

MHT CET 2021 Mathematics Memory Based Question Paper PDF

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:
 - (1) 4400×10^{-7}
 - (2) 4200×10^{-7}
 - (3) 4800×10^{-7}
 - (4) 4600×10^{-7}
2. 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):
 - (1) 6400 km
 - (2) 800 km
 - (3) 1600 km
 - (4) 3200 km
3. 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:
 - (1) 1 cm
 - (2) 8 cm
 - (3) 4 cm
 - (4) 2 cm
4. 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):
 - (1) $\frac{v^2}{T} = \text{constant}$
 - (2) $v^2 T = \text{constant}$
 - (3) $v T^2 = \text{constant}$
 - (4) $\frac{v}{T^2} = \text{constant}$
5. 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:

- (1) $2\epsilon_0 EAd$
 (2) $\frac{1}{2}\epsilon_0 E^2 Ad$
 (3) $\frac{\epsilon_0 E^2}{2Ad}$
 (4) $\frac{E^2 Ad}{2\epsilon_0}$
6. Two massless springs of spring constant K_1 and K_2 are connected one after the other forming a single chain, suspended vertically. If e_1 and e_2 are their respective extensions and 'f' is their stretching force, the total extension produced is:
- (1) $f(\frac{1}{K_1} + \frac{1}{K_2})$
 (2) $f(\frac{1}{K_1} - \frac{1}{K_2})$
 (3) $f(K_1 + K_2)$
 (4) $f(K_1 - K_2)$
7. 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:
- (1) $\frac{T}{12}$ s
 (2) $\frac{T}{2}$ s
 (3) $\frac{T}{4}$ s
 (4) $\frac{T}{6}$ s
8. 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):
- (1) $\frac{4\epsilon_0 nh^3}{me^2}$
 (2) $\frac{4\epsilon_0 n^2 h^2}{me^2}$
 (3) $\frac{4\epsilon_0^2 n^3 h^3}{me^4}$
 (4) $\frac{4\epsilon_0^2 n^2 h^3}{me^3}$
9. If the kinetic energy of a free electron doubles, its de Broglie wavelength (λ) changes by a factor:
- (1) $1/\sqrt{2}$
 (2) $1/2$
 (3) $\sqrt{2}$
 (4) 2

10. In a full wave rectifier circuit without filter, the output current is:
- (1) an eddy current
 - (2) a constant direct current
 - (3) a sinusoidal current
 - (4) unidirectional but not steady current
11. The excess pressure inside a soap bubble of radius 2 cm is 50 dyne/cm^2 . The surface tension is:
- (1) 50 dyne/cm
 - (2) 60 dyne/cm
 - (3) 75 dyne/cm
 - (4) 25 dyne/cm
12. Two bodies of masses ' m ' and ' $3m$ ' are rotating. If the centripetal force is same, the body of mass ' m ' rotates n times the speed of the heavier body. The value of n is:
- (1) 3
 - (2) 1
 - (3) 9
 - (4) 6
13. In a medium, the phase difference between two particles separated by a distance ' x ' is $\pi/5$. 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:
- (1) 0.4 m
 - (2) 0.1 m
 - (3) 0.2 m
 - (4) 0.3 m
14. The work done in blowing a soap bubble of radius R is ' W_1 ' at room temperature. Now the soap solution is heated and another bubble of radius $2R$ is blown with work done ' W_2 '. Then:
- (1) $W_2 = W_1$
 - (2) $W_2 = 4W_1$
 - (3) $W_2 < 4W_1$
 - (4) $W_2 = 0$

15. A capacitor of capacitance $50\mu\text{F}$ is connected to a.c. source $e = 220\sin 50t$ (e in volt, t in second). The value of peak current is:
- (1) 0.25 A
 - (2) 0.55 A
 - (3) 0.85 A
 - (4) 1.10 A
16. The masses and radii of the moon and the earth are M_1, R_1 and M_2, R_2 respectively. What is the minimum speed with which a body of mass 'm' should be projected from a point midway between their centres (distance d apart) so as to escape to infinity?
- (1) $\frac{G(M_1+M_2)}{d}$
 - (2) $2\sqrt{\frac{G(M_1+M_2)}{d}}$
 - (3) $\sqrt{\frac{2G(M_1+M_2)}{d}}$
 - (4) $\frac{2G(M_1+M_2)}{d}$
17. A monoatomic gas ($\gamma = 5/3$) initially at 27°C is suddenly compressed to one-eighth of its original volume. After the compression its temperature becomes:
- (1) 580 K
 - (2) 1200 K
 - (3) 1160 K
 - (4) 927 K
18. Self inductance of a solenoid cannot be increased by:
- (1) decreasing its length
 - (2) increasing its area of cross-section
 - (3) increasing the current through it
 - (4) increasing the number of turns in it
19. An electron and a proton having the same momenta enter perpendicularly into a magnetic field. What are their trajectories in the field?
- (1) Path of electron is more curved
 - (2) Path of proton is more curved
 - (3) Both describe the same curved path

- (4) They travel undeflected
- 20.** The resistance offered by an inductor (X_L) in an a.c. circuit is:
- (1) inversely proportional to inductance
 - (2) directly proportional to inductance and frequency
 - (3) inversely proportional to frequency
 - (4) independent of inductance
- 21.** 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:
- (1) $2\pi\sqrt{r/g}$
 - (2) $\frac{1}{2\pi}\sqrt{r/g}$
 - (3) $\frac{1}{2\pi}\sqrt{g/r}$
 - (4) $2\pi\sqrt{g/r}$
- 22.** 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:
- (1) decreases with increase of slitwidth
 - (2) may increase or decrease
 - (3) decreases with decrease of slitwidth
 - (4) increases with increase in slitwidth
- 23.** A steel coin of thickness ' d ' and density ' ρ ' is floating on water of surface tension ' T '. The radius of the coin (R) is:
- (1) $\frac{T}{\rho g d}$
 - (2) $\frac{4T}{3\rho g d}$
 - (3) $\frac{3T}{4\rho g d}$
 - (4) $\frac{2T}{\rho g d}$
- 24.** The thermodynamic process in which no work is done on or by the gas is:
- (1) isochoric process
 - (2) adiabatic process
 - (3) isothermal process

- (4) isobaric process
25. In a Fraunhofer diffraction at a single slit of width 'd' and incident light of wavelength $5500 \text{ \AA}$, the first minimum is observed at an angle 30° . The first secondary maxima is observed at an angle θ , equal to:
- (1) $\sin^{-1}(1/4)$
 - (2) $\sin^{-1}(3/4)$
 - (3) $\sin^{-1}(\sqrt{3}/2)$
 - (4) $\sin^{-1}(1/\sqrt{2})$
26. A shell is fired at an angle of 30° to the horizontal with velocity 196 m/s . The time of flight is:
- (1) 6.5 s
 - (2) 20 s
 - (3) 16.5 s
 - (4) 10 s
27. Three equal charges q_1, q_2, q_3 are placed on the three corners of a square of side 'a'. The ratio of magnitudes of forces F_{12}/F_{13} is:
- (1) $1/2$
 - (2) $\sqrt{2}$
 - (3) 2
 - (4) 4
28. A thin rod of length $2L$ is rotating about an axis passing through its centre and perpendicular to its length. The radius of gyration for the rod is:
- (1) $L/\sqrt{3}$
 - (2) $L/\sqrt{4}$
 - (3) $L/\sqrt{14}$
 - (4) $L/\sqrt{12}$
29. A 2kW motor is used to pump water from a well 20m deep. The quantity of water pumped out per second is nearly:
- (1) 10 kg
 - (2) 20 kg

- (3) 5 kg
(4) 25 kg
- 30.** A force of $(3\hat{i} + 2\hat{j} - \hat{k})$ N acts on a particle with position vector $(\hat{i} + \hat{j} - \hat{k})$ m. The magnitude of torque is:
- (1) $\sqrt{10}$
(2) $\sqrt{6}$
(3) $\sqrt{8}$
(4) $\sqrt{5}$
- 31.** In the phenomena of refraction of light, which of the following characteristics remains unchanged?
- (1) Intensity
(2) Amplitude
(3) Frequency
(4) Velocity
- 32.** A particle starts oscillating SHM from mean position with period 'T'. At time $t = T/12$, the ratio of the potential energy to kinetic energy of the particle is:
- (1) 1 : 2
(2) 3 : 1
(3) 2 : 1
(4) 1 : 3
- 33.** A hollow pipe of length 0.8 m is closed at one end. A 0.5 m long uniform string vibrating in its second harmonic resonates with the fundamental frequency of the pipe. If tension is 50 N and speed of sound is 320 m/s, mass of the string is:
- (1) 20 g
(2) 10 g
(3) 40 g
(4) 5 g
- 34.** A graph of magnetic flux (ϕ) versus current (I) is drawn for four inductors A, B, C, D. The larger value of self inductance is for:
- (1) D

- (2) B
- (3) C
- (4) A

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

- (1) momentum
- (2) velocity
- (3) acceleration
- (4) kinetic energy

36. A door 1.2 m wide requires 1 N to be applied perpendicular at the free end. The perpendicular force required at a point 0.2 m from the hinges is:

- (1) 3.6 N
- (2) 2.4 N
- (3) 1.2 N
- (4) 6.0 N

37. The speed of sound in a mixture of 1 mole of He and 2 mole of oxygen at 27°C is:

- (1) 400 m/s
- (2) 401 m/s
- (3) 402 m/s
- (4) 403 m/s

38. Two circular coils A and B are made from the same wire but radius of A is twice that of B. If magnetic fields at centres are same, the ratio of potential differences applied across A to B is:

- (1) 1 : 4
- (2) 4 : 1
- (3) 2 : 1
- (4) 1 : 2

39. A geostationary satellite at 36000km height has 24h time period. The time-period of a spy satellite at $R = 6400\text{km}$ will be:

- (1) 1.2h
- (2) 1.3h

- (3) $1.53h$
(4) $2h$
40. The magnitude of the projection of the vector $2\hat{i} + 3\hat{j} + \hat{k}$ on the vector perpendicular to the plane containing $\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 3\hat{k}$ is:
- (1) $3\sqrt{6}$
(2) $\sqrt{3}/2$
(3) $1/\sqrt{6}$
(4) $\sqrt{3/2}$
41. In a two input logic gate, when one input is 1 and other is 0 output is 1. Even if both inputs are 0, output is 1. The gate is:
- (1) XOR
(2) AND
(3) NOR
(4) NAND
42. A charge of magnitude $3e$ and mass $2m$ is moving in an electric field E . The acceleration imparted is:
- (1) $3Ee/2m$
(2) $3m/2Ee$
(3) $2Ee/3m$
(4) $2m/3Ee$
43. A spherical solid ball falls through a liquid ($\rho_2 < \rho_1$) with viscous force proportional to the square of speed ($F = Kv_t^2$). The terminal speed is:
- (1) $\sqrt{Vg(\rho_1 - \rho_2)/K}$
(2) $Vg(\rho_1 - \rho_2)/K$
(3) $\sqrt{K/Vg(\rho_1 - \rho_2)}$
(4) $K/Vg(\rho_1 - \rho_2)$
44. Frequency of the series limit of Balmer series of hydrogen atom of Rydberg's constant R and velocity of light c is:
- (1) $4Rc$

- (2) $4/Rc$
(3) Rc
(4) $Rc/4$
45. A bar magnet of magnetic moment M_1 is cut into two pieces along its axis. The pieces are kept perpendicular with unlike poles in contact. The resultant moment M_2 has a ratio M_1/M_2 :
- (1) $1/2\sqrt{2}$
(2) 1
(3) $\sqrt{2}$
(4) $1/\sqrt{2}$
46. A condenser of capacitance $2.4\mu F$ used in a transmitter with inductor 10^{-8} H has a resonant wavelength λ of:
- (1) 200m
(2) 254m
(3) 292m
(4) 320m
47. An α -particle and a proton accelerated through same potential enter a magnetic field. If radius of proton path is $\sqrt{2}$ cm, radius of α -particle path is:
- (1) 1cm
(2) 2cm
(3) 3cm
(4) 4cm
48. A cell is balanced against 120cm and 100cm of potentiometer wire in open and short circuit (10Ω). The internal resistance is:
- (1) 1Ω
(2) 1.5Ω
(3) 2Ω
(4) 0.5Ω
49. A 1kg stone attached to a 60cm chain slows from 3rev/s to 1rev/s in 30s. The mean torque is:
- (1) 0.15 Nm

- (2) 0.32 Nm
(3) 0.25 Nm
(4) 0.20 Nm
- 50.** A toroid has major radius R and cross-sectional radius r . If it has N turns, the coefficient of mutual induction is:
- (1) $\mu_0 NR/2r$
(2) $\mu_0 N^2 R^2/2r$
(3) $\mu_0 Nr/2R$
(4) $\mu_0 N^2 r^2/2R$
- 51.** Identify the last element in lanthanoid series:
- (1) Nd
(2) Tm
(3) Lu
(4) Tb
- 52.** 0.05F electricity is passed through CuSO_4 solution. Calculate mass of Cu produced:
- (1) 3.17g
(2) 2.54g
(3) 0.795g
(4) 1.59g
- 53.** Identify the products obtained when chlorine reacts with hot and conc. NaOH:
- (1) $\text{NaClO}_3, \text{NaCl}, \text{H}_2\text{O}$
(2) NaCl, HOCl
(3) $\text{Na}_2\text{O}, \text{NaCl}$
(4) $\text{NaOCl}, \text{H}_2\text{O}$
- 54.** Which of the following elements does NOT react with water?
- (1) Ca
(2) Sr
(3) Be

(4) Mg

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

- (1) sp^3
- (2) dsp^2
- (3) d^2sp^3
- (4) sp^3d^2

56. Calculate the solubility of a gas in water at 0.8 atm and 25°C (Henry's constant = 6.85×10^{-4}):

- (1) 2.74×10^{-4}
- (2) 3.94×10^{-4}
- (3) 6.85×10^{-4}
- (4) 5.48×10^{-4}

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

- (1) 273.15°C
- (2) -373.15°C
- (3) 0°C
- (4) -273.15°C

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

- (1) Stephen reaction : $\text{SnCl}_2, \text{HCl}$
- (2) Etard reaction : CrO_2Cl_2
- (3) Gatterman-Koch : $\text{CrO}_3/(\text{CH}_3\text{CO})_2\text{O}$
- (4) Rosenmund : $\text{H}_2/\text{Pd} - \text{BaSO}_4$

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

- (1) Iodobenzene
- (2) Chlorobenzene
- (3) Benzonitrile
- (4) Bromobenzene

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

- (1) n-butyl bromide

- (2) n-butyl chloride
- (3) sec-butyl chloride
- (4) n-butyl iodide

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

- (1) HCl
- (2) HI
- (3) HBr
- (4) HF

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

- (1) 52.36%
- (2) 68%
- (3) 80%
- (4) 74%

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

- (1) Magnesium
- (2) Sodium
- (3) Silver
- (4) Zinc

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

- (1) Good conductors
- (2) All are non-radioactive
- (3) Co-ord number > 6
- (4) Strongly paramagnetic

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

- (1) BCl_3
- (2) HNO_3
- (3) NH_3
- (4) HSO_4^-

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

- (1) CH_3COONH_4
- (2) Na_2CO_3
- (3) NH_4Cl
- (4) $NaCl$

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

- (1) Ammonium salt of higher fatty acid
- (2) Sodium salt of formic acid
- (3) Potassium salt of higher fatty acid
- (4) Ammonium salt of formic acid

68. How long will it take to produce 5.4 g of Ag from molten AgCl passing 5 amp current?

- (1) 1930 s
- (2) 193 s
- (3) 965 s
- (4) 9650 s

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

- (1) Lead storage
- (2) Dry cell
- (3) Nickel-cadmium
- (4) Mercury cell

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

- (1) Four
- (2) Two
- (3) Zero
- (4) Six

71. Calculate the density of metal with unit cell $64 \times 10^{-24} \text{ cm}^3$ and molar mass 192 g/mol containing 4 particles:

- (1) 14.92 g/cm^3

- (2) 16.00 g/cm^3
(3) 19.93 g/cm^3
(4) 18.00 g/cm^3
- 72.** Calculate work done when 2 moles of ideal gas expand from 5 dm^3 to $7 \times 10^{-3} \text{ m}^3$ against 2.02 bar:
- (1) 20.2 J
(2) -404 J
(3) 202 J
(4) -35 J
- 73.** Which among the following pair of monomers does not generate polyamide polymer?
- (1) Urea/Formaldehyde
(2) Glycine/caproic acid
(3) Adipic acid/hexamethylene diamine
(4) 3-Hydroxybutanoic/pentanoic acid
- 74.** What type of following phenomena is NOT exhibited by adsorption?
- (1) Irreversible
(2) Bulk
(3) Exothermic
(4) Endothermic
- 75.** Find the rate constant of first order reaction with half life of 2.5 hours:
- (1) 4.3×10^{-5}
(2) 7.7×10^{-5}
(3) 6.9×10^{-5}
(4) 8.4×10^{-5}
- 76.** Which nitrogen atom of pyrimidine base (1-6) is bonded with furanose sugar?
- (1) 4
(2) 2
(3) 1

(4) 5

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

- (1) Er
- (2) Lu
- (3) Eu
- (4) Yb

78. Identify the product obtained when ethyl benzene is oxidized by alk. $KMnO_4$:

- (1) Benzenol
- (2) Benzoic acid
- (3) Benzene
- (4) Acetone

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

- (1) Cytosine
- (2) Uracil
- (3) Guanine
- (4) Thymine

80. What is the bond order of CO molecule?

- (1) 1
- (2) 2
- (3) 3
- (4) 0

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

- (1) He
- (2) He^+
- (3) Li^{2+}
- (4) Be^{3+}

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

- (1) Phenoxide ion

- (2) Sodium phenoxide
 - (3) Benzene diazonium
 - (4) Benzene
83. If rate of reaction is given by $\frac{1}{3} \frac{dx}{dt} = -\frac{1}{2} \frac{dy}{dt} = -\frac{dz}{dt}$, the reaction is:
- (1) $2y + Z \rightarrow 3x$
 - (2) $2y \rightarrow 3x + Z$
 - (3) $3x + 2y \rightarrow Z$
 - (4) $3x \rightarrow 2y + Z$
84. Which compound contains highest number of chlorine atoms per single molecule?
- (1) Mustard gas
 - (2) Phosgene
 - (3) Tear gas
 - (4) Phosphine
85. Heat of formation of HCl from $H_2 + Cl_2 \rightarrow 2HCl$, $\Delta H = -194$ kJ is:
- (1) -388 kJ
 - (2) -194 kJ
 - (3) -97 kJ
 - (4) 194 kJ
86. Identify the concentration where ΔT_f and K_f are numerically same:
- (1) 1 m
 - (2) 1 M
 - (3) 1 N
 - (4) N/10
87. What is the product formed when cumene is air oxidised and treated with dilute acid?
- (1) Cumene hydroperoxide
 - (2) Phenol/ CO_2
 - (3) Acetone/Benzoic acid
 - (4) Phenol/Acetone

88. Identify the use of polystyrene for household purposes:

- (1) Shopping bags
- (2) Microwavable trays
- (3) Disposable cups/plates
- (4) Mouth wash bottles

89. Identify compound A in: Benzene + Ozone (excess) $\rightarrow$ Benzenetriozone $\xrightarrow{A}$ Glyoxal

- (1) conc. HNO_3
- (2) Ni
- (3) $Zn + H_2O$
- (4) Zn

90. Which of the following is an example of metamerism?

- (1) But-2-ene/But-1-ene
- (2) Butane/Isobutane
- (3) Ethoxyethane/methoxypropane
- (4) Dimethyl ether/ethyl alcohol

91. If Q is heat liberated and W is work done, first law of thermodynamics is:

- (1) $Q = W - \Delta U$
- (2) $Q = \Delta U - W$
- (3) $Q = \Delta U + W$
- (4) $Q = -W$

92. Calculate atoms in 5g metal crystallising in simple cubic ($a = 336$ pm, $d = 9.4$):

- (1) 1.0×10^{22}
- (2) 2.1×10^{22}
- (3) 1.4×10^{22}
- (4) 1.8×10^{22}

93. Identify the molecule with sp^3 hybridisation at central atom:

- (1) BF_3
- (2) H_2O

- (3) C_2H_4
- (4) $BeCl_2$

94. Which conversion does NOT involve oxidation or reduction?

- (1) $Na \rightarrow Na^+$
- (2) $VO_2^+ \rightarrow V_2O_3$
- (3) $Zn^{2+} \rightarrow Zn$
- (4) $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$

95. Calculate Λ_0 of $CH_2ClCOOH$ if $HCl = 4.2$, $KCl = 1.5$, $CH_2ClCOOK = 1.1$:

- (1) 2.7
- (2) 3.8
- (3) 1.9
- (4) 4.2

96. Identify product A in the Hoffmann's β -elimination of quaternary ammonium ion:

- (1) Propene
- (2) Ethene
- (3) Propane
- (4) Propyne

97. Calculate solute mass in 160g solvent (B.P. $85^\circ C$, K_b 2.7, solvent B.P. $76^\circ C$, Molar mass 120):

- (1) 42g
- (2) 60g
- (3) 64g
- (4) 50g

98. Identify ether from the following:

- (1) Benzenol
- (2) Benzene-1,2-diol
- (3) Methoxymethane
- (4) Propan-2-ol

99. Which polymer is used to obtain bristles for brushes?

- (1) Nylon 2-6
- (2) Nylon 6,6
- (3) Nylon 6
- (4) Polyacrylamide

100. What is the pH of 2×10^{-3} M monoacidic base ionising at 5%?

- (1) 14
- (2) 6
- (3) 4
- (4) 2

101. The value of $\int_{\pi/4}^{3\pi/4} \frac{dx}{1+\cos x}$ is:

- (1) $-2\sqrt{2}$
- (2) 2
- (3) $-2 - 2\sqrt{2}$
- (4) -2

102. If $\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2} \tan^{-1} x$, then x is:

- (1) 3
- (2) 1
- (3) $1/\sqrt{3}$
- (4) $\sqrt{3}$

103. If $p : \forall n \in \mathbb{N}, n^2 + n$ is even and $q : \forall n \in \mathbb{N}, n^2 - n$ is odd, truth values of $p \wedge q, p \vee q, p \rightarrow q$:

- (1) F, T, F
- (2) F, F, T
- (3) T, T, F
- (4) F, T, T

104. If $f(x) = x^3 - 3(a-2)x^2 + 3ax + 7$ increases in $(0, 1]$ and decreases in $[1, 5)$, a root of $\frac{f(x)-14}{(x-1)^2} = 0$:

- (1) 14
- (2) 7
- (3) -14

(4) -7

105. If $\vec{a} = \hat{i} - \hat{k}$, $\vec{b} = x\hat{i} + \hat{j} + (1-x)\hat{k}$ and $\vec{c} = y\hat{i} + x\hat{j} + (1+x-y)\hat{k}$, then $[\vec{a} \vec{b} \vec{c}]$ depends on:

- (1) only y
- (2) neither x nor y
- (3) both x and y
- (4) only x

106. If $\cot(A+B) = 0$, then $\sin(A+2B)$ is:

- (1) $\sin A$
- (2) $\cos 2A$
- (3) $\sin 2A$
- (4) $\cos A$

107. Joint equation of lines through origin making an equilateral triangle with $y = 5$ is:

- (1) $x^2 - 3y^2 = 0$
- (2) $\sqrt{3}x^2 - y^2 = 0$
- (3) $3x^2 - y^2 = 0$
- (4) $5x^2 - y^2 = 0$

108. For $f(x) = \sqrt{\tan x}$ and $g(x) = \sin x \cos x$, the integral $\int \frac{f(x)}{g(x)} dx$ is:

- (1) $2\sqrt{\tan x}$
- (2) $\frac{1}{2}\sqrt{\tan x}$
- (3) $\sqrt{\tan x}$
- (4) $\frac{3}{2}\sqrt{\tan x}$

109. The general solution of $\frac{dy}{dx} = \frac{3x+y}{x-y}$ is:

- (1) $\tan^{-1}\left(\frac{y}{x}\right) + \dots$
- (2) $\dots \log\left(\frac{y^2+3x^2}{x^2}\right)$
- (3) $\frac{1}{\sqrt{3}} \tan^{-1}\left(\frac{y}{x\sqrt{3}}\right) + \dots$
- (4) None

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 $(AB)^{-1}$ is:

- (1) $\begin{bmatrix} 17/5 & 9/5 \\ 2 & 1 \end{bmatrix}$
- (2) $\begin{bmatrix} -17/5 & 9/5 \\ 2 & -1 \end{bmatrix}$
- (3) $\begin{bmatrix} 17/5 & 2 \\ 9/5 & 1 \end{bmatrix}$
- (4) $\begin{bmatrix} -17/5 & 2 \\ -9/5 & -1 \end{bmatrix}$

111. 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:

- (1) $2\sqrt{5}/3$
- (2) $\sqrt{5}/3$
- (3) $5\sqrt{5}/3$
- (4) $4\sqrt{5}/3$

112. Maximum value of $Z = 5x + 2y$, subject to $2x - y \geq 2$, $x + 2y \leq 8$ and $x, y \geq 0$ is:

- (1) 40
- (2) 17.6
- (3) 28
- (4) 25.6

113. The value of $\sin(2 \sin^{-1} 0.8)$ is:

- (1) 0.96
- (2) 0.16
- (3) 0.12
- (4) 0.48

114. A line makes same angle α with x and y axes. If angle θ with z-axis satisfies $\sin^2 \theta = 2 \sin^2 \alpha$, then α is:

- (1) $\pi/4$
- (2) $\pi/2$

(3) $\pi/3$

(4) $\pi/6$

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

(1) $\sim p \wedge (q \wedge r)$

(2) $\sim p \wedge (q \wedge \sim r)$

(3) $\sim p \vee (\sim q \wedge r)$

(4) $\sim p \wedge (\sim q \wedge \sim r)$

116. For $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, if $\vec{b} \times \vec{c} = \vec{b} \times \vec{a}$ and $\vec{c} \cdot \vec{a} = 0$, then $\vec{c} \cdot \vec{b}$ is:

(1) $-1/2$

(2) $3/2$

(3) $1/2$

(4) $-3/2$

117. Probability that out of 5 workmen with 10% disease rate, 3 or more contract it:

(1) 0.000856

(2) 0.856

(3) 0.0000856

(4) 0.00856

118. If $y = \log \sqrt{\frac{1+\sin x}{1-\sin x}}$, then dy/dx at $x = \pi/3$ is:

(1) $1/2$

(2) $-1/2$

(3) 2

(4) $1/4$

119. Variance/mean of 15 items is 6/10. If each increases by 8, new variance/mean:

(1) 6, 18

(2) 6, 10

(3) 14, 10

(4) 14, 18

120. If $y = \sin(2 \tan^{-1} \sqrt{\frac{1+x}{1-x}})$, then dy/dx is:

- (1) $-x/\sqrt{1-x^2}$
- (2) $-2x/\sqrt{1-x^2}$
- (3) $-1/\sqrt{1-x^2}$
- (4) $1/\sqrt{1-x^2}$

121. Magnitude of projection of $2\hat{i} + 3\hat{j} + \hat{k}$ on vector normal to plane of $\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 3\hat{k}$:

- (1) $3\sqrt{6}$
- (2) $\sqrt{3}/2$
- (3) $1/\sqrt{6}$
- (4) $\sqrt{3}/2$

122. If $f(x)$ is defined piecewise for $|2x - 3| \geq 2$ and $1/2 < x < 5/2$, continuity implies $a + b$:

- (1) $13/5$
- (2) $31/5$
- (3) $23/5$
- (4) $1/5$

123. Vector $\vec{r}$ in plane of $\vec{a}$ and $\vec{b}$ with projection on $\vec{c}$ as $1/\sqrt{3}$ is:

- (1) $(2t + 1)\hat{i} - \dots$
- (2) $(2t + 1)\hat{i} - \hat{j} + (2t - 1)\hat{k}$
- (3) $(2t - 1)\hat{i} \dots$
- (4) $(2t - 1)\hat{i} + \dots$

124. Angle between faces OPQ and PQR of tetrahedron with vertices P, Q, R and origin:

- (1) $\cos^{-1}(17/35)$
- (2) $\cos^{-1}(17/31)$
- (3) $\cos^{-1}(19/35)$
- (4) $\cos^{-1}(19/31)$

125. Principal value of $\sin^{-1}(\sin(2\pi/3))$ is:

- (1) $\pi/3$
- (2) $2\pi/3$
- (3) $-2\pi/3$

(4) $5\pi/3$

126. Differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines circles with:

- (1) fixed radius 1, variable X-centres
- (2) variable radii
- (3) fixed centre
- (4) None

127. Value of $\int_0^1 \sqrt{\frac{1-x}{1+x}} dx$ is:

- (1) $\pi/2 + 1$
- (2) $\pi/2 - 1$
- (3) 1
- (4) -1

128. Ways to select 6 questions from 11 (6 in Sec I, 5 in Sec II) taking at least 2 from each:

- (1) 425
- (2) 275
- (3) 350
- (4) 225

129. Area of region $x^2 + y^2 \leq 1$ and $y^2 \leq 1 - x$ is:

- (1) $\pi/2 + 2/3$
- (2) $\pi/2 + 4/3$
- (3) $\pi/2 - 4/3$
- (4) $\pi/2 - 2/3$

130. Production rate $\frac{dP}{dx} = 100 - 12\sqrt{x}$. If 25 more workers are added to 0, new production:

- (1) 4500
- (2) 3000
- (3) 2500
- (4) 3500

131. $\int \frac{3x-2}{(x+1)(x-2)^2} dx$ results in:

- (1) $-5/9 \log(x+1) + 5/9 \log(x-2) - 4/3(x-2)$
- (2) $\dots - 1/(x-2)$
- (3) $\dots + 5/9 \log \dots$
- (4) None

132. If normal at (3,4) makes $3\pi/4$ with X-axis, $f'(3)$ is:

- (1) -1
- (2) $4/3$
- (3) $-3/4$
- (4) 1

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

- (1) 1.1
- (2) 1.6
- (3) 1.8
- (4) 0.6

134. If $\lim_{x \rightarrow 1} \frac{x^2 - ax + b}{x - 1} = 5$, then $a + b$ is:

- (1) -4
- (2) -7
- (3) 7
- (4) -3

135. If $y = \cos(\sin x^2)$, then dy/dx at $x = \sqrt{\pi/2}$ is:

- (1) 0
- (2) 2
- (3) -1
- (4) -2

136. Mean number of kings in drawing two cards with replacement:

- (1) $4/169$
- (2) $1/13$
- (3) $1/169$

(4) $2/13$

137. Polar coordinates of $(-2\sqrt{3}, 2)$ are:

- (1) $(4, 3\pi/4)$
- (2) $(4, 5\pi/6)$
- (3) $(4, 2\pi/3)$
- (4) $(4, 11\pi/12)$

138. If $|z| + z = 3 + i$, then $|z|$ is:

- (1) $5/4$
- (2) $5/3$
- (3) $\sqrt{34}/3$
- (4) $\sqrt{41}/4$

139. If $xyz = 60$ and $8x + 4y + 3z = 20$, then $A(\text{adj } A)$ is:

- (1) $60I$
- (2) $108I$
- (3) $20I$
- (4) $68I$

140. If $y^{1/m} + y^{-1/m} = 2x$, then $(x^2 - 1)(dy/dx)^2$:

- (1) my^2
- (2) m^2y
- (3) m^2y^2
- (4) $my^2/2$

141. $\int_0^2 [x] dx + \int_0^2 |x - 1| dx$:

- (1) 4
- (2) 3
- (3) 1
- (4) 2

142. Tangents to $x - 2y - 3 = 0$ from $(3, 2)$ at 45° :

- (1) $3x + y - 11 = 0 \dots$

- (2) $3x - y - 7 = 0 \dots$
- (3) $3x + y - 11 = 0 \dots$
- (4) $x + 2y - 7 = 0 \dots$

143. If $2[2x - 5] - 1 = 7$ for G.I.F, x lies in:

- (1) $(9/2, 5)$
- (2) $(9/2, 5]$
- (3) $[9/2, 5]$
- (4) $[9/2, 5)$

144. Line through $(1, 2, 3)$ parallel to $x - y + 2z = 5$ and $3x + y + z = 6$:

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

145. Circle with area 49π whose diameters are $3x - 4y - 7 = 0$ and $2x - 3y - 5 = 0$:

- (1) $x^2 + y^2 - 2x + 2y - 47 = 0$
- (2) $\dots + 51 = 0$
- (3) $\dots + 2x - 2y - 51 = 0$
- (4) $\dots + 47 = 0$

146. Ice ball radius 10 melts at $50 \text{ cm}^3/\text{min}$. If thickness is 5, rate of decrease:

- (1) $-1/18\pi$
- (2) $2/9\pi$
- (3) $1/18\pi$
- (4) $1/3\pi$

147. $\int \frac{\sin(5x/2)}{\sin(x/2)} dx$:

- (1) $x + \sin x + \sin 2x$
- (2) $\dots - C$
- (3) $x + 2 \sin x + 2 \sin 2x$
- (4) None

148. Plane through (2,3,1) and (4,-5,3) parallel to X-axis:

- (1) $3y + 4z = 13$
- (2) $y - 4z = -1$
- (3) $2y + 4z = 19$
- (4) $y + 4z = 7$

149. If $\int e^{x^2} x^3 dx = e^{x^2} [f(x) + C]$ and $f(1) = 0$, then $f(2)$ is:

- (1) $-3/2$
- (2) $-1/2$
- (3) $3/2$
- (4) $1/2$

150. Negation of "Payment made if and only if work finished in time":

- (1) "Work finished and no payment..."
- (2) "...payment made and work not finished"
- (3) "Either A or B"
- (4) None