MHT CET 2022 PCM Aug 11 Shift 2 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

Time Allowed: 180 Minutes **Total Questions: 150** **Maximum Marks: 200**

General Instructions

(i) This **PCM** paper is from **MHT CET 2022**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

(ii) Answer all **150 multiple choice questions**: **50 Physics**, **50 Chemistry** and **50 Mathematics**.

(iii) Each question offers **four choices**, with **one correct answer**.

(iv) Allow **90 minutes for Physics and Chemistry together**, followed by **90 minutes for Mathematics**. The first group closes before the second opens.

(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

(vi) There is **no negative marking**. Unanswered questions score zero.

1. The magnetic susceptibility of the material of a rod is 349 and permeability of vacuum μ_0 is $4\pi \times 10^{-7}$ SI units. Absolute permeability of the material of the rod in SI units is

(A) 4400×10^{-7} (B) 4200×10^{-7}
(C) 4800×10^{-7} (D) 4600×10^{-7}

2. The magnetic flux through a coil of resistance 'R' changes by an amount '$\Delta\phi$' in time 'Δt'. The total quantity of induced electric charge 'Q' is

(A) $-\frac{\Delta\varrho}{\Delta t} + R$ (B) $\frac{\Delta\varrho}{\Delta t} \times R$
(C) $\frac{\Delta\varrho}{R}$ (D) $\frac{\Delta\varrho}{\Delta t}$

3. A body weighs 500 N on the surface of the earth. At what distance below the surface of the earth it weighs 250 N ? (Radius of earth, $R = 6400$ km)

(A) 6400 km (B) 800 km
(C) 1600 km (D) 3200 km

4. Three discs x, y and z having radii 2 m, 3 m and 6 m respectively are coated on outer surfaces. The wavelength corresponding to maximum intensity are 300 nm, 400 nm and 500 nm respectively. If P_x, P_y and P_z are power radiated by them respectively then

(A) P_X is maximum (B) P_Z is maximum
(C) P_y is maximum (D) $P_x = P_y = P_z$

5. A stationary wave is represented by

$$y = 10 \sin\left(\frac{\pi x}{4}\right) \cos(20\pi t)$$

where x and y are in cm and t in second. The distance between two consecutive nodes is

(A) 1 cm (B) 8 cm
(C) 4 cm (D) 2 cm

6. When the rms velocity of a gas is denoted by 'v', which one of the following relations is true? (T = Absolute temperature of the gas.)

(A) $\frac{v^2}{T}$ = constant (B) v^2T = constant
(C) vT^2 = constant (D) $\frac{v}{T^2}$ = constant

7. A parallel plate air capacitor has a uniform electric field 'E' in the space between the plates. Area of each plate is A and the distance between the plates is 'd'. The energy stored in the capacitor is [ε_0 = permittivity of free space)

(A) $2\epsilon_0 EAd$ (B) $\frac{1}{2}\epsilon_0 E^2 Ad$
(C) $\frac{\epsilon_0 E^2}{2Ad}$ (D) $\frac{E^2 Ad}{2\epsilon_0}$

8. Two massless springs of spring constant K_1 and K_2 are connected one after the other forming a single chain, suspended vertically and certain mass is attached to the free end. If 'e_1' and 'e_2' are their respective extensions and 'f' is their stretching force, the total extension produced is

(A) $f(\frac{1}{K_1} + \frac{1}{K_2})$ (B) $f(\frac{1}{K_1} - \frac{1}{K_2})$
(C) $f(K_1 + K_2)$ (D) $f(K_1 - K_2)$

9. The time taken by a particle executing simple harmonic motion of period 'T', to move from the mean position to half the maximum displacement is

(A) $\frac{T}{12}$ s (B) $\frac{T}{2}$ s
(C) $\frac{T}{4}$ s (D) $\frac{T}{6}$ s

10. Using Bohr's model, the orbital period of electron in hydrogen atom in the n^{th} orbit is (ε_0 = permittivity of vacuum, h = Planck's constant, m = mass of electron, e = electronic charge)

(A) $\frac{4\epsilon_0 nh^3}{me^2}$ (B) $\frac{4\epsilon_0 n^2 h^2}{me^2}$
(C) $\frac{4\epsilon_0^2 n^3 h^3}{me^4}$ (D) $\frac{4\epsilon_0^2 n^2 h^3}{me^3}$

11. A parallel plate capacitor is charged and then disconnected from the charging battery. If the plates are now moved further apart by pulling them by means of insulating handles, then

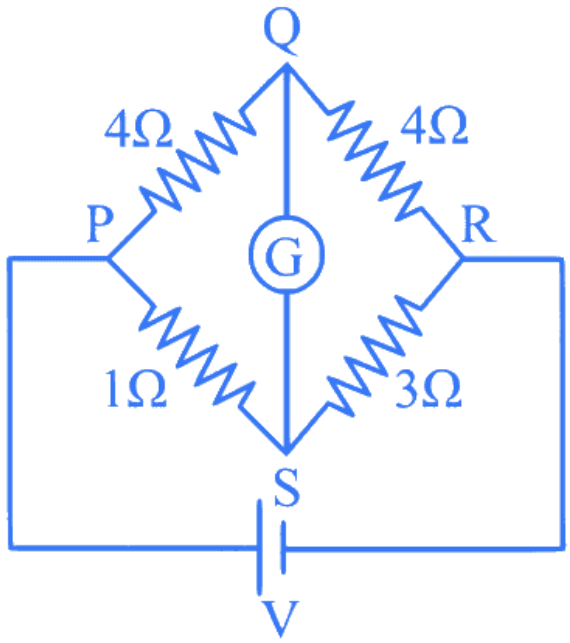
(A) the capacitance of the capacitor increases
(B) the charge on the capacitor decreases
(C) the voltage across the capacitor increases
(D) the energy stored in the capacitor decreases

12. If the kinetic energy of a free electron doubles, it's de Broglie wavelength (λ) changes by a factor

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$

(C) $\sqrt{2}$ (D) 2

13. In the following network, the current through galvanometer will



(A) be zero (B) flow from Q to S

(C) flow in a direction which depends on value of V (D) flow from S to Q

14. In a medium, the phase difference between two particles separated by a distance 'x' is

$$\left(\frac{\pi}{5}\right)^{c}$$

. If the frequency of the oscillation of particles is 25 Hz and the velocity of propagation of the waves is 75 m/s, then the value of x is

(A) 0.4 m (B) 0.1 m

(C) 0.2 m (D) 0.3 m

15. The work done in blowing a soap bubble of radius R is 'W_1' at room temperature. Now the soap solution is heated. From the heated solution another soap bubble of radius 2R is blown and the work done is 'W_2'. Then

(A) $W_2 = W_1$ (B) $W_2 = 4\,W_1$

(C) $W_2 < 4\,W_1$ (D) $W_2 = 0$

16. A capacitor of capacitance 50μF is connected to a.c. source

$$e = 220 \sin 50t$$

(e in volt, t in second). The value of peak current is

(A) $\frac{0.55}{\sqrt{2}}$ A (B) $\frac{\sqrt{2}}{0.55}$ A

(C) 0.55 A (D) $\sqrt{2}$ A

17. Two waves are superimposed whose ratio of intensities is 9 : 1. The ratio of maximum and minimum intensity is

(A) 9 : 1 (B) 4 : 1

(C) 3 : 1 (D) 5 : 3

18. The masses and radii of the moon and the earth are M_1, R_1 and M_2, R_2 respectively. Their centres are at a distance d apart. What should be the minimum speed with which a body of mass 'm' should be projected from a point midway between their centres, so as to escape to infinity?

(A) $\frac{G(M_1+M_2)}{d}$ (B) $2\sqrt{\frac{G(M_1+M_2)}{d}}$

(C) $\sqrt{\frac{Gd}{M_1+M_2}}$ (D) $\sqrt{\frac{M_1+M_2}{Gd}}$

19. A monoatomic gas

$$\left(\gamma = \frac{5}{3}\right)$$

initially at 27°C having volume 'V' is suddenly compressed to one-eighth of its original volume

$$\left(\frac{V}{8}\right)$$

. After the compression its temperature becomes

(A) 580 K (B) 1200 K

(C) 1160 K (D) 927 K

20. Two parallel conducting wires of equal length are placed distance 'd' apart, carry currents 'I_1' and 'I_2' respectively in opposite directions. The resultant magnetic field at the midpoint of the distance between both the wires is

(A) $\frac{\mu_0(I_1-I_2)}{\pi d}$ (B) $\frac{\mu_0(I_1+I_2)}{2\pi d}$

(C) $\frac{\mu_0(I_1-I_2)}{2\pi d}$ (D) $\frac{\mu_0(I_1+I_2)}{\pi d}$

21. Self inductance of a solenoid cannot be increased by

(A) decreasing its length (B) increasing its area of cross-section

(C) increasing the current through it (D) increasing the number of turns in it

22. For a NAND gate, the inputs and outputs are given below.

Input A	Input B	Output Y
0	1	C
0	0	D
1	0	E
1	1	F

The values taken by C, D, E, F are respectively

(A) 0, 1, 0, 0 (B) 1, 1, 1, 0

(C) 1, 0, 1, 1 (D) 0, 1, 0, 1

23. An electron and a proton having the same momenta enter perpendicularly into a magnetic field. What are their trajectories in the field?

(A) Path of the electron is more curved than that of proton

(B) They will travel undeflected

(C) Path of the proton is more curved than that of the electron

(D) Both the electron and the proton will move along the same curved path but they will move in opposite directions

24. The resistance offered by an inductor (X_L) in an a.c. circuit is

(A) inversely proportional to inductance and frequency of the alternating current

(B) inversely proportional to frequency of alternating current and directly proportional to inductance

(C) inversely proportional to inductance and directly proportional to the frequency of alternating current

(D) directly proportional to inductance and frequency of alternating current

25. The force between the plates of a parallel plate capacitor of capacitance 'C' and distance of separation of the plates 'd' with a potential difference 'V' between the plates is

(A) $\frac{V^2 d}{C}$ (B) $\frac{C^2 V^2}{d^2}$

(C) $\frac{CV^2}{2d}$ (D) $\frac{C^2 V^2}{2d^2}$

26. Consider the following statements about stationary waves.

A. The distance between two adjacent nodes or antinodes is equal to $\frac{\lambda}{2}(\lambda =$ wavelength of the wave)

B. A node is always formed at the open end of the open organ pipe.

Choose the correct option from the following.

(A) Both statements A and B are wrong.

(B) Only the statement B is true.

(C) Only the statement A is true.

(D) Both statements A and B are true.

27. If the radius of the spherical gaussian surface is increased then the electric flux due to a point charge enclosed by the surface

(A) increases (B) remains unchanged

(C) decreases (D) zero

28. The wave number of the last line of the Balmer series in hydrogen spectrum will be (Rydberg's constant $= 10^7\ m^{-1}$)

(A) $250\ m^{-1}$ (B) $2.5 \times 10^6\ m^{-1}$

(C) $0.25 \times 10^9\ m^{-1}$ (D) $2.5 \times 10^5\ m^{-1}$

29. A bucket containing water is revolved in a vertical circle of radius r. To prevent the water from falling down, the minimum frequency of revolution required is (g = acceleration due to gravity)

(A) $2\pi\sqrt{\frac{r}{g}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{r}{g}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{g}{r}}$ (D) $2\pi\sqrt{\frac{g}{r}}$

30. Two monatomic ideal gases A and B of molecular masses 'm_1' and 'm_2' respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas A to that in gas B is given by

(A) $\sqrt{\frac{m_2}{m_1}}$ (B) $\frac{m_1}{m_2}$

(C) $\sqrt{\frac{m_1}{m_2}}$ (D) $\frac{m_2}{m_1}$

31. A particle starts oscillating simple harmonically from its mean position with time period 'T'. At time

$$t = \frac{T}{12}$$

, the ratio of the potential energy to kinetic energy of the particle is

$(\sin 30^\circ = \cos 60^\circ = 0.5, \cos 30^\circ = \sin 60^\circ = \sqrt{3}/2)$

(A) 1 : 2 (B) 3 : 1

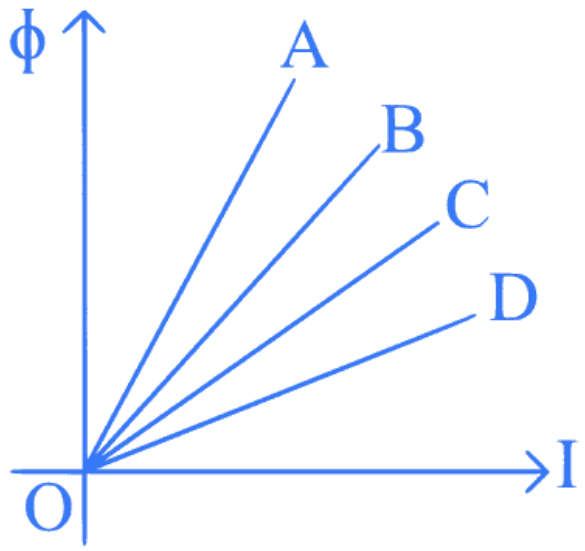
(C) 2 : 1 (D) 1 : 3

32. A hollow pipe of length 0.8 m is closed at one end. At its open end, a 0.5 m long uniform string is vibrating in its second harmonic and it resonates with the fundamental frequency of pipe. If the tension in the string is 50 N and speed of sound in air is 320 m/s, the mass of the string is

(A) 20 g (B) 10 g

(C) 40 g (D) 5 g

33. A graph of magnetic flux (ϕ) versus current (I) is drawn for four inductors A, B, C, D. Larger value of self inductance is for inductor.



(A) D (B) B

(C) C (D) A

34. A parallel beam of monochromatic light falls normally on a single narrow slit. The angular width of the central maximum in the resulting diffraction pattern

(A) decreases with increase of slitwidth (B) may increase or decrease

(C) decreases with decrease of slitwidth (D) increases with increase in slitwidth

35. A body moving in a circular path with a constant speed has constant

(A) momentum (B) velocity

(C) acceleration (D) kinetic energy

36. A steel coin of thickness 'd' and density 'ρ' is floating on water of surface tension 'T'. The radius of the coin (R) is [g = acceleration due to gravity]

(A) $\frac{T}{\rho g d}$ (B) $\frac{4T}{3\rho g d}$

(C) $\frac{3T}{4\rho g d}$ (D) $\frac{2T}{\rho g d}$

37. A door 1.2 m wide requires a force of 1 N to be applied perpendicular at the free end to open or close it. The perpendicular force required at a point 0.2 m distant from the hinges for opening or closing the door is

(A) 3.6 N (B) 2.4 N

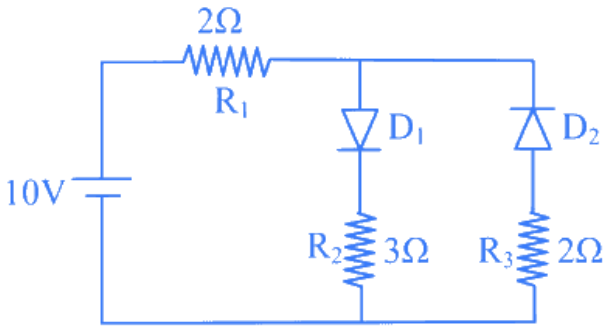
(C) 1.2 N (D) 6.0 N

38. The thermodynamic process in which no work is done on or by the gas is

(A) isochoric process (B) adiabatic process

(C) isothermal process (D) isobaric process

39. The given circuit has two ideal diodes D_1 and D_2 connected as shown in the figure. The current flowing through the resistance R_1 will be



(A) 7 A (B) 3.3 A

(C) 2 A (D) 2.5 A

40. In a Fraunhofer diffraction at a single slit of width 'd' and incident light of wavelength $5500\,\mathring{A}$, the first minimum is observed at an angle 30°. The first secondary maxima is observed at an angle θ, equal to

(A) $\sin^{-1}(\frac{1}{4})$ (B) $\sin^{-1}(\frac{3}{4})$
(C) $\sin^{-1}(\frac{\sqrt{3}}{2})$ (D) $\sin^{-1}(\frac{1}{\sqrt{2}})$

41. A galvanometer of resistance 200Ω is to be converted into an ammeter. The value of shunt resistance which allows 3% of the mains current through the galvanometer is equal to (nearly)

(A) 6Ω (B) 7Ω
(C) 10Ω (D) 5Ω

42. The speed of light in two media M_1 and M_2 are 1.5×10^8 m/s and 2×10^8 m/s respectively. If the light undergoes total internal reflection, the critical angle between the two media is

(A) $\sin^{-1}(\frac{3}{2})$ (B) $\sin^{-1}(\frac{2}{3})$
(C) $\sin^{-1}(\frac{4}{3})$ (D) $\sin^{-1}(\frac{3}{4})$

43. The minimum distance between an object and its real image formed by a convex lens of focal length 'f' is

(A) 2f (B) 4f
(C) 1.5f (D) 2.5f

44. Heat given to a body, which raises its temperature by 1°C is known as

(A) specific heat (B) thermal capacity
(C) water equivalent (D) temperature gradient

45. A shell is fired at an angle of 30° to the horizontal with velocity 196 m/s. The time of flight is $\left[\sin 30^\circ = \frac{1}{2} = \cos 60^\circ\right]$

(A) 6.5 s (B) 20 s
(C) 16.5 s (D) 10 s

46. Three equal charges 'q_1', "q_2' and 'q_3' are placed on the three corners of a square of side 'a'. If the force between q_1 and q_2 is 'F_{12}' and that between q_1 and q_3 is 'F_{13}', then the ratio of magnitudes $\left(\frac{F_{12}}{F_{13}}\right)$ is

(A) $\frac{1}{2}$ (B) $\sqrt{2}$
(C) $\frac{1}{\sqrt{2}}$ (D) 2

47. A coil having an inductance of $\frac{1}{\pi}$H is connected in series with a resistance of 300Ω. If A.C. Source (20 V – 200 Hz) is connected across the combination, the phase angle between voltage and current is

(A) $\tan^{-1}(\frac{3}{4})$ (B) $\tan^{-1}(\frac{4}{3})$
(C) $\tan^{-1}(\frac{5}{4})$ (D) $\tan^{-1}(\frac{4}{5})$

48. In a full wave rectifier circuit without filter, the output current is

(A) an eddy current (B) a constant direct current
(C) a sinusoidal current (D) unidirectional but not steady current

49. The excess pressure inside a soap bubble of radius 2 cm is 50 dyne/cm^2. The surface tension is

(A) 50 dyne/cm (B) 60 dyne/cm
(C) 75 dyne/cm (D) 25 dyne/cm

50. Two bodies of masses 'm' and '3 m' are rotating in horizontal speed of the body of mass 'm' is n times that of the value of heavier body; while the centripetal force is same for both. The value of n is

(A) 3 (B) 1
(C) 9 (D) 6

51. For the reaction $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$, rate of disappearance of $N_{2(g)}$ is 2.22×10^{-3} mol dm^{-3}. What is the rate of appearance of $NH_{3(g)}$?

(A) 2.22×10^{-3} mol dm^{-3}

(B) 1.11×10^{-3} mol dm^{-3}

(C) 4.44×10^{-3} mol dm^{-3}

(D) 3.33×10^{-3} mol dm^{-3}

52. Identify the products obtained when chlorine reacts with hot and conc. NaOH.

(A) $NaClO_3$, NaCl and H_2O

(B) NaCl and HOCl

(C) Na_2O and NaCl

(D) NaOCl and H_2O

53. Which from following elements does NOT react with water?

(A) Ca

(B) Sr

(C) Be

(D) Mg

54. Identify the type of hybridization involved in hexaaminecobalt (III) complex ion.

(A) sp^3

(B) dsp^2

(C) d^2sp^3

(D) sp^3d^2

55. Calculate the solubility of a gas in water at 0.8 atm and 25°C.
[Henry's law constant is 6.85×10^{-4} mol dm^{-3} atm^{-1}]

(A) 2.74×10^{-4} mol dm^{-3}

(B) 3.94×10^{-4} mol dm^{-3}

(C) 6.85×10^{-4} mol dm^{-3}

(D) 5.48×10^{-4} mol dm^{-3}

56. What is the value of temperature in degree Celsius at absolute zero ?

(A) 273.15°C

(B) −373.15°C

(C) 0°C

(D) −273.15°C

57. Which among the following reactions does NOT correctly match with its reagent?

(A) Stephen reaction: $SnCl_2$, HCl

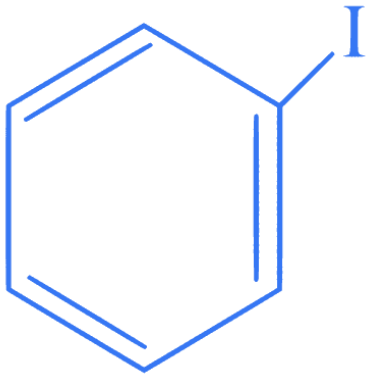
(B) Etard reaction : CrO_2Cl_2

(C) Gatterman - Koch formulation : $CrO_3/(CH_3CO)_2O$

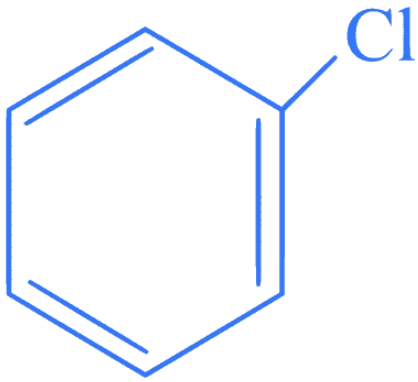
(D) Rosenmund reduction : $H_2/Pd - BaSO_4$

58. Which among the following compounds is NOT prepared by Sandmeyer's reaction ?

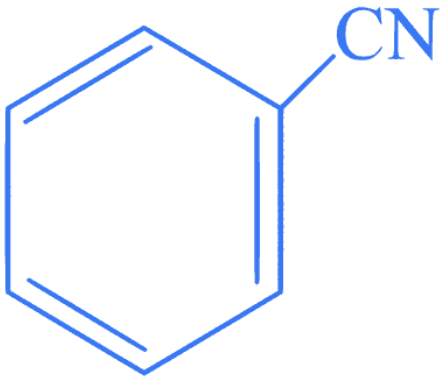
(A)



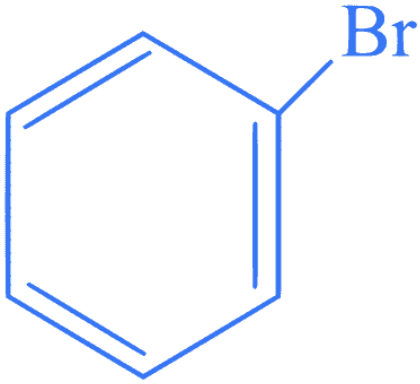
(B)



(C)



(D)



59. Which among the following compounds undergoes SN^2 reaction fastly ?

(A) 

(B) 

(C) 

(D) 

60. Which of the following molecules possesses highest dipole-dipole interactions ?

(A) HCl (B) HI
(C) HBr (D) HF

61. What is the total volume occupied by atoms in bcc unit cell ?

(A) 52.36% (B) 68%
(C) 80% (D) 74%

62. Which among the following metals is involved in preparation of Grignard reagent ?

(A) Magnesium (B) Sodium
(C) Silver (D) Zinc

63. Which among the following properties of lanthanoids is NOT true?

(A) Good conductors of heat and electricity (B) All are non-radioactive elements
(C) Have greater co-ordination number than six (D) Strongly paramagnetic

64. Which of the following is a Lewis acid but NOT a Bronsted acid?

(A) BCl_3 (B) HNO_3
(C) NH_3 (D) HSO_4^-

65. Which of the following aqueous solutions of salts will have highest pH value?

(A) CH_3COONH_4 (B) Na_2CO_3
(C) NH_4Cl (D) NaCl

66. Which among the following compounds represents a soap molecule?

(A) Ammonium salt of higher fatty acids (B) Sodium salt of formic acid
(C) Potassium salt of higher fatty acids (D) Ammonium salt of formic acid

67. How long will it take to produce 5.4 g of Ag from molten AgCl by passing 5 amp current? (Molar mass Ag = 108 g mol^{-1})

(A) 1930 second (B) 193 second
(C) 965 second (D) 9650 second

68. Which of the following is NOT an example of secondary voltaic cell?

(A) Lead storage battery (B) Dry cell
(C) Nickel-cadmium cell (D) Mercury cell

69. What is the number of unpaired electrons in $[Co(NH_3)_6]^{3+}$ complex?

(A) Four (B) Two
(C) Zero (D) Six

70. Which among the following methods is used to prepare Grignard reagent?

(A) Action of magnesium powder on alkyl halide in aqueous medium (B) Action of magnesium hydroxide on alkyl halide
(C) Action of magnesium metal on alkyl halide in presence of dry ether (D) Action of $MgCl_2$ on alkyl halide in presence of dry ether

71. Calculate the density of metal having volume of unit cell 64×10^{-24} cm^3 and molar mass of metal 192 g mol^{-1} containing 4 particles in unit cell.

(A) 14.92 g cm^{-3} (B) 16.00 g cm^{-3}
(C) 19.93 g cm^{-3} (D) 18.00 g cm^{-3}

72. Calculate the work done when 2 moles of an ideal gas expand from a volume of $5\ dm^3$ to $7 \times 10^{-3}\ m^3$ against a constant external pressure of $2.02 \times 10^5\ Nm^{-2}$?

(A) 20.2 J
(B) −404 J
(C) 202 J
(D) −35.0 J

73. Which among the following pair of monomers does not generate polyamide polymer?

(A) Urea and Formaldehyde
(B) Glycine and ϵ amino caproic acid
(C) Adipic acid and hexamethylene diamine
(D) 3-Hydroxybutanoic acid and 3-Hydroxy pentanoic acid

74. What type of following phenomena is NOT exhibited by adsorption?

(A) Irreversible
(B) Bulk
(C) Exothermic
(D) Endothermic

75. Find the rate constant of first order reaction in second having half life of 2.5 hours.

(A) $4.3 \times 10^{-5} sec^{-1}$
(B) $7.7 \times 10^{-5} sec^{-1}$
(C) $6.9 \times 10^{-5} sec^{-1}$
(D) $8.4 \times 10^{-5} sec^{-1}$

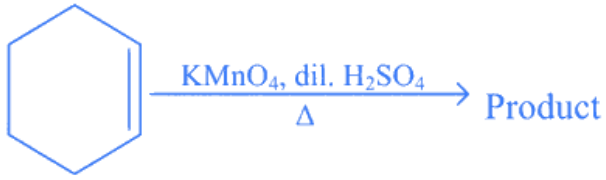
76. Which nitrogen atom of pyrimidine base numbered from 1 to 6 is bonded with furanose sugar ?

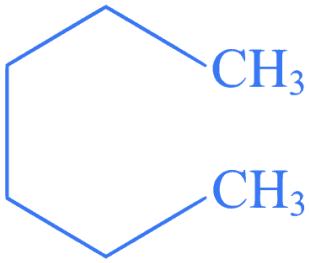
(A) 4
(B) 2
(C) 1
(D) 5

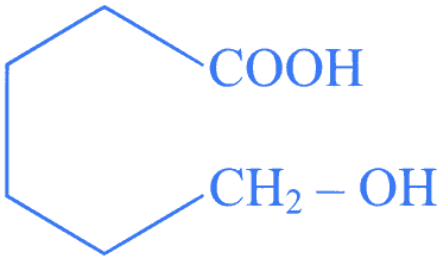
77. Identify the element with smallest ionic radius in +3 oxidation state from following.

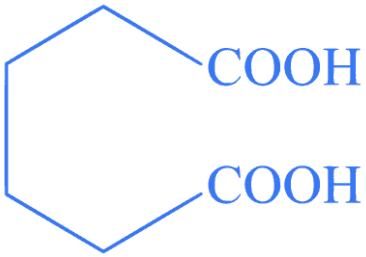
(A) Er
(B) Lu
(C) Eu
(D) Yb

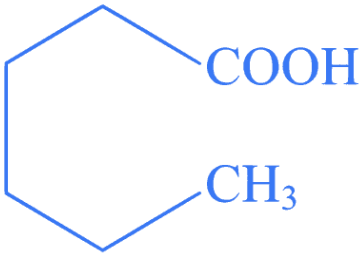
78. Identify the product in the following reaction.



(A)


(B)


(C)


(D)


79. Which among following compounds possesses highest number of N atoms in it ?

(A) Cytosine
(B) Uracil
(C) Guanine
(D) Thymine

80. What is the bond order of CO molecule?

(A) 1
(B) 2
(C) 3
(D) 0

81. Which of the following is NOT hydrogen like species?

(A) He (B) He^{+}

(C) Li^{2+} (D) Be^{3+}

82. What is the intermediate compound formed when chlorobenzene is treated with fused NaOH under pressure?

(A) Phenoxide ion (B) Sodium phenoxide

(C) Benzene diazonium chloride (D) Benzene

83. If rate of reaction is given as

$$\frac{1}{3}\frac{d[x]}{dt} = -\frac{1}{2}\frac{d[y]}{dt} = -\frac{d[Z]}{dt}$$

,
the reaction can be represented as

(A) $2y + Z \rightarrow 3x$ (B) $2y \rightarrow 3x + Z$

(C) $3x + 2y \rightarrow Z$ (D) $3x \rightarrow 2y + Z$

84. Which among the following compounds contains highest number of chlorine atoms in their single molecule ?

(A) Mustard gas (B) Phosgene

(C) Tear gas (D) Phosphine

85. What is the heat of formation of $HCl_{(g)}$ from following equation?

$$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)} \Delta_f H = -194 \text{ kJ}$$

(A) -388 kJ (B) -194 kJ

(C) -97 kJ (D) 194 kJ

86. Identify the concentration of the solution from following so that values of ,ΔT_f and K_f are same.

(A) 1 m (B) 1 M

(C) 1 N (D) $\frac{N}{10}$

87. What is the product formed when cumene is air oxidised in presence of Co-naphthenate and further treated with dilute acid?

(A) Cumene hydroperoxide (B) Phenol and CO_2

(C) Acetone and Benzoic acid (D) Phenol + Acetone

88. Identify the use of polystyrene for household purposes.

(A) To prepare shopping bags (B) To prepare microwavable food trays

(C) To manufacture disposable cups and plates (D) To prepare bottles for storage of mouth wash

89. Identify compound A in following reaction Benzene + Ozone (excess) $\rightarrow$ Benzenetriozonide $\xrightarrow{A}$ Glyoxal

(A) conc. HNO_3 (B) Ni

(C) $Zn + H_2O$ (D) Zn

90. Which from following pairs of compounds is an example of metamerism?

(A) But-2-ene and But-1-ene (B) m-Butane and 2-Methylpropane

(C) Ethoxyethane and methoxypropane (D) Dimethyl ether and ethyl alcohol

91. If Q is the heat liberated from the system and W is the work done on the system then first law of thermodynamics can be written as,

(A) $Q = W - \Delta U$ (B) $Q = \Delta U - W$

(C) $Q = \Delta U + W$ (D) $Q = -W$

92. Calculate the number of atoms in 5 gram metal that crystallises to form simple cubic unit cell structure having edge length 336 pm. (Density of metal

$$= 9.4 \text{ g cm}^{-3}$$

)

(A) 1.0×10^{22} (B) 2.1×10^{22}

(C) 1.4×10^{22} (D) 1.8×10^{22}

93. Identify the molecule in which central atom undergoes sp^3 hybridisation?

(A) BF_3 (B) H_2O

(C) C_2H_4 (D) $BeCl_2$

94. Which one of the following conversions does NOT involve either oxidation or reduction?

(A) $Na \rightarrow Na^{+}$ (B) $VO_2^{+} \rightarrow V_2O_3$

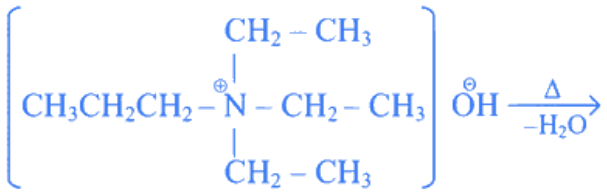
(C) $Zn^{2+} \rightarrow Zn$ (D) $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$

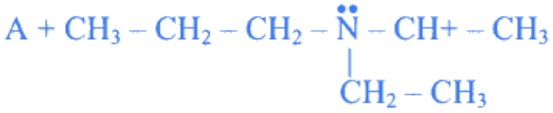
95. Calculate $\wedge_0$ of $CH_2ClCOOH$ if $\wedge_0$ for HCl, KCl and $CH_2ClCOOK$ are $4.2, 1.5$ and $1.1\Omega^{-1}\ cm^2\ mol^{-1}$ respectively?

(A) $2.7\Omega^{-1}\ cm^2\ mol^{-1}$ (B) $3.8\Omega^{-1}\ cm^2\ mol^{-1}$

(C) $1.9\Omega^{-1}\ cm^2\ mol^{-1}$ (D) $4.2\Omega^{-1}\ cm^2\ mol^{-1}$

96. Identify the product A in the following reaction.





(A) $CH_3 - CH = CH_2$ (B) $H_2C = CH_2$

(C) $CH_3 - CH_2 - CH_3$ (D) $CH_3 - C \equiv CH$

97. Calculate the amount of solute dissolved in 160 gram solvent that boils at 85°C, the molar mass of solute is 120 g mol^{-1}. (K_b for solvent $= 2.7°C\ kg\ mol^{-1}$ and boiling point of solvent $= 76°C$)

(A) 42 gram (B) 60 gram

(C) 64 gram (D) 50 gram

98. Identify ether from the following compounds.

(A) Benzenol (B) Benzene-1, 2-diol

(C) Methoxymethane (D) Propan-2-ol

99. Which from following polymers is used to obtain bristles for brushes?

(A) Nylon 2 - nylon 6 (B) Nylon 6, 6

(C) Nylon 6 (D) Polyacrylamide

100. What is the pH of 2×10^{-3}M solution of monoacidic weak base if it ionises to the extent of 5% ?

(A) 14 (B) 6

(C) 4 (D) 2

101.

$$\int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} \frac{dx}{1+\cos x}$$

is equal to

(A) $-2\sqrt{2}$ (B) 2

(C) $-2-2\sqrt{2}$ (D) -2

102. If

$$\tan^{-1}\left(\frac{1-x}{1+x}\right)=\frac{1}{2}\tan^{-1}x$$

, then x has the value

(A) 3 (B) 1

(C) $\frac{1}{\sqrt{3}}$ (D) $\sqrt{3}$

103. If $p:\forall n\in IN, n^2+n$ is an even number $q:\forall n\in IN, n^2-n$ is an odd numer, then the truth values of $p\wedge q, p\vee q$ and $p\to q$ are respectively

(A) F,T,F (B) F,F,T

(C) T,T,F (D) F,T,T

104. If the function

$$f(x)=x^3-3(a-2)x^2+3ax+7$$

, for some $a\in IR$ is increasing in $(0,1]$ and decreasing in $[1,5)$, then a root of the equation

$$\frac{f(x)-14}{(x-1)^2}=0(x\neq 1)$$

is

(A) 14 (B) 7

(C) -14 (D) -7

105. If

$$\bar{a}=\hat{i}-\hat{k}, \bar{b}=x\hat{i}+\hat{j}+(1-x)\hat{k}$$

and

$$\bar{c}=y\hat{i}+x\hat{j}+(1+x-y)\hat{k}$$

, then $[\bar{a}\bar{b}\bar{c}]$ depends on

(A) only y (B) neither x nor y

(C) both x and y (D) only x

106. If

$$\cot(A+B)=0$$

, then $\sin(A+2B)$ is equal to

(A) $\sin A$ (B) $\cos 2A$

(C) $\sin 2A$ (D) $\cos A$

107. The joint equation of pair of lines through the origin and making an equilateral triangle with the line

$$y=5$$

is

(A) $x^2-3y^2=0$ (B) $\sqrt{3}x^2-y^2=0$

(C) $3x^2-y^2=0$ (D) $5x^2-y^2=0$

108. If

$$f(x)=\sqrt{\tan x}$$

and

$$g(x)=\sin x\cdot\cos x$$

then

$$\int \frac{f(x)}{g(x)}dx$$

is equal to (where C is a constant of integration)

(A) $2\sqrt{\tan x}+C$ (B) $\frac{1}{2}\sqrt{\tan x}+C$

(C) $\sqrt{\tan x}+C$ (D) $\frac{3}{2}\sqrt{\tan x}+C$

109. The general solution of the differential equation

$$\frac{dy}{dx}=\frac{3x+y}{x-y}$$

is (where C is a constant of integration.)

(A) $\tan^{-1}(\frac{y}{x})+\log(\frac{y^2+3x^2}{x^2})=\log(x)+C$

(B) $\frac{1}{\sqrt{3}}\tan^{-1}(\frac{y}{x\sqrt{3}})+\log(\frac{y^2+3x^2}{x^2})^{\frac{1}{2}}=\log(x)+C$

(C) $\frac{1}{\sqrt{3}}\tan^{-1}(\frac{y}{x\sqrt{3}})-\log(\frac{y^2+3x^2}{x^2})^{\frac{1}{2}}=\log(x)+C$

(D) $\tan^{-1}(\frac{x}{y})+\log(\frac{y^2+3x^2}{x^2})=\log(x)+C$

110. If

$$A=\begin{bmatrix}1 & 2 & 1\\ 3 & 1 & 3\end{bmatrix}$$

and

$$B=\begin{bmatrix}2 & 3\\ 1 & 2\\ 1 & 2\end{bmatrix}$$

, then

$$(AB)^{-1}=$$

(A) $\begin{bmatrix}\frac{17}{5} & \frac{9}{5}\\ 2 & 1\end{bmatrix}$ (B) $\begin{bmatrix}\frac{-17}{5} & \frac{9}{5}\\ 2 & -1\end{bmatrix}$

(C) $\begin{bmatrix}\frac{17}{5} & 2\\ \frac{8}{5} & 1\end{bmatrix}$ (D) $\begin{bmatrix}\frac{-17}{5} & 2\\ \frac{-9}{5} & -1\end{bmatrix}$

111. The distance between parallel lines

$$\frac{x-1}{2}=\frac{y-2}{-2}=\frac{z-3}{1}$$

and

$$\frac{x}{2}=\frac{y}{-2}=\frac{z}{1}$$

is :

(A) $\frac{2\sqrt{5}}{3}$ units (B) $\frac{\sqrt{5}}{3}$ units

(C) $\frac{5\sqrt{5}}{3}$ units (D) $\frac{4\sqrt{5}}{3}$ units

112. Maximum value of

$$Z=5x+2y$$

, subject to $2x-y\geq 2, x+2y\leq 8$ and $x,y\geq 0$ is

(A) 40 (B) 17.6

(C) 28 (D) 25.6

113. The value of $\sin\left(2\sin^{-1}0.8\right)$ is equal to

(A) 0.96 (B) 0.16

(C) 0.12 (D) 0.48

114. A line makes the same angle 'α' with each of the x and y axes. If the angle 'θ', which it makes with the z-axis, is such that

$$\sin^2\theta=2\sin^2\alpha$$

, then the angle α is

(A) $(\frac{\pi}{4})$ (B) $(\frac{\pi}{2})$

(C) $(\frac{\pi}{3})$ (D) $(\frac{\pi}{6})$

115. The negation of the statement pattern $p\vee(q\rightarrow\sim r)$ is

(A) $\sim p\wedge(q\wedge\sim r)$ (B) $\sim p\wedge(q\wedge r)$

(C) $\sim p\wedge(\sim q\wedge r)$ (D) $\sim p\wedge(\sim q\wedge\sim r)$

116. Let

$$\bar{a}=\hat{\mathbf{i}}-2\hat{\mathbf{j}}+\hat{\mathbf{k}}$$

and

$$\bar{b}=\hat{\mathbf{i}}-\hat{\mathbf{j}}+\hat{\mathbf{k}}$$

be two vectors. If $\bar{c}$ is a vector such that

$$\bar{b}\times\bar{c}=\bar{b}\times\bar{a}$$

and

$$\bar{c}\cdot\bar{a}=0$$

, then $\bar{c}\cdot\bar{b}$ is equal to

(A) $-\frac{1}{2}$ (B) $\frac{3}{2}$

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

117. The incidence of occupational disease in an industry is such that the workmen have a 10% chance of suffering from it. The probability that out of 5 workmen, 3 or more will contract the disease is

(A) 0.000856 (B) 0.856

(C) 0.0000856 (D) 0.00856

118. If

$$y=\log\sqrt{\frac{1+\sin x}{1-\sin x}}$$

, then

$$\frac{dy}{dx}$$

at

$$x=\frac{\pi}{3}$$

is

(A) $\frac{1}{2}$ (B) $-\frac{1}{2}$

(C) 2 (D) $\frac{1}{4}$

119. The variance and mean of 15 observations are respectively 6 and 10 . If each observation is increased by 8 then the new variance and new mean of resulting observations are respectively

(A) 6, 18 (B) 6, 10

(C) 14, 10 (D) 14, 18

120. If

$$y=\sin\left(2\tan^{-1}\sqrt{\frac{1+x}{1-x}}\right)$$

then

$$\frac{dy}{dx}$$

is equal to

(A) $\frac{-x}{\sqrt{1-x^2}}$ (B) $\frac{-2x}{\sqrt{1-x^2}}$

(C) $\frac{-1}{\sqrt{1-x^2}}$ (D) $\frac{1}{\sqrt{1-x^2}}$

121. The magnitude of the projection of the vector $2\hat{\mathbf{i}}+3\hat{\mathbf{j}}+\hat{\mathbf{k}}$ on the vector perpendicular to the plane containing the vectors $\hat{\mathbf{i}}+\hat{\mathbf{j}}+\hat{\mathbf{k}}$ and $\hat{\mathbf{i}}+2\hat{\mathbf{j}}+3\hat{\mathbf{k}}$ is

(A) $3\sqrt{6}$ units (B) $\frac{\sqrt{3}}{2}$ units

(C) $\frac{1}{\sqrt{6}}$ units (D) $\sqrt{\frac{3}{2}}$ units

122.

$$f(x)=ax^2+bx+1,\quad if\quad |2x-3|\geq 2$$
$$=3x+2,\qquad if\quad \frac{1}{2}<x<\frac{5}{2}$$

is continuous on its domain, then $a+b$ has the value

(A) $\frac{13}{5}$ (B) $\frac{31}{5}$

(C) $\frac{23}{5}$ (D) $\frac{1}{5}$

123. If
$$\bar{a} = \hat{i} + \hat{j} + \hat{k}, \bar{b} = \hat{i} - \hat{j} + \hat{k}$$
and
$$\bar{c} = \hat{i} - \hat{j} - \hat{k}$$
are three vectors then vector $\bar{r}$ in the plane of $\bar{a}$ and $\bar{b}$, whose projection on $\bar{c}$ is
$$\frac{1}{\sqrt{3}}$$
, is given by

(A) $\hat{i} - 3\hat{j} + 3\hat{k}$ (B) $-3\hat{i} - 3\hat{j} - \hat{k}$

(C) $3\hat{i} - \hat{j} + 3\hat{k}$ (D) $\hat{i} + 3\hat{j} - 3\hat{k}$

---

124. A tetrahedron has verticles $P(1,2,1), Q(2,1,3), R(-1,1,2)$ and $O(0,0,0)$. Then the angle between the faces OPQ and PQR is

(A) $\cos^{-1}(\frac{17}{35})$ (B) $\cos^{-1}(\frac{17}{31})$

(C) $\cos^{-1}(\frac{19}{35})$ (D) $\cos^{-1}(\frac{19}{31})$

---

125. The principal value of
$$\sin^{-1}\left(\sin\left(\frac{2\pi}{3}\right)\right)$$
is

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

(C) $-(\frac{2\pi}{3})$ (D) $(\frac{5\pi}{3})$

---

126. The differential equation
$$\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$$
determines a family of circles with

(A) fixed radius of 1 unit and variable centres along the X-axis

(B) fixed radius of 1 unit and variable centres along the Y-axis

(C) variable radii and a fixed centre at $(0,1)$

(D) variable radii and a fixed centre at $(0,-1)$

---

127. The value of the integral
$$\int_0^1 \sqrt{\frac{1-x}{1+x}}\,dx$$
is

(A) $(\frac{\pi}{2}) + 1$ (B) $(\frac{\pi}{2}) - 1$

(C) 1 (D) -1

---

128. If a question paper consists of 11 questions divided into two sections I and II. Section I consists of 6 questions and section II consists of 5 questions, then the number of different ways can student select 6 questions, taking at least 2 questions from each section, is

(A) 425 (B) 275

(C) 350 (D) 225

---

129. The area (in sq. units) of the region described by
$$A = \{(x,y)/x^2 + y^2 \le 1$$
and $y^2 \le 1 - x\}$ is

(A) $(\frac{\pi}{2} + \frac{2}{3})$ (B) $(\frac{\pi}{2} + \frac{4}{3})$

(C) $(\frac{\pi}{2} - \frac{4}{3})$ (D) $(\frac{\pi}{2} - \frac{2}{3})$

---

130. A firm is manufacturing 2000 items. It is estimated that the rate of change of production P with respect to additional number of workers x is given by
$$\frac{dP}{dx} = 100 - 12\sqrt{x}$$
. If the firm employs 25 more workers, then the new level of production of items is

(A) 4500 (B) 3000

(C) 2500 (D) 3500

131.
$$\int \frac{3x-2}{(x+1)(x-2)^2}\,dx =$$
(where C is a constant of integration)

(A) $\frac{-5}{9}\log(x+1) + \frac{5}{9}\log(x-2) - \frac{4}{3} \times \frac{1}{(x-2)} + C$

(B) $\frac{-5}{9}\log(x+1) + \frac{5}{9}\log(x-2) - \frac{1}{x-2} + C$

(C) $\frac{1}{9}\log(x+1) + \frac{5}{9}\log(x-2) - \frac{4}{3} \times \frac{1}{(x-2)} + C$

(D) $\frac{-5}{9}\log(x+1) + \frac{1}{9}\log(x-2) - \frac{1}{x-2} + C$

---

132. If the normal to the curve
$$y = f(x)$$
at the point $(3,4)$ makes an angle
$$\left(\frac{3\pi}{4}\right)^c$$
with positive X-axis, then $f'(3)$ is equal to

(A) -1 (B) $\frac{4}{3}$

(C) $-\frac{3}{4}$ (D) 1

---

133. If
$$P(A \cup B) = 0.7, P(A \cap B) = 0.2$$
, then $P(A') + P(B')$ is

(A) 1.1 (B) 1.6

(C) 1.8 (D) 0.6

134. If

$$\lim_{x \to 1} \frac{x^2 - ax + b}{(x-1)} = 5$$

, then $(a+b)$ is equal to

(A) -4 (B) -7

(C) 7 (D) -3

---

135. If

$$y = \cos\left(\sin x^2\right)$$

, then

$$\frac{dy}{dx}$$

at

$$x = \sqrt{\frac{\pi}{2}}$$

is

(A) 0 (B) 2

(C) -1 (D) -2

---

136. Two cards are drawn successively with replacement from a well shuffled pack of 52 cards. Then mean of number of kings is

(A) $\frac{4}{169}$ (B) $\frac{1}{13}$

(C) $\frac{1}{169}$ (D) $\frac{2}{13}$

---

137. The polar co-ordinates of the point, whose Cartesian coordinates are $(-2\sqrt{3}, 2)$, are

(A) $(4, (\frac{3\pi}{4}))$ (B) $(4, (\frac{5\pi}{6}))$

(C) $(4, (\frac{2\pi}{3}))$ (D) $(4, (\frac{11\pi}{12}))$

---

138. Let z be a complex number such that

$$|z| + z = 3 + i, i = \sqrt{-1}$$

, then $|z|$ is equal to

(A) $\frac{5}{4}$ (B) $\frac{5}{3}$

(C) $\frac{\sqrt{34}}{3}$ (D) $\frac{\sqrt{41}}{4}$

---

139. Given

$$A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$$

, if

$$xyz = 60$$

and

$$8x + 4y + 3z = 20$$

, then $A.(\text{adj}A)$

(A) $\begin{bmatrix} 60 & 0 & 0 \\ 0 & 60 & 0 \\ 0 & 0 & 60 \end{bmatrix}$

(B) $\begin{bmatrix} 108 & 0 & 0 \\ 0 & 108 & 0 \\ 0 & 0 & 108 \end{bmatrix}$

(C) $\begin{bmatrix} 20 & 0 & 0 \\ 0 & 20 & 0 \\ 0 & 0 & 20 \end{bmatrix}$

(D) $\begin{bmatrix} 68 & 0 & 0 \\ 0 & 68 & 0 \\ 0 & 0 & 68 \end{bmatrix}$

---

140. If

$$y^{\frac{1}{m}} + y^{\frac{-1}{m}} = 2x, x \neq 1$$

, then

$$\left(x^2 - 1\right)\left(\frac{dy}{dx}\right)^2$$

is equal to

(A) my^2 (B) m^2y

(C) m^2y^2 (D) $\frac{my^2}{2}$

141.

$$\int_0^2 [x]dx + \int_0^2 |x-1|dx =$$

(where $[x]$ denotes the greatest integer function.)

(A) 4 (B) 3

(C) 1 (D) 2

---

142. The equations of the lines passing through the point $(3, 2)$ and making an acute angle of 45° with the line

$$x - 2y - 3 = 0$$

are

(A) $3x + y - 11 = 0, x + 3y + 9 = 0$

(B) $3x - y - 7 = 0, x + 3y - 9 = 0$

(C) $3x + y - 11 = 0, x + 3y - 9 = 0$

(D) $x + 2y - 7 = 0, 2x - y - 4 = 0$

143. If $[x]$ is greatest integer function and

$$2[2x-5]-1=7$$

, then x lies in

(A) $(\frac{9}{2},5)$ (B) $(\frac{9}{2},5]$

(C) $[\frac{9}{2},5]$ (D) $[\frac{9}{2},5)$

144. The Cartesian equation of a line passing through $(1,2,3)$ and parallel to

$$x-y+2z=5$$

and

$$3x+y+z=6$$

is

(A) $\frac{x-1}{-3}=\frac{y-2}{5}=\frac{z-3}{4}$ (B) $\frac{x-1}{3}=\frac{y-2}{1}=\frac{z-3}{1}$

(C) $\frac{x-1}{1}=\frac{y-2}{-1}=\frac{z-3}{1}$ (D) $\frac{x-1}{-3}=\frac{y-2}{-5}=\frac{z-3}{4}$

145. If the lines

$$3x-4y-7=0$$

and

$$2x-3y-5=0$$

pass through diameters of a circle of area 49π square units, then the equation of the circle is

(A) $x^2+y^2-2x+2y-47=0$

(B) $x^2+y^2-2x+2y+51=0$

(C) $x^2+y^2+2x-2y-51=0$

(D) $x^2+y^2+2x+2y+47=0$

146. A spherical iron ball of 10 cm radius is coated with a layer of ice of uniform thickness that melts at the rate of 50 cm^3/min. If the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases is

(A) $\frac{-1}{18\pi}$cm/min (B) $\frac{2}{9\pi}$cm/min

(C) $\frac{1}{18\pi}$cm/min (D) $\frac{1}{3\pi}$cm/min

147.

$$\int \frac{\sin\frac{5x}{2}}{\sin\frac{x}{2}}dx=$$

(where C is a constant of integration.)

(A) $x+\sin x+\sin 2x+C$

(B) $x+\sin x+\sin 2x-C$

(C) $x+2\sin x+2\sin 2x+C$

(D) None of these

148. The equation of the plane passing through the points $(2,3,1),(4,-5,3)$ and parallel to X-axis is

(A) $3y+4z=13$ (B) $y-4z=-1$

(C) $2y+4z=19$ (D) $y+4z=7$

149.

$$\text{If } \int e^{x^2}\cdot x^3\,dx=e^{x^2}\cdot[f(x)+C]$$

(where C is a constant of integration.) and

$$f(1)=0$$

, then value of $f(2)$ will be

(A) $\frac{-3}{2}$ (B) $\frac{-1}{2}$

(C) $\frac{3}{2}$ (D) $\frac{1}{2}$

150. The negation of the statement, "The payment will be made if and only if the work is finished in time" is

(A) The work is finished in time and the payment is not made or the payment is made and the work is finished in time.

(B) The work is finished in time and the payment is not made.

(C) The payment is made and the work is not finished in time.

(D) Either the work is finished in time and the payment is not made or the payment is made and the work is not finished in time.

- End of Question Paper -