PHYSICS

1. A boat at anchor is rocked by waves whose nearest crests are 100 cm apart and whose velocity is 25 cm s^{-1}. These waves reach the boat after every
(a) 0.2 s (b) 2.5 s
(c) 8 s (d) 4 s.

2. The terminal velocity of a sphere of radius r in a viscous liquid is v. The terminal velocity of a sphere of radius $2r$ of the same density will be
(a) $\frac{v}{4}$ (b) $\frac{v}{2}$
(c) $2v$ (d) $4v$.

3. The photoelectric work function of a metal is 1 eV. Light of wavelength 3000 Å falls on it. Photoelectrons come out of the metal with velocity
(a) 10 m s^{-1} (b) 10^3 m s^{-1}
(c) 10^4 m s^{-1} (d) 10^6 m s^{-1}.

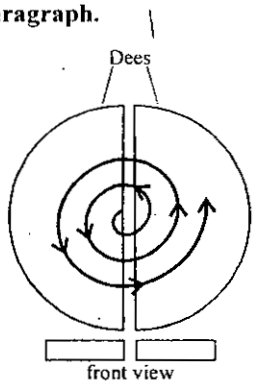
4. Light passes through a glass plate of thickness l and refractive index μ. If the speed of light in vacuum is c then in how much time the light will pass through the plate.
(a) $\frac{\mu l}{c}$ (b) $\frac{\mu c}{l}$
(c) $\frac{\mu}{l}$ (d) none of these.

5. The potential energy of a spring when stretched through a distance S is 10 joule. The amount of work (in joule) that must be done on this spring to stretch it through an additional distance S will be
(a) 30 J (b) 40 J
(c) 10 J (d) 20 J.

6. In a vernier callipers, N divisions of vernier scale coincide with $(N-1)$ division of main scale (in which one division represents 1 mm). The vernier constant is (cm)
(a) N (b) $N-1$
(c) $\frac{1}{N-1}$ (d) $\frac{1}{10N}$

Directions : Questions 7 and 8 are based on the following paragraph.

A cyclotron is a device for accelerating ions and charged particles. It was developed by Lawrence in 1932. The heart of the apparatus consists of a split metal pillbox. Figure shows top and front views of the halves called dees. A rapidly oscillating potential difference is applied between the dees. This produces an oscillating electric field in the gap between the dees, the region inside each dee being essentially free of electric field. The dees are enclosed in an evacuated container, and the entire unit is placed in a uniform magnetic field B whose direction is normal to the plane of dees. A charged particle of mass 'm' and charge 'q' in the gap between the dees is accelerated by the electric field towards one of them Inside the dees, it moves with constant speed in a semi-circle.



The period of uniform circular motion is $T = \frac{2\pi m}{qB}$ and is independent of speed. If the time period of the oscillating electric field is equal to this time, then the charged particle will be accelerated again and again.

7. A cyclotron is accelerating deutrons having mass = $2 \times 1.6 \times 10^{-27}$ kg and charge $+e$. If $B = 2$ T, then the required angular frequency of oscillating electric field is
(a) 10^8 radian/sec (b) 10^7 radian/sec
(c) 10^{10} radian/sec (d) 10^9 radian/sec.

8. The maximum radius of the dees required if deutron is to acquire 100 MeV of energy in the above question is
(a) 0.5 m (b) 1 m
(c) 2 m (d) 4 m.

Directions : Questions 9 and 10 contain statement-1 and statement-2. Of the four choices given, choose the one that best describes the two statements.
(a) Statement-1 is true, Statement-2 is false
(b) Statement-1 is false, Statement-2 is true
(c) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
(d) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.

9. **Statement-1 :** The graph between velocity and displacement for a simple harmonic motion is a parabola.
Statement-2 : Velocity does not change uniformly with displacement in simple harmonic motion.

10. **Statement-1 :** Thin films such as soap bubble or a thin layer of oil on water show beautiful colours when illuminated by monochromatic light.
Statement-2 : The colours are obtained by dispersion of light.

11. State which of the following is correct?
(a) joule = coulomb × volt
(b) joule = volt × ampere
(c) joule = volt
(d) joule = ampere.

12. If v_e and v_o denote the escape velocity and orbital velocity of a satellite corresponding to a circular orbit of radius R, then

(a) $v_e = \frac{v_o}{\sqrt{2}}$ (b) $v_e = \frac{v_o}{2}$

(c) $v_e = v_o$ (d) $v_e = \sqrt{2}\, v_o$.

13. A second pendulum has a time period of 2 second on the earth. In order to have the same time period of the given pendulum on the moon, one has to

(a) decrease the amplitude of vibrations

(b) increase the mass of the bob

(c) decrease the length of the pendulum

(d) increase the size of the bob.

14. A radio transmitter operates at a frequency of 880 kHz and a power of 10 kW. The number of photons emitted per second are

(a) 1.7×10^{31} (b) 1327×10^{34}

(c) 13.27×10^{34} (d) 0.075×10^{-34}

15. A particle of mass m moves along z - axis in such a way that its distance from the origin varies with time t as $z^2 = t^2 + 1$. The acceleration of the particle at time t is

(a) $\frac{1}{z}$ (b) $\frac{1}{z^3}$

(c) $\frac{3}{z^5}$ (d) $\frac{4}{\sqrt{z}}$

16. At absolute zero temperature

(a) molecular motion ceases

(b) water becomes ice

(c) electrons travel faster

(d) potential energy is zero.

17. A freely suspended magnet remains horizontal at

(a) the magnetic equator

(b) the magnetic north pole

(c) the geographic pole

(d) the magnetic south pole.

18. The refractive indices of violet and red light are 1.54 and 1.52 respectively. If the angle of prism is 10°, the angular dispersion is

(a) 0.02 (b) 0.2

(c) 3.06 (d) 30.6.

19. Which has the lowest resistance?

(a) Ammeter (b) Milliammeter

(c) Microammeter (d) Millivoltmeter.

20. In a working nuclear reactor, cadmium rods are used to

(a) slow down the neutrons

(b) speed up the neutrons

(c) absorb some neutrons

(d) absorb all neutrons.

21. A proton and an alpha particle are accelerated through same voltage. The ratio of their de Broglie wavelengths will be

(a) 1 : 2 (b) $\sqrt{2}$: 1

(c) $2\sqrt{2}$: 1 (d) 2 : 1.

22. A galvanometer (G) gives full scale deflection with 0.1 mA. The resistance of the coil is 1000 ohm. This has to be converted into an ammeter to read current upto 10 A. Then the following is to be done

(a) 0.01 ohm is to be connected in series to G

(b) 0.01 ohm is to be connected in parallel to G

(c) 10,000 ohm is to be connected in parallel to G

(d) 10,000 ohm is to be connected in series to G.

23. 50 g of ice at 0° C is mixed with 50 g of water at 20° C. The final temperature of the mixture would be

(a) – 10° C (b) – 30° C

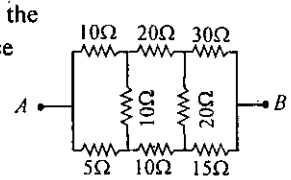
(c) 0°C (d) 10° C.

24. The range of a projectile, which is launched at an angle of 15° with the horizontal is 1.5 km. What is the range of the projectile if it is projected at an angle of 45° to the horizontal?

(a) 1.5 km (b) 3 km

(c) 6 km (d) 0.75 km.

25. In the figure given, the equivalent resistance between A and B is



(a) 90 Ω

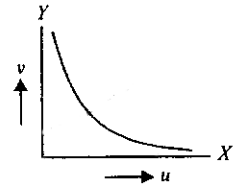
(b) 45 Ω

(c) 20 Ω

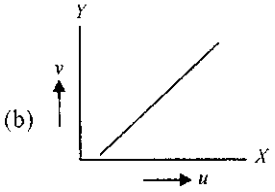
(d) 12 Ω.

26. The shape of graph of u versus v in case of a convex lens is

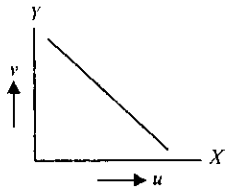
(a)



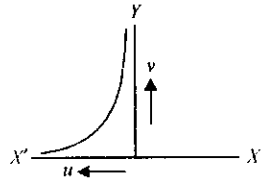
(b)



(c)



(d)



Directions : Questions 27, 28 and 29 are based on the following paragraph.

Two parallel rail tracks run north-south. Train A moves north with a speed of 54 kmh^{-1} and train B moves south with a speed of 90 kmh^{-1}.

27. The velocity of B with respect to A will be
(a) 40 ms^{-1} (b) – 40 ms^{-1}
(c) 30 ms^{-1} (d) – 30 ms^{-1}.

28. The velocity of ground with respect to B will be
(a) 25 ms^{-1} (b) –25 ms^{-1}
(c) 40 ms^{-1} (d) 20 ms^{-1}.

29. Velocity of a monkey running on the roof of the train A against its motion (with a velocity of 18 km h^{-1} with respect to the train A) as observed by a man standing on the ground will be
(a) 40 ms^{-1} (b) 20 ms^{-1}
(c) 10 ms^{-1} (d) 25 ms^{-1}

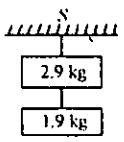
30. If germanium is to be doped with donor impurity then the donor atom should be
(a) tetravalent (b) pentavalent
(c) trivalent (d) none of these.

31. The sensitivity of a moving coil galvanometer can be increased by
(a) increasing the number of turns
(b) decreasing the number of turns
(c) decreasing the area of the coil
(d) none of the above.

32. In producing X- rays, a beam of electrons accelerated by a potential difference V is made to strike a metal target. For what value of V, X - rays have the lowest wavelength?
(a) 10 kV (b) 20 kV
(c) 30 kV (d) 40 kV.

33. The radius, density and tension of a string A are twice the radius, density and tension of another string B. If the lengths of the strings are equal, the ratio $\frac{\upsilon_A}{\upsilon_B}$ of their frequencies of vibration will be
(a) 1 (b) 2
(c) 1/2 (d) 1/4

34. Two blocks of masses 2.9 kg and 1.9 kg are suspended from a rigid support S by two inextensible wires each of length 1 m. The upper wire has negligible mass and the lower wire has a uniform mass of 0.2 kg/m. The whole system of blocks have an upward acceleration of 0.2 m s^{-2}.



The tension at the midpoint of upper wire is (Given : g = 9.8 m s^{-2}).
(a) 20 N (b) 30 N
(c) 40 N (d) 50 N.

35. A body on a smooth inclined plane required four second to slide to the bottom starting from rest at the top. How much time it would take to cover the one - fourth the distance starting from rest at the top?
(a) 1 s (b) 2 s
(c) 3 s (d) 4 s.

CHEMISTRY

36. $C_6H_5OCH_3 \xrightarrow[[POCl_3]]{HCOOH + NHR_2} CH_3OC_6H_4CHO.$

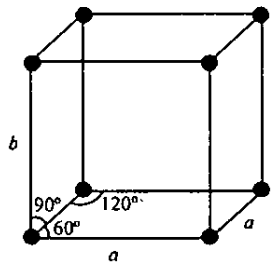
This reaction is called
(a) Gattermann's aldehyde synthesis
(b) Stephen's reduction
(c) Étard's reduction
(d) Vilsmeier - Haack reaction.

37. If KCN is added to a carbonyl compound then the pH value of resulting solution
(a) decreases (b) increases
(c) remains the same
(d) depends upon the nature of carbonyl compound and concentration of KCN solution.

38. Which one will give Cannizzaro reaction?
(a) $Cl_3C - CHO$ (b) $(CH_2OH)_3 - C - CHO$
(c) $C_6H_5 - CHO$ (d) all of these.

Directions : Questions 39, 40 and 41 are based on the following paragraph.

Ice crystallises in a hexagonal lattice figure. At the low temperature at which the structure was determined, the lattice constants were a = 4.53 Å and b = 7.41 Å. (Given, d(ice) = 0.92 g/cm^3)



39. Volume of the unit cell is
(a) 100×10^{-24} cc (b) 131.7×10^{-24} cc
(c) 50.21×10^{-24} cc (d) 200×10^{-24} cc.

40. Mass of the unit cell is
(a) 55 g (b) 60 g
(c) 82 g (d) 73 g.

41. Number of H_2O molecules per unit cell is
(a) 1 (b) 2
(c) 3 (d) 4.

42. The hydrolysis of raffinose in acidic medium is of ..... order.
(a) zero (b) first
(c) second (d) third

43. If the value of ionisation constant of ammonia is 1.8×10^{-5} the value of ionisation constant of its conjugate acid will be
(a) 1.8×10^{-5} (b) 5.5×10^{6}
(c) 5.5×10^{-6} (d) 5.5×10^{-10}

44. Dissociation energy of acetic acid is 0.30 kcal per mole. The heat of neutralisation of acetic acid and caustic potash will be
(a) 13.70 kcal mole^{-1} (b) 14.0 kcal mole^{-1}
(c) 13.40 kcal mole^{-1} (d) none of these.

Directions : Questions 45 and 46 contain statement-1 and statement-2. Of the four choices given, choose the one that best describes the two statements.
(a) Statement-1 is true, Statement-2 is false
(b) Statement-1 is false, Statement-2 is true
(c) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
(d) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.

45. **Statement-1 :** The molality of the solution does not change with change in temperature.
Statement-2 : The molality is expressed in units of moles per 1000 gm of solvent.

46. **Statement-1 :** Zinc and not copper is used in the recovery of Ag from the complex $[Ag(CN)_2]^-$.
Statement-2 : Zinc is a powerful reducing agent than copper.

47. $CH \equiv CH + CH_3 - COOH \xrightarrow{[Hg^{++}]} X \xrightarrow{300°C} \underset{\underset{CHO}{|}}{CH_3} + Z$

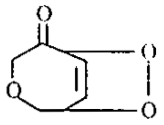
The product Z is
(a) ethyl acetate (b) acetaldehyde
(c) acetic anhydride (d) none of these.

48. How many resonating structures are possible for *trityl carbonium ion*?
(a) 9 (b) 10
(c) 38 (d) 36.

49. BH_3 is not known, since
(a) BH_3 is quite unstable
(b) BH_3 undergoes dimerisation to form B_2H_6
(c) boron and hydrogen are stable in nature
(d) all of these.

50. Reaction between $KMnO_4$ and concentrated H_2SO_4 is highly explosive due to the formation of
(a) K_2MnO_4 (b) Mn_2O_7
(c) Mn_2O_4 (d) $Mn_2(SO_4)_7$.

51. Which one is diamagnetic in nature?
(a) $[Sc(H_2O)_6]^{3+}$ (b) $[Fe(CN)_6]^{4-}$
(c) $[Ti(H_2O)_6]^{3+}$ (d) all of these.

52. The IUPAC name of  is
(a) 2,4,7,8-tetraoxo-bicyclo-[4.2.2]-dec-9-ene
(b) bicyclo-[4.2.2]-dec-9-en-2,4,7,8-tetraone
(c) 4,7,8-trioxo-bicyclo-[4. 2. 2]-dec-9-en-2-one
(d) none of these.

53. Compound *A* is passed over lead painting blackened by the action of H_2S, it gets oxidised and shines. This compound *A* is
(a) O_2 (b) Ne
(c) O_3 (d) H_2O_2

54. Which compound has a *three dimensional structure*?
(a) diamond (b) carborundum
(c) silica (d) all of these.

55. A blue coloured liquid *A* gives dark brown vapours on heating. Liquid *A* is
(a) N_2O_4 (b) N_2O_5
(c) N_2O_3 (d) NO.

56. $R - CH_2 - Br + Ag - C \equiv N \xrightarrow{\text{alcohol}} Z$

The product Z may be
(a) $R - CH_2 - C \equiv N$
(b) $R - CH_2 - N \equiv C$
(c) both (a) and (b)
(d) $R - CH_2 - CH_2 - R$ and $R - CH_2 - CN$ both.

57. Which one is not a true peroxide?
(a) H_2O_2 (b) Caro's acid
(c) Marshall's acid (d) Thiosulphuric acid.

58. Inorganic acid *A* turns KI solution violet and gives off oxygen gas when heated and reduces MnO_4^- ions to Mn^{++} ion. The acid *A* is
(a) SO_2 (b) H_2O_2
(c) SO_3 (d) none of these.

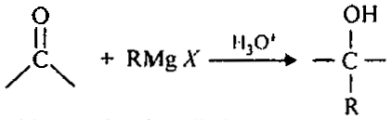
59. Which statement is correct about the alcohols?
(a) Solubility of aliphatic alcohols decreases in water with mass due to the hydrophobic nature of alkyl chain.
(b) Solubility increases with branching in alkyl group chain.

(c) Boiling points decreases with branching in chain.
(d) All of these.

60. Sulphurous acid and sulphuric acid can be distinguished by the addition of
(a) litmus paper (b) Na_2CO_3 solution
(c) active metal (d) chlorine water.

61. Which alloy is called *babbit metal* used for making bearings for machinery?
(a) Sn + Cu + Sb (b) Sn + Pb + Sb
(c) Pb + Cu + Sb (d) Sn + Cu + Sb + Bi.

62. Nitric oxide on treatment with chlorine gives
(a) NCl_3 (b) NOCl
(c) $NOCl_2$ (d) $N_2O_2Cl_2$.

63. 

This reaction is called
(a) Grignard reaction
(b) Oxo process (c) Vilsmeier reaction
(d) Baeyer-Villiger reaction.

64. When 0.5 g of sulphur is burnt to SO_2 4.6 kJ of heat is liberated. What is the enthalpy of formation of sulphur dioxide? (S = 32 and O = 16).
(a) –147.2 kJ (b) +147.2 kJ
(c) +294.4 kJ (d) –294.4 kJ.

65. For the reaction $A \rightarrow$ product, following data are given.

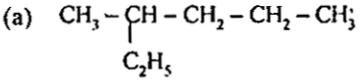
Conc. of [A] (mole/litre)	$\frac{d[\text{product}]}{dt}$ (mole L^{-1} sec^{-1})
0.0025	15×10^{-4}
0.0075	5×10^{-4}
0.0225	1.67×10^{-4}

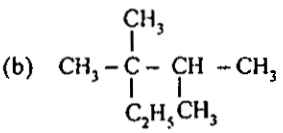
The order of reaction is .....
(a) + 1 (b) – 1
(c) + 2 (d) – 2.

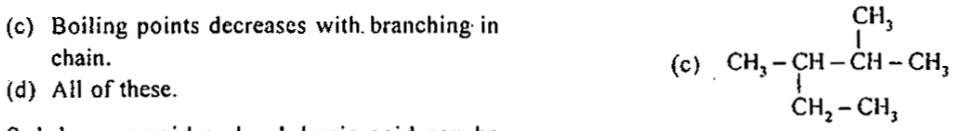
Directions : Questions 66, 67 and 68 are based on the following paragraph.

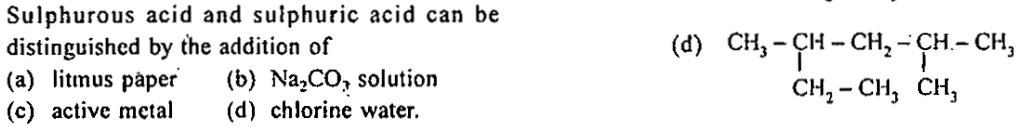
Six isomeric alkene on catalytic reduction gives lowest molecular mass optically active alkane. One of which on oxidation gives ketone having more than 5 carbon atoms.

66. Structure of alkane is

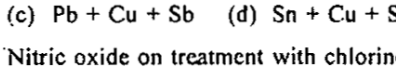
(a) 

(b) 

(c) 

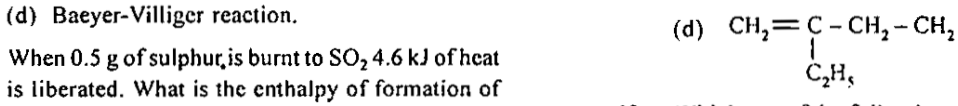
(d) 

67. Structure of alkene which on oxidation gives ketone having more than five C-atoms according to question is

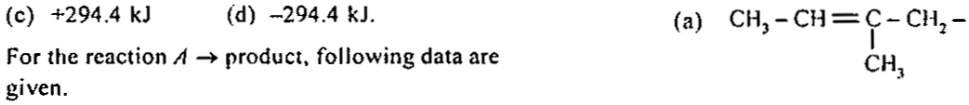
(a) 

(b)

(c) 

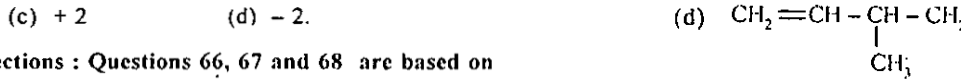
(d) 

68. Which one of the following alkene (being optically active) on oxidation gives two moles of acid?

(a) 

(b) 

(c) 

(d) 

69. Glucose on oxidation with periodic acid gives
(a) formaldehyde and formic acid
(b) gluconic acid and glucosaccharic acid
(c) formaldehyde and aldopentose
(d) all.

70. Which one undergoes nucleophilic as well as an electrophilic substitution reactions?
(a) nitrobenzene (b) pyridine
(c) pyrimidine (d) all.

MATHEMATICS

Directions : Questions 71 to 75 contain statement-1 and statement-2. Of the four choices given, choose the one that best describes the two statements.

(a) Statement-1 is true, Statement-2 is false
(b) Statement-1 is false, Statement-2 is true
(c) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
(d) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.

71. **Statement - 1 :** The system of equations $x - ay + bz = 0$, $ax + y - cz = 0$, $-bx + cy + z = 0$ does not have nontrivial solutions.
Statement - 2 : If A is skew symmetric matrix, then $I - A$ is non-singular.

72. **Statement-1 :** $\lim_{x\to 1} \frac{x^{15}-1}{x^{10}-1} = \frac{3}{2}$

Statement-2 : $\lim_{x\to a} \frac{x^n - a^n}{x-a} = n \cdot a^{n-1}$

73. **Statement - 1 :** Let N be the number of 3-digit numbers with distinct digits so that the digits in any number neither increase nor decrease. Then the sum of the divisors of N is 1055.
Statement - 2 : If p_1, p_2, p_3 are distinct primes, then the sum of the divisors of
$N = p_1^{\alpha_1} \cdot p_2^{\alpha_2} \cdot p_3^{\alpha_3}$ is
$$\frac{(p_1^{\alpha_1+1}-1)(p_2^{\alpha_2+1}-1)(p_3^{\alpha_3+1}-1)}{(p_1-1)(p_2-1)(p_3-1)}.$$

74. **Statement - 1 :** The foot of perpendicular from the point (4, 6, 2) on the line $\vec{r} = 2(\hat{i}+\hat{j}+\hat{k}) + t(3\hat{i}+2\hat{j}+\hat{k})$ is (5, 4, 3).
Statement - 2 : The foot of perpendicular from the point $\vec{c}$ on the line $\vec{r} = \vec{a} + t\vec{b}$ is $\vec{a} + \frac{(\vec{c}-\vec{a})\cdot\vec{b}}{\vec{b}\cdot\vec{b}}\vec{b}$.

75. Let z_1, z_2, z_3 be distinct complex numbers and $\omega^3 = 1$, $\omega \neq 1$.
Statement - 1 : If $z_1 + \omega z_2 + \omega^2 z_3 = 0$, then z_1, z_2, z_3 are the vertices of an equilateral triangle.
Statement - 2 : If $z_3 - z_1 = (z_2 - z_1)e^{i\pi/3}$, then z_1, z_2, z_3 are the vertices of an equilateral triangle.

76. If $\vec{a} = \hat{i}+\hat{j}+\hat{k}$, $\vec{b} = 4\hat{i}+3\hat{j}+4\hat{k}$ and $\vec{c} = \hat{i}+\alpha\hat{j}+\beta\hat{k}$ are linearly independent vectors and $|\vec{c}| = \sqrt{3}$, then

77. Let n be an odd integer. If $\sin n\theta = \sum_{r=0}^{n} b_r \sin^r\theta$, for every value of θ, then
(a) $b_0 = 1$, $b_1 = 3$ (b) $b_0 = 0$, $b_1 = n$
(c) $b_0 = -1$, $b_1 = n$ (d) $b_0 = 0$, $b_1 = n^2 - 3n + 3$.

78. Number of divisors of the form $4n + 2$ ($n \geq 0$) of the integer 240 is
(a) 4 (b) 8
(c) 10 (d) 3.

79. If $a_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$, then $\sum_{r=0}^{n} \frac{r}{{}^nC_r}$ equals
(a) $(n-1)a_n$ (b) na_n
(c) $\frac{1}{2}na_n$ (d) none of these.

80. For any three vectors $\vec{u}, \vec{v}, \vec{w}$ which of the following expressions is not equal to any of the remaining three?
(a) $\vec{u}\cdot(\vec{v}\times\vec{w})$ (b) $(\vec{v}\times\vec{w})\cdot\vec{u}$
(c) $\vec{v}\cdot(\vec{u}\times\vec{w})$ (d) $(\vec{u}\times\vec{v})\cdot\vec{w}$.

81. If $f(x) = 3x - 5$, then $f^{-1}(x)$
(a) is given by $\frac{1}{3x-5}$.
(b) is given by $\frac{x+5}{3}$
(c) does not exist because f is not one-one
(d) does not exist because f is not onto.

82. Let T_r be the r^{th} term of an A.P., for $r = 1, 2, 3, \ldots$. If for some positive integers m, n we have $T_m = \frac{1}{n}$ and $T_n = \frac{1}{m}$, then T_{mn} equals
(a) $\frac{1}{mn}$ (b) $\frac{1}{m}+\frac{1}{n}$
(c) 1 (d) 0.

83. If $g(f(x)) = |\sin x|$ and $f(g(x)) = (\sin\sqrt{x})^2$, then
(a) $f(x) = \sin^2 x$, $g(x) = \sqrt{x}$
(b) $f(x) = \sin x$, $g(x) = |x|$
(c) $f(x) = x^2$, $g(x) = \sin\sqrt{x}$
(d) f and g cannot be determined.

84. Let $f(x) = x - [x]$, for every real number x, where $[x]$ is the integral part of x. Then $\int_{-1}^{1} f(x)\,dx$ is
(a) 1 (b) 2
(c) 0 (d) 1/2.

85. If the circle $x^2 + y^2 = a^2$ intersects the hyperbola $xy = c^2$ in four points $P(x_1, y_1)$, $Q(x_2, y_2)$, $R(x_3, y_3)$, $S(x_4, y_4)$, then
(a) $x_1 + x_2 + x_3 + x_4 = 0$
(b) $y_1 + y_2 + y_3 + y_4 = 0$
(c) $x_1 x_2 x_3 x_4 = c^4$ (d) all of these.

86. There are four machines and it is known that exactly two of them are faulty. They are tested, one by one, in a random order till both the faulty machines are identified. Then the probability that only two tests are needed is
(a) 1/3 (b) 1/6
(c) 1/2 (d) 1/4

87. The order of the differential equation whose general solution is given by
$y = (C_1 + C_2)\cos(x + C_3) - C_4 e^{x + C_5}$,
where C_1, C_2, C_3, C_4, C_5 are arbitrary constants is
(a) 5 (b) 4
(c) 3 (d) 2.

88. The diagonals of a parallelogram $PQRS$ are along the lines $x + 3y = 4$ and $6x - 2y = 7$. Then $PQRS$ must be a
(a) rectangle (b) square
(c) cyclic quadrilateral
(d) rhombus.

89. In a college of 300 students, every student reads 5 newspapers and every newspaper is read by 60 students. The number of newspaper is
(a) at least 30 (b) at most 20
(c) exactly 25 (d) none of these.

90. If $P = (x, y)$, $F_1 = (3, 0)$, $F_2 = (-3, 0)$ and $16x^2 + 25y^2 = 400$, then $PF_1 + PF_2$ equals
(a) 8 (b) 6
(c) 10 (d) 12.

91. The number of values of x where the function $f(x) = \cos x + \cos(\sqrt{2}x)$ attains its maximum is
(a) 0 (b) 1
(c) 2 (d) infinite.

92. If $x > 1, y > 1, z > 1$ are in G.P., then
$\frac{1}{1+\ln x}, \frac{1}{1+\ln y}, \frac{1}{1+\ln z}$ are in
(a) A.P. (b) H.P.
(c) G.P. (d) none of these.

93. The number of values of x in the interval $[0, 5\pi]$ satisfying the equation $3\sin^2 x - 7\sin x + 2 = 0$ is
(a) 0 (b) 5
(c) 6 (d) 10

94. If the vertices P, Q, R of a triangle PQR are rational points, which of the following points of the triangle PQR is (are) always rational point(s)?
(a) centroid (b) incentre
(c) circumcentre (d) orthocentre.
(A rational point is a point both of whose co-ordinates are rational numbers.)

95. Let $f(\theta) = \sin\theta(\sin\theta + \sin 3\theta)$. Then $f(\theta)$
(a) ≥ 0 only when $\theta \geq 0$
(b) ≤ 0 for all real θ
(c) ≥ 0 for all real θ
(d) ≤ 0 only when $\theta \leq 0$.

96. If a, b, c, d are positive real numbers such that $a + b + c + d = 2$, then $M = (a + b)(c + d)$ satisfies the relation
(a) $0 \leq M \leq 1$ (b) $1 \leq M \leq 2$
(c) $2 \leq M \leq 3$ (d) $3 \leq M \leq 4$.

97. In a triangle ABC, $2ac \sin\frac{1}{2}(A - B + C) =$
(a) $a^2 + b^2 - c^2$ (b) $c^2 + a^2 - b^2$
(c) $b^2 - c^2 - a^2$ (d) $c^2 - a^2 - b^2$.

98. For $x \in R$, $\lim_{x\to\infty}\left(\frac{x-3}{x+2}\right)^x =$
(a) e (b) e^{-1}
(c) e^{-5} (d) e^5.

99. In a triangle ABC, let $\angle C = \pi/2$. If r is the inradius and R is the circumradius of the triangle, then $2(r + R)$ is equal to
(a) $a + b$ (b) $b + c$
(c) $c + a$ (d) $a + b + c$.

100. Let PS be the median of the triangle with vertices $P(2, 2)$, $Q(6, -1)$ and $R(7, 3)$. The equation of the line passing through $(1, -1)$ and parallel to PS is
(a) $2x - 9y - 7 = 0$ (b) $2x - 9y - 11 = 0$
(c) $2x + 9y - 11 = 0$ (d) $2x + 9y + 7 = 0$.

Directions : Q. 101, 102 and 103 are based on the following paragraph.

Let $n \in N$. The A.M., G.M., H.M. and R.M.S. (root-mean square) of the n numbers $n + 1, n + 2, n + 3, \ldots n + n$ are A_n, G_n, H_n, R_n respectively. Then

101. $\lim_{n\to\infty}\frac{A_n}{n} =$
(a) 1 (b) 3/2
(c) 2 (d) 1/2

102. $\lim_{n\to\infty} \frac{G_n}{n} =$

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

(c) $\frac{3}{e}$ (d) $\frac{4}{e}$

103. $\lim_{n\to\infty} \frac{H_n}{n} =$

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

(c) 1 (d) e

Directions : Questions 104 and 105 are based on the following paragraph.

The sides of a triangle ABC are 8, 7, 6. The smallest angle is C.

104. The length of the median through the vertex C is

(a) $\sqrt{95}$ (b) $\sqrt{\frac{95}{2}}$

(c) $\frac{\sqrt{95}}{2}$ (d) $\frac{\sqrt{95}}{4}$

105. The length of the altitude from the vertex C is

(a) $\frac{7}{4}\sqrt{15}$ (b) $\frac{7}{3}\sqrt{15}$

(c) $\frac{\sqrt{35}}{2}$ (d) $5\sqrt{3}$