PHYSICS

1. A particle perform simple harmonic motion with amplitude A. It's speed is trebled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is:

   A. $A\sqrt{3}$

   B. $\frac{7A}{3}$

   C. $\frac{A}{3}\sqrt{41}$

   D. 3A

2. For a common emitter configuration, if α and β have their usual meanings, the correct relationship between α and β is:

   A. $\alpha = \frac{\beta}{1+\beta}$

   B. $\alpha = \frac{\beta^2}{1+\beta^2}$

   C. $\alpha = \frac{1}{\beta} + 1$

   D. $\alpha = \frac{\beta}{1-\beta}$

3. A student measures the time period of 100 oscillations of a simple pendulum four times. The data set is 90s, 91s, 95 s and 92 s. If The minimum division in the measuring clock is 1s, then the reported mean time should be :
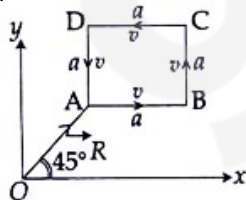   A. 92 ± 1.8 s   B. 92 ± 3 s
   C. 92 ± 2s   D. 92 ± 5.0 s

4. If a, b, c, d are inputs to a gate and x is its output, then, as per the following time graph, the gate is :
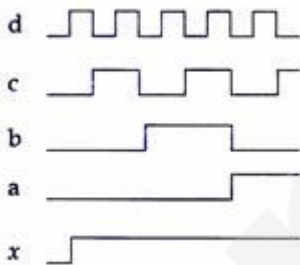
   A. OR   B. NAND
   C. NOT   D. AND

5. A particle of mass m is moving along the side of a square of side 'a', with a uniform speed v in the x-y plane as shown in the figure.

   Which of the following statements is false for the angular momentum $\vec{L}$ about the origin?

   A. $\vec{L} = mv\left[\frac{2}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from B to C

   B. $\vec{L} = \frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving form D to A.

   C. $\vec{L} = -\frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving from A to B.

   D. $\vec{L} = mv\left[\frac{R}{\sqrt{2}} - a\right]\hat{k}$ when the particle is moving from C to A.

6. Choose the correct statement:
   A. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio single.
   B. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the frequency of the audio signal.
   C. In amplitude modulation the amplitude of the high 'frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.
   D. In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

7. Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the sped of the fastest emitted electron will be:

   A. $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

   B. $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

   C. $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

   D. $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

8. Two identical wires A and B, each of length 'I', carry the same current I. Wire A is bent into a circle of radius of radius R and wire B is bent to form a square of side 'a'. If B_A and B_B are the values of magnetic field at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is :

   A. $\frac{\pi^2}{16}$

   B. $\frac{\pi^2}{8\sqrt{2}}$

   C. $\frac{\pi^2}{8}$

   D. $\frac{\pi^2}{16\sqrt{2}}$

9. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now:
   A. 2f   B. f

   C. $\frac{f}{2}$

   D. $\frac{3f}{4}$

10. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), have volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of

the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant is
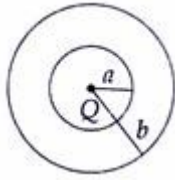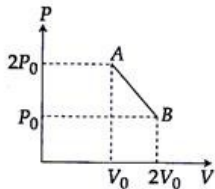

A. $\dfrac{2Q}{\pi\left(a^2-b^2\right)}$ B. $\dfrac{2Q}{\pi\alpha^2}$

C. $\dfrac{Q}{2\pi\alpha^2}$ D. $\dfrac{Q}{2\pi\left(b^2-a^2\right)}$

11. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to
A. 0.044 H   B. 0.065H
C. 80H   D. 0.08H

12. 'n' moles of an ideal gas undergoes a process $A \rightarrow B$ as shown in the figure. The maximum temperature of the gas during the process will be

A. $\dfrac{9P_0V_0}{2nR}$ B. $\dfrac{9P_0V_0}{nR}$

C. $\dfrac{9P_0V_0}{4nR}$ D. $\dfrac{3P_0V_0}{2nR}$

13. A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1 m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up? Fat supplies 3.8×10^7 J of energy per kg which is converted to mechanical energy with a 20% efficiency rate. [Take g = 9.8 ms^{-2}]
A. 9.89×10^{-3} kg   B. 12.89×10^{-3} kg
C. 2.45×10^{-3} kg   D. 6.45×10^{-3} kg

14. A point particle of mass m, moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ . The particle is released, from rest, from the point P and it comes to rest at a point R. The energies, lost by the ball, over the parts, PQ and QR, of the track, are equal to each other, and no energy is lost when particle changes direction from PQ to QR.

The values of the coefficient of friction μ and the distance x(= QR), are respectively close to
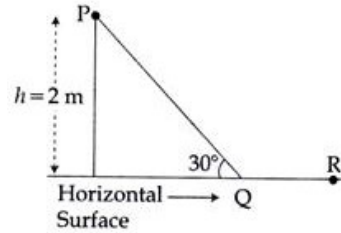
A. 0.29 and 3.5 m   B. 0.29 and 6.5 m
C. 0.2 and 6.5 m   D. 0.2 and 3.5 m

15. The temperature dependence of resistances of Cu and undoped Si in the temperature range 300–400 K, is best described by
A. Linear increase for Cu, exponential decrease for Si
B. Linear decrease for Cu, linear decrease for Si
C. Linear increase for Cu, linear increase for Si
D. Linear increase for Cu, exponential increase for Si

16. Arrange the following electromagnetic radiations per quantum in the order of increasing energy:
A : Blue light
B : Yellow light
C : X-ray
D : Radiowave
A. C, A, B, D   B. B, A, D, C
C. D, B, A, C   D. A, B, D, C

17. A galvanometer having a coil resistance of 100Ω gives a full scale deflection, when a current of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A, is
A. $0.1\ \Omega$ B. $3\ \Omega$
C. $0.01\ \Omega$ D. $2\ \Omega$

18. Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed numbers of A and B nuclei will be
A. 1 : 4   B. 5 : 4
C. 1 : 16   D. 4 : 1

19. Identify the semiconductor devices whose characteristics are given below, in the order (a), (b), (c), (d)
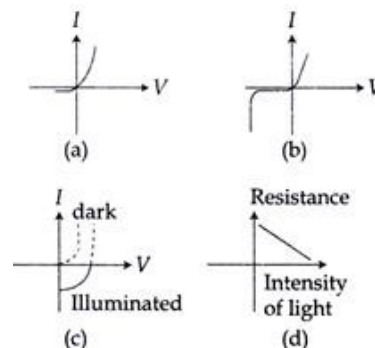
A. Solar cell, Light dependent resistance, Zener diode, simple diode
B. Zener diode, Solar cell, Simple diode, Light dependent resistance
C. Simple diode, Zener diode, Solar cell, Light dependent resistance
D. Zener diode, Simple diode, Light dependent resistance, Solar cell

20. A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the $4\mu F$ and $9\mu F$ capacity), at a point distant 30 m from it, would equal
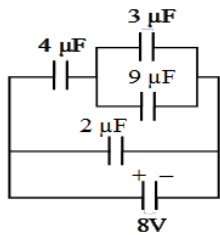

A. 420 N/C
B. 480 N/C
C. 240 N/C
D. 360 N/C

21. A satellite revolving in a circular orbit at a height 'h' from the earth's surface (radius of earth R; h << R). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to: (Neglect the effect of atmosphere.)

A. $\sqrt{gR/2}$
B. $\sqrt{gR}\left(\sqrt{2}-1\right)$
C. $\sqrt{2gR}$
D. $\sqrt{gR}$

22. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a time sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45th division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25th division coincides with the main scale line?
A. 0.70 mm
B. 0.50 mm
C. 0.75 mm
D. 0.80 mm

23. A roller is made by joining together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), with its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre O moving parallel to CD in the direction shown. As it moves, the roller will tend to:
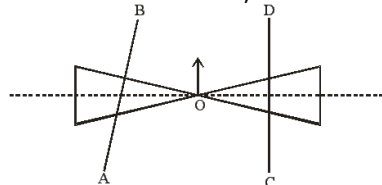
A. go straight
B. turn left and right alternately

C. turn left
D. turn right

24. Hysteresis loops for two magnetic material A and B are given below:
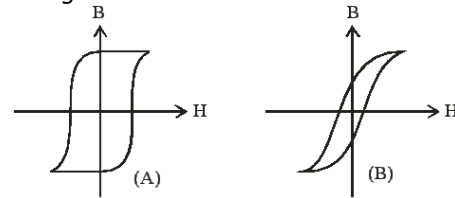
These materials are used to make magnets for electric generators, transformer core and electromagnet core. The it is proper to use:
A. A for transformers and B for electric generators
B. B for electromagnets and transformers
C. A for electric generators and transformers
D. A for electromagnets and B for electric generators

25. The box of a pin hole camera, of length L, has a hole of radius a. It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say b_{min}) when:

A. $a=\sqrt{\lambda L}$ and $b_{min}=\sqrt{4\lambda L}$

B. $a=\dfrac{\lambda^2}{L}$ and $b_{min}=\sqrt{4\lambda L}$

C. $a=\dfrac{\lambda^2}{L}$ and $b_{min}=\left(\dfrac{2\lambda^2}{L}\right)$

D. $a=\sqrt{\lambda L}$ and $b_{min}=\left(\dfrac{2\lambda^2}{L}\right)$

26. A uniform straight of length 20 m is suspended from a rigid support. A short wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the support is: (take $g=10\ ms^{-2}$)

A. $2\sqrt{2}s$
B. $\sqrt{2}s$
C. $2\pi\sqrt{2}s$
D. 2s

27. An ideal gas undergoes a quasi static reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by $PV^n=$ constant, then n is given by (Here C_p and C_V are molar specific heat at constant pressure and constant volume, respectively):

A. $n=\dfrac{C_p-C}{C-C_V}$
B. $n=\dfrac{C-C_V}{C-C_p}$
C. $n=\dfrac{C_P}{C_V}$
D. $n=\dfrac{C-C_P}{C-C_V}$

28. An observer looks at a distance tree of height 10m with a telescope of magnifying power of 20. To the observer the tree appears:
    A. 20 times taller   B. 20 times nearer
    C. 10 times taller   D. 10 times nearer

29. In an experiment for determination of refractive index of glass of a prism by $i - \delta$, plot, it was found that a ray incident at angle 35°, suffers a deviation of 40° and that it emerges at angle 79°. In that case which of the following is closest to the maximum possible value of the refractive index?
    A. 1.7   B. 1.8
    C. 1.5   D. 1.6

30. A pendulum clock loses $12\,s$ a day if the temperature is 40°C and gains $4s$ a day if the temperature is 20°C. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (a) of the metal of the pendulum shaft are respectively:
    A. 30°C; $a = 1.85 \times 10^{-3}/°C$
    B. 55°C; $a = 1.85 \times 10^{-2}/°C$
    C. 25°C; $a = 1.85 \times 10^{-5}/°C$
    D. 60°C; $a = 1.85 \times 10^{-4}/°C$

CHEMISTRY

31. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_1 and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is :
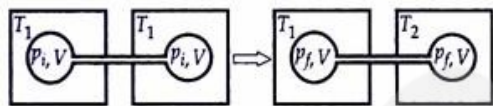

A. $2p_i\left(\dfrac{T_2}{T_1+T_2}\right)$ B. $2p_i\left(\dfrac{T_1 T_2}{T_1+T_2}\right)$

C. $p_i\left(\dfrac{T_1 T_2}{T_1+T_2}\right)$ D. $2p_i\left(\dfrac{T_1}{T_1+T_2}\right)$

32. Which one of the following statements about water is FALSE?
    A. There is extensive intramolecular hydrogen bonding in the condensed phase.
    B. Ice formed by heavy water sinks in normal water.
    C. Water is oxidized to oxygen during photosynthesis.
    D. Water can act both as an acid and as a base.

33. In the Hofmann bromamide degradation reaction, the number of moles of NaOH and Br_2 used per mole of amine produced are:
    A. Two moles of NaOH and two moles of Br_2
    B. Four moles of NaOH and one mole of Br_2
    C. One mole of NaOH and one mole of Br_2
    D. Four moles of NaOH and two moles of Br_2

34. Which of the following atoms has the highest first ionization energy?
    A. K   B. Sc
    C. Rb   D. Na

35. The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of :
    A. Nitrate   B. Iron
    C. Fluoride   D. Lead

36. The heats of combustion of carbon and carbon monoxide are -393.5 and -283.5 kJ mol^{-1}, respectively. The heat of formation (in kJ) of carbon monoxide per mole is
    A. -676.5 B. -110.5
    C. 110.5   D. 676.5

37. The equilibrium constant at 298 K for a reaction $A+B \rightleftharpoons C+D$ is 100. If the initial concentration of all the four species were 1 M each, then equilibrium concentration of D (in mol L^{-1}) will be :
    A. 1.818   B. 1.182
    C. 0.182   D. 0.818

38. The absolute configuration of
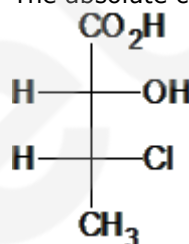
A. (2S, 3S)   B. (2R, 3R)
C. (2R, 3S)   D. (2S, 3R)

39. For a linear plot of log (x/m) versus log p in a Freundlich adsorption isotherm, which of the following statements is correct ? (k and n are constants)
    A. Only 1/n appears as the slope
    B. log (1/n) appears as the intercept
    C. Both k and 1/n appear in the slope term
    D. 1/n appears as the intercept

40. The distillation technique most suited for separating, glycerol from spent-lye in the soap industry is :
    A. Steam distillation
    B. Distillation under reduced pressure
    C. Simple distillation
    D. Fractional distillation

41. Which of the following is an anionic detergent?
    A. Cetytrimethyl ammonium bromide
    B. Glyceryl oleate
    C. Sodium stearte
    D. Sodium lauryl sulphate

42. The species in which the N atom is in a state of sp hybridization is
    A. NO_3^- B. NO_2
    C. NO_2^+ D. NO_2^-

43. Thiol group is present in
    A. Cysteine   B. Methionine
    C. Cytosine   D. Cystine

44. Which one of the following ores is best concentrated by froth floatation method?

A. Galena   B. Malachite
C. Magnetite   D. Siderite

45. Which of the following statement about low density polythene is FALSE?
A. Its synthesis requires dioxygen or a peroxide initiator as a catalyst
B. It is used in the manufacture of buckets, dust-bins etc.
C. Its synthesis requires high pressure
D. It is a poor conductor of electricity

46. Which of the following compounds is metallic and ferromagnetic?
A. VO_2 B. MnO_2
C. TiO_2 D. CrO_2

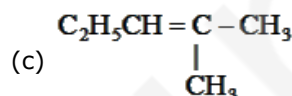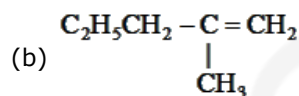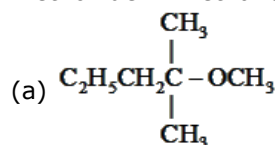47. The product of the reaction given below is
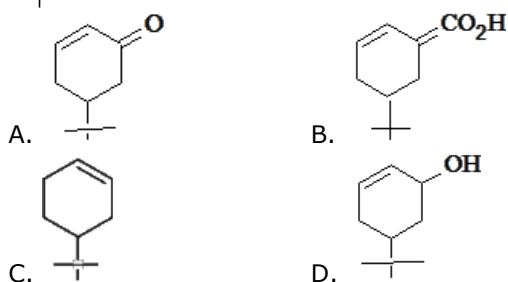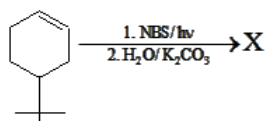
48. The hottest region of Bunsen flame shown in the figure below is
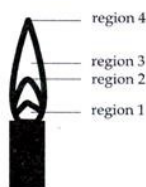
A. region 3   B. region 4
C. region 1   D. region 2

49. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 345 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is
A. C_4H_8 B. C_4H_{10}
C. C_3H_6 D. C_3H_8

50. The pair in which phosphorous atoms have a formal oxidation state of +3 is
A. Orthophosphorous and hypophosphoric acids
B. Pyrophosphorous and pyrophosphoric acids
C. Orthophosphorous and pyrophosphorous acids
D. Pyrophosphorous and hypophosphoric acids

51. The reaction of propene with HOCl (Cl_2 + H_2O) proceeds through the intermediate:
A. $CH_3 - CH(OH) - CH_2^+$
B. $CH_3 - CHCl - CH_2^+$
C. $CH_3 - CH^+ - CH_2 - OH$
D. $CH_3 - CH^+ - CH_2 - Cl$
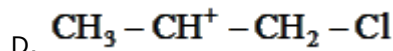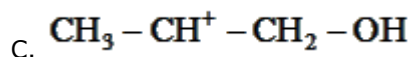
52. 2-chloro-2-methylpentane on reaction with sodium methoxide in methanol yields:

(a) $C_2H_5CH_2\underset{CH_3}{\overset{CH_3}{C}}-OCH_3$

(b) $C_2H_5CH_2 - \underset{CH_3}{C}=CH_2$

(c) $C_2H_5CH = \underset{CH_3}{C} - CH_3$

A. (c) only   B. (a) and (b) only
C. All of these   D. (a) and (c)

53. Which one of the following complexes shows optical isomerism?
A. $trans[Co(en)_2Cl_2]Cl$ (en = ethylenediamine)
B. $[Co(NH_3)_4Cl_2]Cl$
C. $[Co(NH_3)_3Cl_3]$
D. $cis[Co(en)_2Cl_2]Cl$ (en = ethylenediamine)

54. The main oxides formed on combustion of Li, Na and K in excess of air are, respectively:
A. Li_2O_2, Na_2O_2 and KO_2
B. Li_2O, Na_2O_2 and KO_2
C. Li_2O, Na_2O and KO_2
D. LiO_2, Na_2O_2 and K_2O

55. 18 g glucose ($C_6H_{12}O_6$) is added to 178.2 g water. The vapour pressure of water (in torr) for this aqueous solution is :
A. 752.4   B. 759.0
C. 7.6   D. 76.0

56. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces:
A. NO and N_2O B. NO_2 and N_2O
C. N_2O and NO_2 D. NO_2 and NO

57. Decomposition of H_2O_2 follows a first order reaction In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be:
A. 2.66 L min⁻¹ at STP   B. 1.34×10^{-2} mol min⁻¹
C. 6.93×10^{-2} mol min⁻¹   D. 6.93×10^{-4} mol min⁻¹

58. The pair having the same magnetic moment is:
[At. No. : Cr = 24, Mn = 25, Fe = 26, Co = 27]
A. $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$
B. $[CoCl_4]^{2-}$ and $[Fe(H_2O)_6]^{2+}$
C. $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$
D. $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

59. Galvanization is applying a coating of:
A. Cu   B. Zn
C. Pb   D. Cr

60. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the

value of h/λ (where λ is wavelength associated with electrons wave) is given by

A. $\sqrt{meV}$ B. $\sqrt{2meV}$
C. meV D. 2meV

MATHEMATICS

61. The area (in sq. units) of the region
$$\{(x,y); y^2 \geq 2x \text{ and } x^2 + y^2 \leq 4x, x \geq 0, y \geq 0\}$$ is:

A. $\pi - \dfrac{4\sqrt{2}}{3}$ B. $\dfrac{\pi}{2} - \dfrac{2\sqrt{2}}{3}$

C. $\pi - \dfrac{4}{3}$ D. $\pi - \dfrac{8}{3}$

62. If $f(x) + 2f\left(\dfrac{1}{x}\right) = 3x, x \neq 0,$

and $S = \{x \in R : f(x) = f(-x)\};$ then S :
A. contains exactly two elements
B. contains more than two elements
C. is an empty set
D. contains exactly one element

63. The integral $\displaystyle\int \dfrac{2x^{12} + 5x^9}{\left(x^5 + x^3 + 1\right)^3} dx$ is equal to:

A. $\dfrac{x^5}{2\left(x^5 + x^3 + 1\right)^2} + C$
Where C is an arbitrary constant.

B. $\dfrac{-x^{10}}{2\left(x^5 + x^3 + 1\right)^2} + C$
Where C is an arbitrary constant.

C. $\dfrac{-x^5}{\left(x^5 + x^3 + 1\right)^2} + C$
Where C is an arbitrary constant.

D. $\dfrac{x^{10}}{2\left(x^5 + x^3 + 1\right)^2} + C$
Where C is an arbitrary constant.

64. For $x \in R, f(x) = |\log 2 - \sin x|$

and $g(x) = f(f(x)),$ then
A. $g'(0) = -\cos(\log 2)$
B. g is differentiable at x = 0
and $g'(0) = -\sin(\log 2)$
C. g is not differentiable at $x = 0$
D. $g'(0) = \cos(\log 2)$

65. The centres of those circles which touch the circle, $x^2 + y^2 - 8x - 8y - 4 = 0$, externally and also touch the x-axis, lie on:
A. a hyperbola
B. a parabola
C. a circle
D. an ellipse which is not a circle

66. The sum of all real values of X satisfying the equation $\left(x^2 - 5x + 5\right)^{x^2 + 4x - 60} = 1$ is:
A. 6 B. 5
C. 3 D. -4

67. If the $2^{nd}, 5^{th}$ and 9th terms of a non-constant A.P., are in G.P., then the common ratio of this G.P. is:

A. 1 B. $\dfrac{7}{4}$
C. $\dfrac{8}{5}$ D. $\dfrac{4}{3}$

68. The eccentricity of the hyperbola whose length of the latus rectum is equal to 8 and the length of its conjugate axis is equal to half of the distance between its foci, is :

A. $\dfrac{2}{\sqrt{3}}$ B. $\sqrt{3}$

C. $\dfrac{4}{3}$ D. $\dfrac{4}{\sqrt{3}}$

69. If the number of terms in the expansion
$\left(1 - \dfrac{2}{x} + \dfrac{4}{x^2}\right)^n, x \neq 0,$
of is 28, then the sum of the coefficients of all the terms in this expansion, is :
A. 243 B. 729
C. 64 D. 2187

70. The Boolean Expression $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to :
A. $p \vee q$ B. $p \vee \sim q$
C. $\sim p \wedge q$ D. $p \wedge q$

71. Consider
$f(x) = \tan^{-1}\left(\sqrt{\dfrac{1 + \sin x}{1 - \sin x}}\right), x \in \left(0, \dfrac{\pi}{2}\right)$

A normal to y = f(x) at x = $\dfrac{\pi}{6}$ also passes through the point:

A. $\left(\dfrac{\pi}{6}, 0\right)$ B. $\left(\dfrac{\pi}{4}, 0\right)$

C. (0, 0) D. $\left(0, \dfrac{2\pi}{3}\right)$

72. $\displaystyle\lim_{n \to \infty}\left(\dfrac{(n+1)(n+2)....3n}{n^{2n}}\right)^{1/n}$ is equal to:

A. $\dfrac{9}{e^2}$ B. $3\log 3 - 2$

C. $\dfrac{18}{e^4}$ D. $\dfrac{27}{e^2}$

73. If one of the diameters of the circle, given by the equation, $x^2 + y^2 - 4x + 6y - 12 = 0$, is a chord of a circle S, whose centre is at $(-3, 2)$, then the radius of S is:

A. 5 B. 10

C. $5\sqrt{2}$ D. $5\sqrt{3}$

74. Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two and E_3 is the event that the sum of numbers on both dice is odd, then which of the following statements is NOT true?

A. E_1 and E_3 are independent
B. E_1, E_2 and E_3 are independent
C. E_1 and E_2 are independent
D. E_2 and E_3 are independent

75. A value of θ for which $\dfrac{2 + 3i\sin\theta}{1 - 2i\sin\theta}$ is purely imaginary, is

A. $\sin^{-1}\left(\dfrac{\sqrt{3}}{4}\right)$ B. $\sin^{-1}\left(\dfrac{1}{\sqrt{3}}\right)$

C. $\dfrac{\pi}{3}$ D. $\dfrac{\pi}{6}$

76. If the sum of the first ten terms of the series $\left(1\dfrac{3}{5}\right)^2 + \left(2\dfrac{2}{5}\right)^2 + \left(3\dfrac{1}{5}\right)^2 + 4^2 + \left(4\dfrac{4}{5}\right)^2 + \ldots$ is $\dfrac{16}{5}m$, then m is equal to

A. 100 B. 99
C. 102 D. 101

77. The system of linear equations

$x + \lambda y - z = 0$

$\lambda x - y - z = 0$

$x + y - \lambda z = 0$

has a non-trivial solution for

A. exactly two values of λ

B. exactly three values of λ

C. infinitely many values of λ

D. exactly one value of λ

78. If the line, $\dfrac{x-3}{2} = \dfrac{y+2}{-1} = \dfrac{z+4}{3}$ lies in the plane, $\ell x + my - z = 9$, then $\ell^2 + m^2$ is equal to

A. 5 B. 2
C. 26 D. 18

79. If all the words (with or without meaning having five letters, formed using the letters of the word SMALL and arranged as in a dictionary; then the position of the word SMALL is

A. 52nd B. 58th
C. 46th D. 59th

80. If the standard deviation of the numbers 2, 3, a and 11 is 3.5, then which of the following is true?

A. $3a^2 - 34a + 91 = 0$
B. $3a^2 - 23a + 44 = 0$
C. $3a^2 - 26a + 55 = 0$
D. $3a^2 - 32a + 84 = 0$

81. A wire of length 2 units is cut into two parts which are bent respectively to form a square of side = x units and a circle of radius = r units. If the sum of the areas of the square and the circle so formed is minimum, then :

A. $x = 2r$
B. $2x = 4$
C. $2x = (\pi + 4)r$
D. $(4 - \pi)x = \pi r$

82. Let $p = \lim_{x \to 0+} \left(1 + \tan^2 \sqrt{x}\right)^{\frac{1}{2x}}$ then log p is equal to :

A. $\dfrac{1}{2}$ B. $\dfrac{1}{4}$
C. 2 D. 1

83. Let p be the point on the parabola, $y^2 = 8x$ which is at a minimum distance from the centre C of the circle, $x^2 + (y + 6)^2 = 1$. Then the equation of the circle, passing through C and having its centre at P is :

A. $x^2 + y^2 - \dfrac{x}{4} + 2y - 24 = 0$
B. $x^2 + y^2 - 4x + 9y + 18 = 0$
C. $x^2 + y^2 - 4x + 8y + 12 = 0$
D. $x^2 + y^2 - x + 4y - 12 = 0$

84. If a curve $y = f(x)$ passes through the point $(1, -1)$ and satisfies the differential equation, $y(1 + xy)\, dx = x\, dy$, then $f\left(-\dfrac{1}{2}\right)$ is equal to :

A. $\dfrac{2}{5}$ B. $\dfrac{4}{5}$

C. $-\dfrac{2}{5}$ D. $-\dfrac{4}{5}$

85. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $\vec{a} \times (\vec{b} \times \vec{c}) = \dfrac{\sqrt{3}}{2}(\vec{b} + \vec{c})$. If $\vec{b}$ is not parallel to $\vec{c}$, then the angle between $\vec{a}$ and $\vec{b}$ is :

A. $\dfrac{2\pi}{3}$ B. $\dfrac{5\pi}{6}$

C. $\dfrac{3\pi}{4}$ D. $\dfrac{\pi}{2}$

86. If $A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$ and A adj A = A A^T, then 5a + b is equal to
   A. 4   B. 13
   C. -1   D. 5

87. A man is walking towards a vertical pillar in a straight path, at a uniform speed. At a certain point A on the path, he observes that the angle of elevation of the top of the pillar is 30 °. After walking for 10 minutes from A in the same direction, at a point B, he observes that the angle of elevation of the top of the pillar is 60 °. Then the time taken (in minutes) by him, from B to reach the pillar, is :
   A. 20   B. 5
   C. 6   D. 10

88. The distance of the point (1, -5, 9) from the plane x − y + z = 5 measured along the line x = y = z is:
   A. $\dfrac{10}{\sqrt{3}}$ B. $\dfrac{20}{3}$
   C. $3\sqrt{10}$ D. $10\sqrt{3}$

89. Two sides of a rhombus are along the lines, x − y + 1 = 0 and 7x − y − 5 = 0. If its diagonals intersect at (-1, -2), then which one of the following is a vertex of this rhombus?
   A. $\left(\dfrac{1}{3}, -\dfrac{8}{3}\right)$ B. $\left(-\dfrac{10}{3}, -\dfrac{7}{3}\right)$
   C. (-3, -9)   D. (-3, -8)

90. If $0 \le x < 2\pi$, then the number of real values of x, which satisfy the equation
   cos x + cos 2x + cos 3x + cos 4x = 0, is
   A. 7   B. 9
   C. 3   D. 5

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