

MHT-CET 2019

SECTION-A

PHYSICS

1. A sotne of mass 1 kg is tied to a string of length 2 m long and is rotated at constant speed of 40 ms^{-1} in a vertical circle. The ratio of the tension at the top and the bottom is [Take $g = 10 \text{ ms}^{-2}$]

(a) $\frac{81}{79}$ (b) $\frac{79}{81}$
(c) $\frac{19}{12}$ (d) $\frac{12}{19}$

2. Two coils have a mutual inductance of 0.01 H. The current in the first coil changes according to equation $I = 5 \sin 200 \pi t$. The maximum value of e.m.f. induced in the second coil is

(a) 10π volt (b) 0.1π volt
(c) π volt (d) 0.01π volt

3. The radius of the earth and the radius of orbit around the sun are 6371 km and 149×10^6 km respectively. The order of magnitude of the diameter of the orbit is greater than that of earth by

(a) 10^3 (b) 10^2
(c) 10^4 (d) 10^5

4. Two open pipes of different lengths and of same diameter in which the air column vibrates with fundamental frequencies ' n_1 ' and ' n_2 ' respectively. When both pipes are joined to form a single pipe, its fundamental frequency will be

(a) $\frac{n_1 + n_2}{n_1 n_2}$ (b) $\frac{n_1 n_2}{2n_2 + n_1}$
(c) $\frac{2n_1 + n_2}{n_1 n_2}$ (d) $\frac{n_1 n_2}{n_1 + n_2}$

5. If ' C_p ' and ' C_v ' are molar specific heats of an ideal gas at constant pressure and volume respectively, ' γ ' is ratio of two specific heats and 'R' is universal gas constant then ' C_p ' is equal to

(a) $\frac{R\gamma}{\gamma-1}$ (b) γR
(c) $\frac{1+\gamma}{1-\gamma}$ (d) $\frac{R}{\gamma-1}$

6. In a series LCR circuit $R = 300 \Omega$, $L = 0.9 \text{ H}$, $C = 2 \mu\text{F}$, $\omega = 1000 \text{ rad/s}$. The impedance of the circuit is

(a) 500Ω (b) 1300Ω
(c) 400Ω (d) 900Ω

7. The quantity which *does not* vary periodically for a particle performing S.H.M. is
 (a) acceleration (b) total energy
 (c) displacement (d) velocity

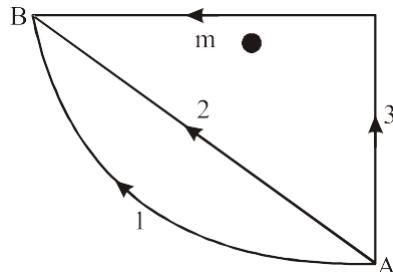
8. Which of the following combinations of 7 identical capacitors each of $2 \mu\text{F}$ gives a resultant capacitance of $\frac{10}{11} \mu\text{F}$?
 (a) 3 in parallel and 4 in series
 (b) 2 in parallel and 5 in series
 (c) 4 in parallel and 3 in series
 (d) 5 in parallel and 2 in series

9. Bohr model is applied to a particle of mass ' m ' and charge ' q ' moving in a plane under the influence of a transverse magnetic field ' B '. The energy of the charged particle in the n^{th} level will be (h = Planck's constant)
 (a) $\frac{2nhqB}{\pi m}$ (b) $\frac{nhqB}{2\pi m}$
 (c) $\frac{nhqB}{4\pi m}$ (d) $\frac{nhqB}{\pi m}$

10. In moving coil galvanometer, strong horse shoe magnet of concave shaped pole pieces is used to
 (a) increase space for rotation of coil
 (b) reduce weight of galvanometer
 (c) produce magnetic field which is parallel to plane of coil at any position
 (d) make magnetic induction weak at the centre

11. Two identical wires of substances 'P' and 'Q' are subjected to equal stretching force along the length. If the elongation of 'Q' is more than that of 'P', then
 (a) both P and Q are equally elastic
 (b) P is more elastic than Q
 (c) P is plastic and Q is elastic
 (d) Q is more elastic than P

12. If W_1 , W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 (as shown in fig.) in the gravitational field of the point mass ' m '. Find the correct relation between ' W_1 ', ' W_2 ' and ' W_3 '



13. Assuming that the junction diode is ideal, the current in the arrangement shown in figure is

(a) 30mA (b) 40mA
 (c) 20mA (d) 10mA

14. The equation of simple harmonic progressive wave is given by $Y = a \sin 2\pi(bt - cx)$
 The maximum particle velocity will be twice the wave velocity if
 (a) $c = \pi a$ (b) $c = \frac{1}{2\pi a}$
 (c) $c = \frac{1}{\pi a}$ (d) $c = 2\pi a$

15. In fundamental mode, the time required for the sound wave to reach upto the closed end of a pipe filled with air is ' t ' second. The frequency of vibration of air column is
 (a) $(2t)^{-1}$ (b) $4(t)^{-1}$
 (c) $2(t)^{-1}$ (d) $(4t)^{-1}$

16. Two small drops of mercury each of radius ' R ' coalesce to form a large single drop. The ratio of the total surface energies before and after the change is
 (a) $2^{2/3} : 1$ (b) $\sqrt{2} : 1$
 (c) $2^{1/3} : 1$ (d) $2 : 1$

17. If radius of the solid sphere is doubled by keeping its mass constant, the ratio of their moment of inertia about any of its diameter is
 (a) 1:8 (b) 2:5
 (c) 2:3 (d) 1:4

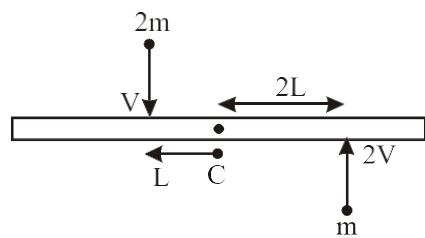
30. The resultant \vec{R} of \vec{P} and \vec{Q} is perpendicular to \vec{P} . Also $|\vec{P}| = |\vec{Q}|$. The angle between \vec{P} and \vec{Q} is $[\tan 45^\circ = 1]$

(a) $\frac{6\pi}{4}$ (b) $\frac{7\pi}{4}$
 (c) $\frac{\pi}{4}$ (d) $\frac{3\pi}{4}$

31. A telescope has large diameter of the objective. Then its resolving power is

(a) independent of the diameter of the objective
 (b) low
 (c) zero
 (d) high

32. A uniform rod of length '6L' and mass '8m' is pivoted at its centre 'C'. Two masses 'm' and '2m' with speed $2v$, v as shown strikes the rod and stick to the rod. Initially the rod is at rest. Due to impact, if it rotates with angular velocity ' w_1 ' then ' w ' will be



(a) $\frac{v}{4L}$ (b) Zero
 (c) $\frac{8v}{6L}$ (d) $\frac{11v}{3L}$

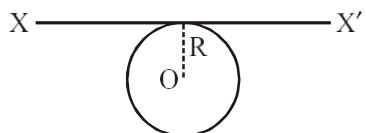
33. If $\sqrt{A^2 + B^2}$ represents the magnitude of resultant of two vectors $(\vec{A} + \vec{B})$ and $(\vec{A} - \vec{B})$, then the angle between two vectors is

(a) $\cos^{-1} \left[\frac{2(A^2 - B^2)}{(A^2 + B^2)} \right]$
 (b) $\cos^{-1} \left[-\frac{A^2 - B^2}{A^2 B^2} \right]$

(c) $\cos^{-1} \left[-\frac{(A^2 + B^2)}{2(A^2 - B^2)} \right]$

(d) $\cos^{-1} \left[-\frac{(A^2 - B^2)}{A^2 + B^2} \right]$

34. A thin metal wire of length 'L' and uniform linear mass density 'Q' is bent into a circular coil with 'o' as centre. The moment of inertia of a coil about the axis XX' is



(a) $\frac{3QL^3}{8\pi^2}$ (b) $\frac{QL^3}{4\pi^2}$
 (c) $\frac{3QL^2}{4\pi^2}$ (d) $\frac{QL^3}{8\pi^2}$

35. The dimensions of torque are same as that of
 (a) moment of force (b) pressure
 (c) acceleration (d) impulse

36. For transistor, the current ratio ' β_{dc} ' is defined as the ratio of
 (a) collector current to emitter current
 (b) collector current to base current
 (c) base current to collector current
 (d) emitter current to collector current

37. A clock pendulum having coefficient of linear expansion $\alpha = 9 \times 10^{-7} / ^\circ\text{C}$ has a period of 0.5 s at 20°C . If the clock is used in a climate where the temperature is 30°C , how much time does the clock lose in each oscillation? ($g = \text{constant}$)
 (a) 2.5×10^{-7} s (b) 5×10^{-7} s
 (c) 1.125×10^{-6} s (d) 2.25×10^{-6} s

38. Two capillary tubes of different diameters are dipped in water. The rise of water is
 (a) zero in both the tube
 (b) same in both the tube
 (c) more in the tube of larger diameter
 (d) more in the tube of smaller diameter

50. The equiconvex lens has a focal length 'f'. If the lens is cut along the line perpendicular to principal axis and passing through the pole, what will be the focal length of any half part?

(a) $\frac{f}{2}$ (b) $2f$
 (c) $\frac{3f}{2}$ (d) f

CHEMISTRY

51. Which of following methods is used to separate wolframite and stannic oxide present in cassiterite?

(a) Hydraulic washing using Wilfley table
 (b) Froth flotation
 (c) Hydraulic classifier
 (d) Magnetic separation

52. In the reaction, $\text{MnO}_4^{-1}(\text{aq.}) + \text{Br}^{-1}(\text{aq.}) \rightarrow \text{MnO}_2(s) + \text{BrO}_3^{-1}(\text{aq.})$, the correct change in oxidation number of the species involved is

(a) Br^{+5} to Br^{-1} (b) Mn^{+7} to Mn^{+2}
 (c) Mn^{+7} to Mn^{+3} (d) Br^{-1} to Br^{+5}

53. How many isoprene units are present in abscisic acid?

(a) Three (b) Two
 (c) Four (d) Five

54. Action of hydrogen iodide on anisole gives,

(a) phenol and iodomethane
 (b) iodobenzene and methanol
 (c) phenol and methanol
 (d) iodobenzene and iodomethane

55. Which among the following compounds is used to decaffeinate coffee?

(a) Iodoform
 (b) Carbon tetrachloride
 (c) Methylene dichloride
 (d) Chloroform

56. Which complex among the following gives a white precipitate on treatment with an aqueous solution of barium chloride?

(a) $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$
 (b) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{NO}_2$

(c) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{SO}_4$
 (d) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$

57. When CuSO_4 solution in water is treated with concentrated HCl it turns

(a) Violet (b) Yellow
 (c) Purple (d) Green

58. Which of the following polymer is used in paints?

(a) Gutta percha (b) Melamine
 (c) Buna-S (d) Novolac

59. Three moles of an ideal gas are expanded isothermally from a volume of 300 cm^3 to 2.5 L at 300 K against a pressure of 1.9 atm . The work done in joules is

(a) -423.56 J (b) $+423.56 \text{ J}$
 (c) -4.18 J (d) $+4.8 \text{ J}$

60. Which among the following is used in the treatment of cancer?

(a) *cis*- $[\text{Pt}(\text{en})_2\text{Cl}_2]$
 (b) *cis*- $[\text{PtCl}_2(\text{NH}_3)_2]$
 (c) *trans*- $[\text{Pt}(\text{en})_2\text{Cl}_2]$
 (d) *trans*- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

61. Which among the following pairs of compounds in **NOT** isomorphous?

(a) NaNO_3 and CaCO_3
 (b) K_2SO_4 and K_2SeO_4
 (c) NaCl and KCl
 (d) NaF and MgO

62. Which among the following compounds is used as selective weed killer?

(a) Pieric acid
 (b) 2,4-dichlorophenoxy acetic acid
 (c) 2,4,6-trichlorophenoxy acetic acid
 (d) Salol

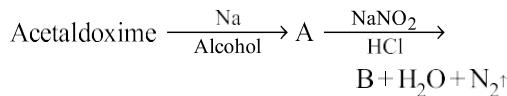
63. Calculate the difference between heat of combustion of carbon monoxide gas at constant pressure and at constant volume at 27°C ? ($R = 2\text{Cal K}^{-1} \text{ mol}^{-1}$)

(a) 54 cal (b) -600 cal
 (c) -300 cal (d) 27 cal

64. The conductivity of an electrolytic solution decreases on dilution due to

(a) decrease in number of ions per unit volume
 (b) increase in ionic mobility of ions
 (c) increase in percentage ionisation
 (d) increase in number of ions per unit volume

65. Identify B in the following reaction,



(a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (b) $\text{C}_2\text{H}_5\text{OH}$
(c) $\text{C}_2\text{H}_5\text{Cl}$ (d) $\text{C}_2\text{H}_5\text{NH}_2$

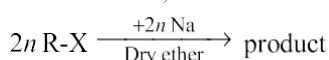
66. Which among the following solids shows Frenkel defect?

(a) NaCl (b) CsCl
(c) KCl (d) AgCl

67. A cold drink bottle contains 200 mL liquid in which CO_2 is 0.1 molar. Considering CO_2 as an ideal gas the volume of the dissolved CO_2 at S.T.P. is

(a) 22.4 L (b) 0.224 L
(c) 2.24 L (d) 0.448 L

68. In the reaction,



The product obtained is

(a) $2n$ Alkene (b) n Sodium halide
(c) n Alcohol (d) n Alkane

69. The bacteriostatic antibiotic from the following is

(a) Tetracycline (b) Aminoglycosides
(c) Penicillin (d) Ofloxacin

70. Nitroalkanes are obtained in laboratory from primary or secondary alkyl halides by the action of

(a) AgNO_2 (b) NaNO_3
(c) AgNO_3 (d) HNO_3

71. Which of following bonds has maximum bond length?

(a) C–O (b) C–H
(c) C–C (d) C–N

72. Which of the following sets of components form homogeneous mixture?

(a) Phenol + Water
(b) Sugar + Benzene
(c) Silver chloride + Water
(d) Ethyl alcohol + Water

73. Which among the following compounds in crystalline form is used for making Nicol's prism?

(a) CaSO_4 (b) Na_2AlF_6
(c) CaCO_3 (d) Al_2O_3

74. Two electrolytic cells are connected in series containing CuSO_4 solution and molten AlCl_3 . If in electrolysis 0.4 moles of 'Cu' are deposited on cathode of first cell. The number of moles of 'Al' deposited on cathode of the second cell is

(a) 0.6 moles (b) 0.27 moles
(c) 0.18 moles (d) 0.4 moles

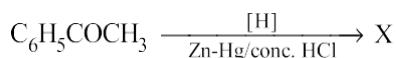
75. Mandelonitrile is obtained by the reaction between hydrogen cyanide and

(a) Propionaldehyde (b) Benzaldehyde
(c) Acetaldehyde (d) Acetone

76. The ionic charges on chromate ion and dichromate ion respectively is

(a) $-2, -2$ (b) $-3, -2$
(c) $-2, -4$ (d) $-4, -2$

77. In the reaction,



X is

(a) toluene (b) methylbenzene
(c) benzylalcohol (d) ethylbenzene

78. What is the percentage of carbon in urea? (At mass C = 12, H = 1, N = 14, O = 16)

(a) 20% (b) 26.6%
(c) 6.67% (d) 46.0%

79. α -butylene when subjected to hydroboration oxidation reaction, yields

(a) iso-butyl alcohol (b) sec-butyl alcohol
(c) n-butyl alcohol (d) tert-butyl alcohol

80. Calculate Vant Hoff factor for 0.2 m aqueous solution of KCl which freezes at -0.680°C . ($K_f = 1.86 \text{ K kg mol}^{-1}$)

(a) 3.72 (b) 1.83
(c) 6.8 (d) 1.86

81. Which among the following sets of compounds is used as raw material for the preparation of sodium carbonate by solvay process?

(a) $\text{NaOH}, \text{HCl}, \text{CO}_2$
(b) $\text{NH}_4\text{Cl}, \text{H}_2\text{O}, \text{NaCl}$
(c) $\text{NaCl}, \text{NH}_3, \text{Ca}(\text{OH})_2$
(d) $\text{NaCl}, \text{CaCO}_3, \text{H}_2\text{SO}_4$

82. What is the H-S-H bond angle is H_2S ?

(a) 104.5° (b) 92.1°
(c) 91° (d) 90°

83. 'K' is Henry's constant and has the unit

- atm mol⁻¹ dm³
- mol⁻¹ dm³ atm⁻¹
- atm mol dm⁻³
- mol dm⁻³ atm⁻¹

84. For the conversion of oxygen to ozone in the atmosphere, nitric oxide in gaseous phase acts as

- enzyme catalyst
- Inhibitor
- homogeneous catalyst
- heterogeneous catalyst

85. Which among the following group 15 elements does not exhibit allotropy?

- N
- As
- Sb
- Bi

86. Which among the following oxides of nitrogen is called nitrogen sesquioxide?

- NO₂
- N₂O₃
- N₂O₄
- N₂O₅

87. For the elementary reaction $2\text{SO}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightarrow 2\text{SO}_{3(\text{g})}$, identify the correct among the following relations

- $\frac{-d[\text{SO}_{2(\text{g})}]}{dt} = \frac{-d[\text{O}_{2(\text{g})}]}{dt}$
- $\frac{+1}{2} \frac{d[\text{SO}_{3(\text{g})}]}{dt} = \frac{d[\text{SO}_{2(\text{g})}]}{dt}$
- $\frac{+d[\text{SO}_{3(\text{g})}]}{dt} = \frac{-2d[\text{O}_{2(\text{g})}]}{dt}$
- $\frac{+d[\text{SO}_{2(\text{g})}]}{dt} = \frac{-d[\text{O}_{2(\text{g})}]}{dt}$

88. For a process, entropy change of a system is expressed as

- H-TS
- $\frac{q_{rev}}{T}$
- $\frac{T}{q_{rev}}$
- $q_{rev} \times T$

89. Which among the following is NOT a semi-synthetic polymer.

- Terylene
- Viscose-Rayon
- Cupra-ammonium silk
- Acetate Rayon

90. Basesemerization is used in the extraction of

- Iron
- Copper
- Aluminium
- Zinc

91. Which among the following reaction is an example of a zero order reaction?

- $\text{C}_{12}\text{H}_{22}\text{O}_{11(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightarrow \text{C}_6\text{H}_{12}\text{O}_{6(\text{aq})} + \text{C}_6\text{H}_{12}\text{O}_{6(\text{aq})}$
- $2\text{NH}_{3(\text{g})} \xrightarrow{\text{Pt}} \text{N}_{2(\text{g})} + 3\text{H}_2$
- $2\text{H}_2\text{O}_{2(\text{l})} \rightarrow 2\text{H}_2\text{O}_{(\text{l})} + \text{O}_{2(\text{g})}$
- $\text{H}_{2(\text{g})} + \text{I}_{2(\text{g})} \rightarrow 2\text{HI}_{(\text{g})}$

92. The resistance of $\frac{1}{10}$ M solution is 2.5×10^3 ohm. What is the molar conductivity of solution? (cell constant = 1.25 cm^{-1})

- $3.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- $5.0 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- $2.5 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- $2.0 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$

93. If the Vant Hoff factor for 0.1 M Ba(NO₃)₂ solution is 2.74, the degree of dissociation is

- 0.87
- 0.74
- 0.91
- 87

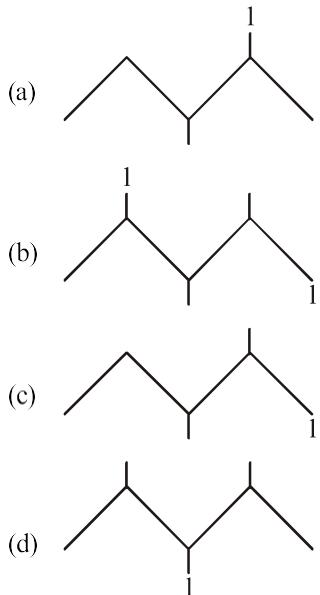
94. What happens when ionic hydrides of S-block elements in molten state are electrolysed?

- Hydride ion migrates at cathode
- Dihydrogen is liberated at cathode
- Hydride ion reforms metal hydride
- Dihydrogen is liberated at anode

95. Which of following is NOT a property of red phosphorus?

- Insoluble in carbon disulphide
- It does not show chemiluminescence by action of air
- If forms phosphine when treated with hot sodium hydroxide solution
- It is non-poisonous

96. The bond line formula of 1-iodo-2, 3-dimethyl pentane is



97. When propene reacts with HCl in presence of peroxide, the product is

(a) 1-chloro propane
 (b) 1, 1-dichloro propane
 (c) 2-chloro propane
 (d) 1, 2-dichloro propane

98. Which hydride among the following is strongest reducing agent?

(a) AsH_3
 (b) BiH_3
 (c) PH_3
 (d) SbH_3

99. Which of the following is NOT an antiseptic compound?

(a) Boric acid
 (b) Iodoform
 (c) Hydrogen peroxide
 (d) Potassium sulphite

100. β -pleated sheets of polypeptide chains are present in

(a) Secondary structure
 (b) Primary structure
 (c) Tertiary structure
 (d) Quaternary structure

SECTION-B

MATHEMATICS

1. If $P(x_1, y_1)$ is a point on the hyperbola $x^2 - y^2 = a^2$, then $SP \cdot S'P = \dots$

(a) $\frac{x_1^2 - y_1^2}{a^2}$ (b) $\frac{x_1^2 + y_1^2}{a^2}$
 (c) $x_1^2 - y_1^2$ (d) $x_1^2 + y_1^2$

2. If $f(x) = \cos^{-1} \left[\frac{1 - (\log x)^2}{1 + (\log x)^2} \right]$, then $f'(e) = \dots$

(a) $\frac{1}{e}$ (b) $\frac{2}{e^2}$
 (c) $\frac{2}{e}$ (d) 1

3. The order of the differential equation of all circles whose radius is 4, is \dots

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

4. If $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ and $A = A^{-1}$, then $x = \dots$

(a) 0 (b) 4
 (c) 2 (d) 1

5. Which of the following function is not continuous at $x = 0$?

(a) $f(x) = \begin{cases} (1+2x)^{1/x}, & x \neq 0 \\ e^2, & x = 0 \end{cases}$

(b) $f(x) = \begin{cases} \sin x - \cos x, & x \neq 0 \\ -1, & x = 0 \end{cases}$

(c) $f(x) = \begin{cases} \frac{e^{1/x} - 1}{e^{1/x} + 1}, & x \neq 0 \\ -1, & x = 0 \end{cases}$

(d) $f(x) = \begin{cases} \frac{e^{5x} - e^{2x}}{\sin 3x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$

6. It is observed that 25% of the cases related to child labour reported to the police station are solved. If 6 new cases are reported, then the probability that atleast 5 of them will be solved is
.....

(a) $\left(\frac{1}{4}\right)^6$

(b) $\frac{19}{1024}$

(c) $\frac{19}{2048}$

(d) $\frac{19}{4096}$

7. For a G.P., if $S_n = \frac{4^n - 3^n}{3^n}$, then $t_2 = \dots$

(a) $\frac{1}{9}$

(b) $\frac{2}{9}$

(c) $\frac{7}{9}$

(d) $\frac{4}{9}$

8. The area of the region bounded by the curve $y = 2x - x^2$ and the line $y = x$ is square units

(a) $\frac{1}{6}$

(b) $\frac{1}{2}$

(c) $\frac{1}{3}$

(d) $\frac{7}{6}$

9. The general solution of $x \frac{dy}{dx} = y - x \tan\left(\frac{y}{x}\right)$ is

(a) $x^2 \sin\left(\frac{x}{y}\right) = c$ (b) $x \sin\left(\frac{x}{y}\right) = c$

(c) $x \sin\left(\frac{y}{x}\right) = c$ (d) $x^2 \sin\left(\frac{y}{x}\right) = c$

10. The statement pattern

$(p \wedge q) \wedge [\sim r \vee (p \wedge q)] \vee (\sim p \wedge q)$

is equivalent to

(a) r (b) q
(c) $p \wedge q$ (d) p

11. A bag contains 6 white and 4 black balls. Two balls are drawn at random. The probability that they are of the same colour is

(a) $\frac{5}{7}$ (b) $\frac{1}{7}$
(c) $\frac{7}{15}$ (d) $\frac{1}{15}$

12. $\int \frac{\cos x + x \sin x}{x^2 + x \cos x} dx = \dots$

(a) $\log \left| \frac{x \sin x}{x + \cos x} \right| + c$
(b) $\log \left| \frac{x}{x + \cos x} \right| + c$
(c) $\log |\cos x + x \sin x| + c$
(d) $\log |x^2 + x \cos x| + c$

13. A stone is dropped into a pond. Waves in the form of circles are generated and radius of outermost ripple increases at the rate of 5 cm/sec. The area increased after 2 seconds is
(a) $100\pi \text{ cm}^2/\text{sec}$ (b) $40 \text{ cm}^2/\text{sec}$
(c) $50 \text{ cm}^2/\text{sec}$ (d) $25 \text{ cm}^2/\text{sec}$

14. If $f(x) = 3x - 2$ and $g(x) = x^2$, then $fog(x) = \dots$
(a) $3x^2 - 2$ (b) $3x^2 + 2$
(c) $3x - 2$ (d) $2 - 3x^2$

15. Which of the following is NOT equivalent to $p \rightarrow q$.
(a) p only if q
(b) q is necessary for p
(c) q only if p
(d) p is sufficient for q

16. The value of $\int_{-3}^3 (ax^5 + bx^3 + cx + k) dx$, where a, b, c, k are constants, depends only on
(a) a, b and c (b) k
(c) a and b (d) a and k

17. The general solution of the differential equation of all circles having centre at $A(-1, 2)$ is
(a) $x^2 + y^2 + x - 2y + c = 0$
(b) $x^2 + y^2 - 2x + 4y + c = 0$
(c) $x^2 + y^2 - x + 2y + c = 0$
(d) $x^2 + y^2 + 2x - 4y + c = 0$

18. If A is non-singular matrix such that $(A-2I)(A-4I) = 0$ then $A + 8A^{-1} = \dots$
(a) I (b) 0
(c) $3I$ (d) $6I$

19. If $G(3, -5, r)$ is centroid of triangle ABC where $A(7, -8, 1)$, $B(p, q, 5)$ and $C(q+1, 5p, 0)$ are vertices of a triangle then values of p, q, r are respectively

(a) 6, 5, 4 (b) -4, 5, 4
(c) -3, 4, 3 (d) -2, 3, 2

20. $\int \frac{1}{(x^2+1)^2} dx = \dots$

(a) $\tan^{-1} x - \frac{1}{2x(x^2+1)} + c$
(b) $\frac{1}{2} \tan^{-1} x + \frac{x}{2(x^2+1)} + c$
(c) $\tan^{-1} x + \frac{x}{x^2+1} + c$
(d) $\tan^{-1} x + \frac{1}{2(x^2+1)} + c$

21. If ${}_0 = \frac{17\pi}{3}$ then $\tan_0 - \cot_0 = \dots$

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

22. Derivative of $\log_e^2(\log x)$ with respect to x is

(a) $\frac{2}{x \log x}$ (b) $\frac{1}{x \log x}$
(c) $\frac{1}{x \log x^2}$ (d) $\frac{2}{\log x}$

23. In $\triangle ABC$; with usual notations, if $\cos A = \frac{\sin B}{\sin C}$, then the triangle is

(a) Acute angled triangle
(b) Equilateral triangle
(c) Obtuse angled triangle
(d) Right angled triangle

24. For a G.P, if $(m+n)^{\text{th}}$ term is p and $(m-n)^{\text{th}}$ term is q , then m^{th} term is

(a) pq (b) \sqrt{pq}
(c) $\frac{p}{q}$ (d) $\frac{q}{p}$

25. A random variable X has following probability distribution

$X=x$	1	2	3	4	5	6
$P(X=x)$	K	3K	5K	7K	8K	K

Then $P(2 \leq x < 5) = \dots$

(a) $\frac{3}{5}$ (b) $\frac{7}{25}$
(c) $\frac{23}{25}$ (d) $\frac{24}{25}$

26. The equation of normal to the curve $y = \log_e x$ at the point $P(1, 0)$ is

(a) $2x+y=2$ (b) $x-2y=1$
(c) $x-y=1$ (d) $x+y=1$

27. The values of x in $\left(0, \frac{\pi}{2}\right)$ satisfying the equation $\sin x \cos x = \frac{1}{4}$ are

(a) $\frac{\pi}{6}, \frac{\pi}{12}$ (b) $\frac{\pi}{12}, \frac{5\pi}{12}$
(c) $\frac{\pi}{8}, \frac{3\pi}{8}$ (d) $\frac{\pi}{8}, \frac{\pi}{4}$

28. If $\vec{a}, \vec{b}, \vec{c}$ and \vec{c}, \vec{a} are coterminous edges of a parallelopiped then its volume is

(a) $3[\vec{a} \vec{c} \vec{b}]$ (b) 0
(c) $2[\vec{a} \vec{b} \vec{c}]$ (d) $4[\vec{b} \vec{a} \vec{c}]$

29. If the c.d.f. (cumulative distribution function) is given by $F(x) = \frac{x-25}{10}$, then $P(27 \leq x \leq 33) = \dots$

(a) $\frac{3}{5}$ (b) $\frac{3}{10}$
(c) $\frac{1}{5}$ (d) $\frac{1}{10}$

30. The joint equation of pair of straight lines passing through origin and having slopes $(1+\sqrt{2})$ and

$$\left(\frac{1}{1+\sqrt{2}}\right) \text{ is}$$

(a) $x^2 - 2\sqrt{2}xy + y^2 = 0$
 (b) $x^2 - 2\sqrt{2}xy - y^2 = 0$
 (c) $x^2 + 2xy - y^2 = 0$
 (d) $x^2 + 2xy + y^2 = 0$

31. The angle between lines $\frac{x-2}{2} = \frac{y-3}{-2} = \frac{z-5}{1}$

and $\frac{x-2}{1} = \frac{y-3}{2} = \frac{z-5}{2}$ is
 (a) 30° (b) 60°
 (c) 45° (d) 90°

32. If the line passes through the points P(6, -1, 2), Q(8, -7, 2λ) and R(5, 2, 4) then value of λ is

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

33. The equivalent form of the statement $\sim(p \rightarrow \sim q)$ is

(a) $p \wedge q$ (b) $p \wedge \sim q$
 (c) $p \vee \sim q$ (d) $\sim p \vee q$

34. If $A = \{x \in \mathbb{R} : x^2 - 5|x| + 6 = 0\}$, then $n(A) = \dots$

(a) 2 (b) 0
 (c) 1 (d) 4

35. If the function $f(x) = \frac{\log(1+ax) - \log(1-bx)}{x}$, $x \neq 0$ is continuous at $x=0$ then, $f(0) = \dots$

(a) $\log a - \log b$ (b) $a + b$
 (c) $\log a + \log b$ (d) $a - b$

36. The coordinates of the foot of perpendicular drawn from origin to the plane $2x - y + 5z - 3 = 0$ are

(a) $\left(\frac{2}{\sqrt{30}}, \frac{-1}{\sqrt{30}}, \frac{5}{\sqrt{30}}\right)$ (b) $(2, -1, 5)$

(c) $\left(\frac{2}{3}, \frac{-1}{3}, \frac{5}{3}\right)$ (d) $\left(\frac{1}{5}, \frac{-1}{10}, \frac{1}{2}\right)$

37. $\int \frac{\sqrt{x^2 - a^2}}{x} dx = \dots$

(a) $\sqrt{x^2 - a^2} - a \cos^{-1}\left(\frac{a}{x}\right) + c$
 (b) $x\sqrt{x^2 - a^2} - \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$
 (c) $\sqrt{x^2 - a^2} + a \sec^{-1}\left(\frac{x}{a}\right) + c$
 (d) $\sqrt{x^2 - a^2} + \frac{1}{x} \sec^{-1}(x) + c$

38. The maximum value of $z = 9x + 11y$ subject to $3x + 2y \leq 12, 2x + 3y \leq 12, x \geq 0, y \geq 0$ is

(a) 44 (b) 54
 (c) 36 (d) 48

39. $\int_0^4 \frac{1}{1+\sqrt{x}} dx = \dots$

(a) $\log\left(\frac{e^4}{6}\right)$ (b) $\log\left(\frac{e^4}{3}\right)$
 (c) $\log\left(\frac{e^4}{9}\right)$ (d) $\log\left(\frac{e^3}{4}\right)$

40. The number of solutions of $\sin^2 \theta = \frac{1}{2}$ in $[0, \pi]$ is

(a) three (b) four
 (c) two (d) one

41. If \vec{p}, \vec{q} and \vec{r} are nonzero, noncoplanar vectors then $[\vec{p} + \vec{q} - \vec{r} \ \vec{p} - \vec{q} \ \vec{q} - \vec{r}] = \dots$

(a) $3[\vec{p} \ \vec{q} \ \vec{r}]$ (b) 0
 (c) $[\vec{p} \ \vec{q} \ \vec{r}]$ (d) $2[\vec{p} \ \vec{q} \ \vec{r}]$

42. Which of the following equation has no solution?
 (a) $\sec \theta = 23$ (b) $\cos \theta = \sqrt{2}$

(c) $\tan \theta = 2019$ (d) $\sin \theta = -\frac{1}{5}$

43. The minimum value of $z = 10x + 25y$ subject to $0 \leq x \leq 3, 0 \leq y \leq 3, x + y \geq 5$ is

(a) 80 (b) 95
 (c) 105 (d) 30

44. If $f(x) = 3x^3 - 9x^2 - 27x + 15$, then the maximum value of $f(x)$ is

(a) -66 (b) 30
(c) -30 (d) 66

45. The equation of the plane passing through the point $(-1, 2, 1)$ and perpendicular to the line joining the points $(-3, 1, 2)$ and $(2, 3, 4)$ is

(a) $\vec{r} \cdot (5\hat{i} + 2\hat{j} + 2\hat{k}) = 1$
(b) $\vec{r} \cdot (5\hat{i} + 2\hat{j} + 2\hat{k}) = -1$
(c) $\vec{r} \cdot (5\hat{i} - 2\hat{j} + 2\hat{k}) = -5$
(d) $\vec{r} \cdot (5\hat{i} - 2\hat{j} - 2\hat{k}) = 1$

46. If the lengths of the transverse axis and the latus rectum of a hyperbola are 6 and $\frac{8}{3}$ respectively, then the equation of the hyperbola is

(a) $4x^2 - 9y^2 = 72$ (b) $4x^2 - 9y^2 = 36$
(c) $9x^2 - 4y^2 = 72$ (d) $9x^2 - 4y^2 = 36$

47. The value of $\tan^{-1} \frac{1}{3} + \tan^{-1} \frac{1}{5} + \tan^{-1} \frac{1}{7} + \tan^{-1} \frac{1}{8}$ is

48. The joint equation of the lines passing through the origin and trisecting the first quadrant is

(a) $\sqrt{3}x^2 - 4xy + \sqrt{3}y^2 = 0$
(b) $x^2 + \sqrt{3}xy - y^2 = 0$
(c) $3x^2 - y^2 = 0$
(d) $x^2 - \sqrt{3}xy - y^2 = 0$

49. If $P(2, 2)$, $Q(-2, 4)$ and $R(3, 4)$ are the vertices of ΔPQR then the equation of the median through vertex R is

(a) $x + 3y + 9 = 0$ (b) $x - 3y + 9 = 0$
(c) $x - 3y - 9 = 0$ (d) $x + 3y - 9 = 0$

50. If $x = \sqrt{a^{\sin^{-1} t}}$, $y = \sqrt{a^{\cos^{-1} t}}$, then $\frac{dy}{dx} = \dots$

(a) $\frac{-y}{x}$ (b) $\frac{x}{y}$
(c) $\frac{y}{x}$ (d) $\frac{-x}{y}$

