 3 - en - 2 - one. Y is ____. **[1]**
a) Acetone
b) 2 - methylcyclohexanone
c) Phenyl acetaldehyde
d) Acetophenone

88) Which of the followings is the most reactive towards the addition reaction of hydrogen cyanide to form the corresponding cyanohydrin? **[1]**
a) Acetone b) Diethylketone
c) Formaldehyde d) Acetaldehyde

89) The general order of reactivity of carbonyl compounds for nucleophilic addition reactions is _____. **[1]**
a) ArCHO > Ar_2C=O > RCHO > R_2C=O > H_2C=O
b) H_2C=O > RCHO > ArCHO > R_2C=O > Ar_2C=O
c) Ar_2C=O > R_2C=O > ArCHO > RCHO > H_2C=O
d) H_2C=O > R_2C=O > Ar_2C=O > RCHO > ArCHO

90) The IUPAC name of the given compound $CH_3-(CH_2)_2-\underset{\underset{NH_2}{|}}{CH}-CH(CH_3)_2$ is _____. **[1]**
a) N,N - dimethylbutan - 2 - amine
b) 2 - methylhexan - 3 - amine
c) 1,1 - dimethylpentan - 3 - amine
d) 2 - methyl - 3 - aminopentane

91) In the reaction, $C_2H_5NH_2 \xrightarrow{HNO_2}$ A $\xrightarrow{PCI_5}$ B $\xrightarrow[Excess]{Alc.NH_3}$ C; the starting compound and product C are _____. **[1]**
a) Homologous
b) Isomers
c) Same
d) Different primary amines

92) The amines that undergo carbylamine reaction are _____. **[1]**
a) 1 ° - aliphatic amines, 2 ° - aromatic amines
b) 2 ° - aliphatic amines, 1 ° - aromatic amines
c) 1 ° - aliphatic amines, 1 ° - aromatic amines
d) 2 ° - aliphatic amines, 2 ° - aromatic amines

93) The amino acid which is basic in nature is _____. [1]
a) Proline b) Valine
c) Histidine d) Tyrosine

94) Which of the following properties are exhibited by a - amino acids?
i. High melting point
ii. Crystalline and water soluble
iii. Amorphous and water insoluble
iv. Formation of dipolar ions
[1]
a) I, II b) II, IV
c) I, II, IV d) I, III, IV

95) Which polymer is used for making hose pipes for the transport of gasoline? [1]
a) Buna - S b) Polyisoprene
c) Bakelite d) Neoprene

96) The compounds that can undergo addition polymerization is _____.
i. Vinyl chloride
ii. Acrylonitrile
iii. Ethene
[1]
a) I and II b) I and III
c) II and III d) I, II, III

97) Identify the copolymer among the following. [1]
a) Teflon b) Polycarbonates
c) Acrylic glass d) Polythene

98) The formula for percentage atom economy is:
i. % atom economy $= \frac{\text{Formula weight of the desired product}}{\text{Sum of formula weights of all the products formed}} \times 100$
ii. % atom economy $= \frac{\text{Formula weight of the byproducts formed}}{\text{Sum of formula weights of all the reactants used in the reaction}} \times 100$
iii. % atom economy $= \frac{\text{Formula weight of the desired product}}{\text{Sum of formula weights of all the reactants used in the reaction}} \times 100$
iv. % atom economy $= \frac{\text{Sum of formula weights of all the reactants used in the reaction}}{\text{Formula weight of the desired product}} \times 100$
[1]
a) Option (b) b) Option (a)
c) Option (c) d) Option (d)

99) Identify the INCORRECT statement from following.
i. Bottom ash of thermal power station can be used as a raw material for cement and brick industry.
ii. Green chemistry plays an important role in sustainable development.
iii. Good atom economy means most of the atoms of the reactants are incorporated in the desired products.
iv. BHC insecticide has been replaced with DDT.
[1]
a) Option (a) b) Option (d)
c) Option (b) d) Option (c)

100) Which of the following information about nanoparticles can be obtained using UV - visible spectrophotometer? [1]
a) Binding nature
b) Morphology
c) Crystal structure
d) Preliminary confirmation of formation of nanoparticles

Section - B (Mathematics)

101) $\cos^2 76° + \cos^2 16° - \cos 76° \cos 16°$ = [2]
a) $\frac{1}{2}$ b) 0
c) $\frac{3}{4}$ d) $-\frac{1}{4}$

102) A straight line through the point A(3, 4) is such that its intercept between the axes is bisected at A. Its equation is [2]
a) X + y = 7 b) 4x + 3y = 24
c) 3x + 4y = 25 d) 3x - 4y + 7 = 0

103) The equation of the circle which touches X - axis at (3, 0) and passes through (1, 4) is given by [2]
a) $X^2 + y^2 - 6x - 5y + 9 = 0$
b) $X^2 + y^2 - 6x + 5y - 9 = 0$
c) $X^2 + y^2 + 6x + 5y - 9 = 0$
d) $X^2 + y^2 + 6x - 5y + 9 = 0$

104) The means of five observations is 4 and their variance is 5.2. If three of these observations are 1, 2 and 6, then the other two are [2]
a) 4 and 7 b) 2 and 9
c) 5 and 6 d) 3 and 8

105) A card is drawn from a pack of 52 cards. A gambler bets that it is a spade or an ace. What are the odds against his winning this bet [2]
a) 17 : 52 b) 9 : 4
c) 4 : 9 d) 52 : 17

106) $I^2 + i^4 + i^6 + ...$ upto (2n + 1) terms = [2]
a) I b) - i
c) 1 d) - 1

107) If $^{12}P_r = 1320$, then r is equal to [2]
a) 4 b) 5
c) 3 d) 2

108) The range of the function $f(x) = \frac{x}{1+x^2}$ is [2]
a) $\left[-\frac{1}{2}, \frac{1}{2}\right]$
b) $\left[-\frac{1}{2}, 0\right) \cup \left(0, \frac{1}{2}\right]$
c) $\left[-\frac{1}{2}, 0\right]$
d) $\left[0, \frac{1}{2}\right]$

109) Negation of the proposition $(p \vee q) \wedge (\sim q \wedge r)$ is [2]
a) $(\sim p \wedge \sim q) \vee (q \vee \sim r)$
b) $(p \wedge q) \wedge (q \wedge \sim r)$
c) $(\sim p \vee \sim q) \wedge (\sim q \wedge r)$
d) $(p \wedge q) \vee (q \vee \sim r)$

110) The inverse of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 3 & 3 & 0 \\ 5 & 2 & -1 \end{bmatrix}$ is [2]
a) $-\frac{1}{3}\begin{bmatrix} -3 & 0 & 0 \\ 3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$
b) $-\frac{1}{3}\begin{bmatrix} 3 & 0 & 0 \\ 3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$
c) $-\frac{1}{3}\begin{bmatrix} -3 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 2 & -3 \end{bmatrix}$
d) $-\frac{1}{3}\begin{bmatrix} -3 & 0 & 0 \\ -3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$

111) If A is an 3× 3 non - singular matrix such that AA' = A'A and B = A^{-1} A', then BB' equals [2]
a) I + B b) I
c) B^{-1} d) $(B^{-1})'$

112) If the inverse of product of the matrix B $=\begin{bmatrix} 2 & 6 & 4 \\ 1 & 0 & 1 \\ -1 & 1 & -1 \end{bmatrix}$ with a matrix A is C $= \begin{bmatrix} -1 & 0 & 1 \\ 1 & 1 & 3 \\ 2 & 0 & 2 \end{bmatrix}$, then A^{-1} equals **[2]**

a) $\begin{bmatrix} -3 & -5 & 5 \\ 0 & 9 & 14 \\ 2 & 2 & 6 \end{bmatrix}$

b) $\begin{bmatrix} -3 & 5 & 5 \\ 0 & 0 & 9 \\ 2 & 14 & 16 \end{bmatrix}$

c) $\begin{bmatrix} -3 & -5 & -5 \\ 0 & 9 & 2 \\ 2 & 14 & 6 \end{bmatrix}$

d) $\begin{bmatrix} -3 & -3 & 5 \\ 0 & 9 & 2 \\ 2 & 14 & 6 \end{bmatrix}$

113) If $3(\sec^2\theta + \tan^2\theta) = 5$, then the general value of θ is **[2]**

a) $N\pi \pm \frac{\pi}{3}$
b) $2n\pi \pm \frac{\pi}{6}$
c) $2n\pi + \frac{\pi}{6}$
d) $N\pi \pm \frac{\pi}{6}$

114) $\cos\left[2\cos^{-1}\frac{1}{5} + \sin^{-1}\frac{1}{5}\right]$ = **[2]**

a) $-\frac{1}{5}$
b) $\frac{1}{5}$
c) $\frac{2\sqrt{6}}{5}$
d) $-\frac{2\sqrt{6}}{5}$

115) In$\triangle$ ABC, cosec A(sin B cos C + cos B sin C) = **[2]**

a) $\frac{c}{a}$ b) $\frac{c}{ab}$
c) $\frac{a}{c}$ d) 1

116) Let PQR be a triangle of area with a = 2, b $=\frac{7}{2}$ and c $=\frac{5}{2}$, where a, b and c are the lengths of the sides of the triangle opposite to the angles at P, Q and R respectively. Then $\frac{2\sin P - \sin 2P}{2\sin P + \sin 2P}$ equals **[2]**

a) $\left(\frac{3}{4\Delta}\right)^2$
b) $\frac{45}{4\Delta}$
c) $\frac{3}{4\Delta}$
d) $\left(\frac{45}{4\Delta}\right)^2$

117) In a$\triangle$ ABC, 2ac sin $\left(\frac{A-B+C}{2}\right)$ is equal to **[2]**

a) $C^2 + a^2 - b^2$ b) $B^2 - c^2 - a^2$
c) $A^2 + b^2 - c^2$ d) $C^2 - a^2 - b^2$

118) If$\int_0^1 x\log\left(1+\frac{x}{2}\right)$ dx = a + b log $\frac{2}{3}$, then **[2]**

a) $a = \frac{3}{4}, b = -\frac{3}{4}$
b) A = b
c) a $= \frac{3}{4}$, b $= \frac{3}{2}$
d) a $= \frac{3}{2}$, b $= \frac{3}{2}$

119) $\int_\alpha^\beta \frac{1}{\sqrt{(x-\alpha)(\beta-x)}}$ dx, $(\beta > \alpha)$ = **[2]**

a) $\frac{\pi}{2}$ b) π
c) $\frac{2\pi}{3}$ d) 2π

120) $\int_{-1}^4 f(x)$ dx = 4 and $\int_2^4 (3-f(x))$ dx = 7, then $\int_{-1}^2 [f(x)]$ dx is **[2]**

a) 2 b) 1
c) 5 d) 3

121) $\int_{-\pi}^{\pi} \frac{2x(1+\sin x)}{1+\cos^2 x}$ dx is **[2]**

a) π^2 b) 0
c) $\frac{\pi^2}{4}$ d) $\frac{\pi}{2}$

122) The value of$\int_1^2 \log x$ dx is **[2]**

a) $\log\left(\frac{2}{e}\right)$
b) $\log\left(\frac{4}{e}\right)$
c) Log 4
d) Log 2

123) If ABC is an equilateral triangle of side a, then the value of$\vec{AB}\cdot\vec{BC} + \vec{BC}\cdot\vec{CA} + \vec{CA}\cdot\vec{AB}$ is equal to **[2]**

a) $-\frac{3a^2}{2}$ b) $3a^2$
c) $\frac{3a^2}{2}$ d) $-3a^2$

124) If$\vec{a} = \frac{1}{\sqrt{10}}(3\hat{i} + \hat{k})$, $\vec{b} = \frac{1}{7}(2\hat{i} + 3\hat{j} - 6\hat{k})$, then the value of $(2\vec{a} - \vec{b})\cdot(\vec{a}\times\vec{b})\times(\vec{a} + 2\vec{b})$ is **[2]**

a) - 3 b) - 5
c) 5 d) 3

125) The unit vector which is orthogonal to the vector$3\hat{i} + 2\hat{j} + 6\hat{k}$ and is coplanar with vectors $2\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} - \hat{j} + \hat{k}$ is **[2]**

a) $\frac{1}{\sqrt{13}}(2\hat{i} - 3\hat{j})$
b) $\frac{1}{\sqrt{41}}(2\hat{i} - 6\hat{j} + \hat{k})$
c) $\frac{1}{\sqrt{10}}(3\hat{j} - \hat{k})$
d) $\frac{1}{\sqrt{34}}(4\hat{i} + 3\hat{j} - 3\hat{k})$

126) The values of**a** for which the points A, B, C with position vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$ and $a\hat{i} - 3\hat{j} + \hat{k}$ respectively are the vertices of a right angled triangle with $C = \frac{\pi}{2}$ are **[2]**

a) 2 and - 1 b) 2 and 1
c) - 2 and - 1 d) - 2 and 1

127) If the angle between the pair of straight lines represented by the equation x^2 - 3xy + λ y^2 + 3x + 5y + 2 = 0 is $\tan^{-1}3$, where λ is a non - negative real number, then X = **[2]**

a) 1 b) 2
c) 0 d) 3

128) If x co - ordinate of a point on the line joining points (2, 2, 1) and (5, 1, - 2) is 4, then its z co - ordinate will be **[2]**

a) 1 b) - 1
c) - 2 d) 2

129) The angle between the pair of lines$\frac{x-2}{2} = \frac{y-1}{5} = \frac{z+3}{-3}$ and $\frac{x+2}{-1} = \frac{y-4}{8} = \frac{z-5}{4}$ is **[2]**

a) $\cos^{-1}\left(\frac{23}{9\sqrt{38}}\right)$
b) $\cos^{-1}\left(\frac{26}{9\sqrt{38}}\right)$
c) $\cos^{-1}\left(\frac{21}{9\sqrt{38}}\right)$
d) $\cos^{-1}\left(\frac{24}{9\sqrt{38}}\right)$

130) The sine of the angle between the straight line$\frac{x-2}{3} - \frac{y-3}{4} - \frac{z-4}{5}$ and the plane 2x - 2y + z = 5 is **[2]**

a) $\frac{2\sqrt{3}}{5}$
b) $\frac{10}{6\sqrt{5}}$
c) $\frac{4}{5\sqrt{2}}$
d) $\frac{\sqrt{2}}{10}$

131) The differential coefficient of f[log(x)]when f(x) = log x is **[2]**

a) $\frac{\log x}{x}$ b) $\frac{x}{\log x}$
c) $\frac{1}{x \log x}$ d) X log x

132) $\frac{d}{dx}\left(\tan^{-1}\frac{\cos x}{1+\sin x}\right)$ = [2]
a) - 1 b) 1
c) $\frac{1}{2}$ d) $-\frac{1}{2}$

133) In [0, 1], Lagrange's mean value theorem is not applicable to [2]
a) F(x) = x |x|
b) $f(x) = \begin{cases} -\frac{1}{2} - x, & x < \frac{1}{2} \\ \left(\frac{1}{2} - x\right)^2, & x \geq \frac{1}{2} \end{cases}$
c) $f(x) = \begin{matrix} \frac{\sin x}{x}, x \neq 0 \\ 1, x = 0 \end{matrix}$
d) F(x) = |x|

134) For all real values of x, increasing function f(x) is [2]
a) X^2 b) X^4
c) X^{-1} d) X^3

135) If the law of motion in a straight line is s = $\frac{1}{2}$ vt, then acceleration is [2]
a) Proportional to v b) Proportional to t
c) A constant d) Proportional to s

136) The maximum value of function $x^3 - 12x^2 + 36x + 17$ in the interval [1, 10]is [2]
a) 27 b) 17
c) 77 d) 177

137) $\int \frac{x^2}{(x^2+2)(x^2+3)}$ dx = [2]
a) $-\sqrt{2}\ \tan^{-1}\left(\frac{x}{\sqrt{2}}\right) + \sqrt{3}\ \tan^{-1}\left(\frac{x}{\sqrt{3}}\right) + c$
b) $-\sqrt{2}\ \tan^{-1}x + \sqrt{3}\ \tan^{-1}x + c$
c) $\sqrt{2}\ \tan^{-1}x + \sqrt{3}\ \tan^{-1}x + c$
d) $\sqrt{2}\ \tan^{-1}\left(\frac{x}{\sqrt{2}}\right) + \sqrt{3}\ \tan^{-1}\left(\frac{x}{\sqrt{3}}\right) + c$

138) $\int \frac{1}{\sqrt{1-e^{2x}}}\ dx =$ [2]
a) $X + \log\left[1+\sqrt{1-e^{2x}}\right] + c$
b) $X - \log\left[1+\sqrt{1-e^{2x}}\right] + c$
c) $X - \log\left[1-\sqrt{1-e^{2x}}\right] + c$
d) $\text{Log}\left[1+\sqrt{1-e^{2x}}\right] - x + c$

139) $\int \sec^4 x \tan x\ dx$ = [2]
a) $\frac{\sec^3 x}{3} + c$
b) $3\sec^3 x + c$
c) $\frac{\tan^2 x}{2} + \frac{\tan^4 x}{4} + C$
d) $4\sec^4 x + c$

140) $\int \sec x \cdot \log(\sec x + \tan x)\ dx$ = [2]
a) Log [log (sec x + tan x)]+ c
b) (sec x + tan x) log (sec x + tan x) + c
c) $\frac{1}{2}$ [log (sec x + tan x)]^2 + c
d) $\frac{1}{2}$ log(sec x + tan x) + c

141) The area of the region bounded by $x = y^2 - y$ and Y - axis is [2]
a) $\frac{3}{2}$ sq. units
b) $\frac{1}{6}$ sq. units
c) $\frac{5}{3}$ sq. units
d) $\frac{2}{3}$ sq. units

142) The area of the region bounded by $x^2 + y^2 - 6x - 4y + 12 = 0$, y = x and x = $\frac{5}{2}$ is [2]
a) $\left(\frac{\pi}{6} + \frac{\sqrt{3}-1}{8}\right)$ sq. unit
b) $\left(\frac{\pi}{6} - \frac{\sqrt{3}-1}{8}\right)$ sq. unit
c) $\left(\frac{\pi}{6} - \frac{\sqrt{3}+1}{8}\right)$ sq. unit
d) $\left(\frac{\pi}{6} + \frac{\sqrt{3}+1}{8}\right)$ sq. unit

143) The slope of the tangent at (x, y) to a curve passing through$\left(1, \frac{\pi}{4}\right)$ is given by $\frac{y}{x} - \cos^2\left(\frac{y}{x}\right)$, then the equation of the curve is [2]
a) $x = y\tan\left[\log\left(\frac{e}{x}\right)\right]$
b) $y = x\tan^{-1}\left[\log\left(\frac{e}{x}\right)\right]$
c) $y = \tan^{-1}\left[\log\left(\frac{e}{x}\right)\right]$
d) $y = x\tan^{-1}\left[\log\left(\frac{x}{e}\right)\right]$

144) The solution for the differential equation $\frac{dy}{y} + \frac{dx}{x} = 0$ is [2]
a) X + y = c
b) Log x· log y = c
c) Xy = c
d) $\frac{1}{y} + \frac{1}{x} = c$

145) The population of a city increases at the rate 3% per year. If at time t the population of city is p, then find equation of p in time t. [2]
a) $p = \frac{3}{100}e^{3t}$
b) $p = 3e^{\frac{3t}{100}}$
c) $p = e^{\frac{3t}{100}}$
d) $p = ce^{\frac{3t}{100}}$

146) If $y = ax^{n+1} + bx^{-n}$, then $x^2\frac{d^2y}{dx^2}$ is equal to [2]
a) Ny b) N^2y
c) N(n - 1)y d) N(n + 1)y

147) A random variable X has the following probability distribution:

X	- 2	- 1	0	1	2	
P(X)	0.1	K	0.2	2k	0.3	

Then the value of k is [2]
a) 0.01 b) 0.1
c) 0.05 d) 0.3

148) If the probability mass function of a discrete random variable X is
P(x) = $\begin{matrix} \frac{C}{x^3}; & x = 1, 2, 3 \\ 0; & \text{otherwise} \end{matrix}$
Then, E(X) = [2]
a) $\frac{251}{297}$ b) $\frac{294}{251}$
c) $\frac{297}{294}$ d) $\frac{343}{297}$

149) Let X B (n = 10, p = 0.2). Then P (X = 1) is [2]
a) 0.4684 b) 0.5684
c) 0.3684 d) 0.2684

150) 8 coins are tossed simultaneously. The probability of getting at least 6 heads is [2]
a) $\frac{37}{256}$ b) $\frac{57}{64}$
c) $\frac{7}{64}$ d) $\frac{229}{256}$