MATHEMATICS

1. The coefficient of x^4 in the expansion of $(x^{1/2} - x^{2/3})$ is :

(A) 0 (B) – 7 (C) 35 (D) – 35

2. The number of complex number z such that $\left|\frac{z}{\bar{z}} + \frac{\bar{z}}{z}\right|$ = 1 and | z | = 1 is :

(A) 2 (B) 4 (C) 6 (D) 8

3. Let A be an invertible 2 × 2 real matrix. If $A^{-1} = \begin{bmatrix} 35 & 37 \\ 41 & 43 \end{bmatrix}$ then det (12A) equals :

(A) –1728 (B) –1 (C) –12 (D) –1/2

4. Given $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$: the value of

$\sum_{n=1}^{\infty} \frac{1+3+5+...+(2n-1)}{1^3+2^3+3^3+.....+n^3}$ is :

(A) $2\pi^2/3$ (B) $4\pi^2/3$ (C) $4\left(\frac{\pi^2}{6} - 1\right)$ (D) $\pi^2/6$

5. If the slope of one of the lines represented by $4ax^2 + xy + 4y^2 = 0$ is the square of the other then equals :

(A) 1/8 (B) 1/4 (C) –1/4 (D) –1/8

6. Let A and B be two points on the parabola $y = 2x^2 + x - 2$ such that the origin is the midpoint of the line segment joining A to B. The length of AB is :

(A) 2 (B) 3 (C) $2\sqrt{3}$ (D) $2\sqrt{2}$

7. The triangle formed by x-axis, y - axis and the line 3x + 4y + c = 0 has inradius 1. Then the value of |c| is :

(A) 12 (B) 7 (C) 5 (D) 1

8. Let p, q and r denote the lengths of the sides QR, PR and PQ of a triangle PQR respectively. Then $p\cos^2(R/2) + r\cos^2(P/2)$

(A) equals q (B) equals $\frac{p+q+r}{2}$

(C) equals $\frac{p+q+r}{4}$ (D) cannot be determined with the given data

9. The number of solutions of the equation : $3\cos^2 x\sin^2 x - \sin^4 x - \cos^2 x = 0$ in the interval $[0, 2\pi]$ is :

(A) 8 (B) 4 (C) 6 (D) 3

10. If $\theta = \frac{1}{2}\sin^{-1}(1/4)$ then $64\sin\theta + 64\cos\theta - 8\sec\theta - 8\operatorname{cosec}\theta + \tan\theta + \cot\theta$ equals :

(A) 8 (B) 4 (C) 0 (D) –1

11. Let

$$L = \left\{\lim_{x\to 0}\left(x\sin\left(\frac{1}{x}\right) + x^2\sin\left(\frac{1}{x^2}\right) + ... + x^n\sin\left(\frac{1}{x^n}\right)\right)\right\}$$

Then

(A) L does not exist (B) L = 1

(C) L = 0 (D) L = 1

12. Let f (x) be a function defined on [0, 2] by :

$$f(x) = \begin{cases} x^3 & \text{for } x \geq 1 \\ ax^2 + bx + c & \text{for } x < 1 \end{cases}$$

where a, b and c are constants such that f(x) has second derivative at x = 1. Then a equals :

(A) – 6 (B) – 3 (C) 6 (D) 3

13. If the function $f(x) = x^3 - 3ax^2 + b$ is strictly increasing derivative for x > 0, then which of the following is always true ?

(A) a can take any real value (B) $a \leq 0$

(C) a < 0 (D) $a \geq 0$

14. The value of the integral : $\int_1^3 [x]\cos\left(\frac{\pi}{2}(x - [x])\right)dx$ where [x] denotes the largest integer not exceeding x is :

(A) 6 (B) 1/6 (C) $\pi/6$ (D) $6/\pi$

15. If $f(n) = \frac{1}{n}\{(2n + 1)(2n + 2)$ ------- $(2n + n)\}^{1/n}$, then $\lim_{n\to\infty} f(n)$ equals :

(A) 4/e (B) 27/ 4e (C) 27 e/4 (D) 4e

16. If V_1, V_2, V_3 are unit vectors such that $V_1 + V_2 + V_3 = 0$ then $|V_1 - V_2|$:

(A) equals $\sqrt{3}$ (B) equals 3/2

(C) can be any value in the interval (0,2) (D) can be any value in the interval $(3/2, \sqrt{3})$

17. A fair coin is tossed five times. If the out comes are 2 heads and 3 tails (in some order), then what is the probability that the fourth toss is a head ?

(A) $\frac{1}{4}$ (B) $\frac{2}{5}$ (C) $\frac{1}{2}$ (D) $\frac{3}{5}$

18. The number of three element subsets of {1, 2 .....10} sum of whose elements is even is :

(A) 50 (B) 60 (C) 70 (D) 90

19. Suppose x, y are positive real numbers such that 2 log (x – 2y) = logx + logy. Then value of $\frac{x}{y}$ is :

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

20. Let x,y and z be positive integers such that gcd(x, y, z) = 1 : x < y < z and $x^2 + y^2 = z^2$. Then which of the following is always true ?

(A) 2 does not divide x (B) 2 does not divide z(x + y)

(C) 4 divides x + y + z (D) 8 does not divide x + y + z

PHYSICS

21. A block of mass m sliding down an incline at constant speed is initially at a height h above the ground. The coefficient of kinetic friction between the incline is μ. If the mass continues to slide down the incline at a constant speed, the energy dissipated by friction by the time the mass reaches the bottom of the incline is -

(A) mgh/μ (B) mgh (C) p mgh/sin 0 (D) mgh sin 0

22. The energy required to remove both electrons from the helium atom in its ground state is 79.0 eV. The energy required to ionize helium (i.e. to remove one electron) is -

(A) 24/6 eV (B) 39.5 eV (C) 51.8 eV (D) 54.4 eV

23. A proton moves in the +ve z- direction after being accelerated from rest through a potential difference V. The proton then passes through a region with uniform electric field E in the +x direction and a uniform magnetic field B in the + y-direction, but the proton's trajectory is not affected. If the experiment is repeated using a potential difference of 2V, the proton will be -

(A) deflected in the +ve x- direction (B) deflected in the –ve x-direction

(C) deflected in the +ve y- direction (D) deflected in the –ve y- direction

24. The displacement (y) of an electric wave as a function of position (x) and time (l) is given by :

y = cosx sint + cos2x sin2t

where the units of x and r are metre (m) and of time, second (s). The equation describes.

(A) a monochromatic (i.e. of fixed wavelength) wave traveling along the positive x-direction with speed 1 ms^{-1}.

(B) a traveling wave along the positive x-direction with speed 1 ms^{-1}, that is a supper position of two harmonic waves.

(C) a stationary monochromic wave of wavelength 2π metre and angular frequency $1s^{-1}$

(D) a superposition of two stationary waves of wavelengths 2π metre and π metre and equal amplitudes.

25. Two polaroids are placed 90° to each other and the transmitted intensity is zero. One more polaroid is placed between them bisecting the angle between them. Let l be the intensity of light just after the first polaroid. The fraction of l transmitted by the system is -

(A) 0 (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) $\frac{1}{8}$

26. A hydrogen gas filled ballon left free in a fast but uniformly moving bus (with closed doors and windows, so not air currents) rises and touches against the ceiling of the bus. If the bus slow down quickly with uniform retardation of magnitude α

(A) The ballon displace in the direction of motion of the bus.

(B) The ballon displaces opposite to the direction of motion of the bus.

(C) The ballon remains where it was before.

(D) The ballon displaces along to the vertical determined by the ratio α/g.

27. Blamer lines of deuterium atoms, compared to those of hydrogen atom, are observed to be of -

(A) higher frequency

(B) higher wavelength

(C) same wavelength but reduced intensity

(D) same wavelength and intensity

28. The isothermal bulk modulus of an ideal gas is - ($\gamma = \frac{C_v}{C_v}$)

(A) γP (B) P (C) $(\gamma - 1) P$ (D) $\sqrt{\gamma^2 + 1}\ P$

29. Unpolarized light is incident at a plane interface from medium 1 to medium 2. With refractive indies μ_1 and μ_2 respectively. The angle of incidence 'I' for which the reflected ray is totally plane polarized is -

(A) $\tan^1\left(\frac{\mu_2}{\mu_1}\right)$ (B) $\sin^{-1}\left(\frac{\mu_2}{\mu_1}\right)$ (C) $\sin^1\left(\frac{\mu_1}{\mu_2}\right)$ (D) $\tan^1\left(\frac{\mu_1}{\mu_2}\right)$

30. The velocity v of waves on the surface of a pool of liquid is given by the formula

(A) $v^2 = \frac{\lambda g}{2\pi} + \frac{2\pi\sigma}{\lambda\rho}$ (B) $v^2 = \frac{\lambda g}{2\pi} + \frac{2\pi\sigma\lambda}{\rho}$ (C) $v^2 = \frac{\lambda g}{2\pi}$ (D) $v^2 = \frac{1}{2\pi} + \sqrt{\frac{\sigma g}{\rho}}$

(λ wavelength : g acceleration due to gravity : σ surface tension : ρ : density)

31. A statelite orbits around the earth at a distance r from the centre of the earth. Taking the zero of gravitational potential energy at infinity (K.E. and P.F. mean kinetic energy and potential energy respectively)

(A) E_{total} = K.E. + P.E. = O (B) E_{total} = –K.E.

(C) $E_{total} = -\frac{1}{2}$ P.E. (D) K.E. = P.E.

32. When the armature coil in a motor rotates in a magnetic field, a back emf ε developes opposing the applied potential v, causing a net current I in the coil. If R is the resistance the coil, the mechanical power output of the motor is -

(A) I^2R (B) εI (C) VI (D) $VI + I^2R$

33. A ball rolling on the floor of a uniformly moving train comes to a stop due to friction after traveling a distance d, losing its initial kinetic energy k into heat H. For an outside observer on the ground, suppose the same quantities have values d^1, k^1 and H^1 respectively. Then

(A) K = K' ; H = H' ; d = d' (B) K $\neq$ K' ; H = H' ; d $\neq$ d'

(C) K = K' ; H $\neq$ H' ; d = d' (D) K $\neq$ K' ; H $\neq$ H' ; d $\neq$ d'

34. A body is projected horizontal on the top of the Mount Everest with speed much greater than $\sqrt{2gr}$, where r is the distance of the projection point from the centre of the earth and g is the acceleration due to gravity there. The trajectory of the body will be a -

(A) straight line (B) parabola (C) hyperbola (D) ellipse

35. Consider two stars A and B having equal radii but different surface temperature. The surface temperature of A is 4000 K while that of B is 40000K. Which of the following statement is false ?

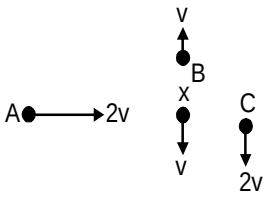
(A) A is less luminous than B.

(B) A emits more light at infrared wavelengths than it does at ultraviolet wavelength.

(C) B emits more light at ultraviolet wavelength than it does at infrared wavelength.

(D) In a given infrared wavelength bond, A emits more light than B.

36. Four stars A, B, C and and X are moving with velocities as shown with respect to the interstellar medium. An observer on a planet of the star X measures the frequencies v of the same spectral line in stars A, B and C and finds : (Ignore planetary velocity in comparison to stellar velocities)



(A) $V_A < V_B > V_C$ (B) $V_A < V_C < V_B$ (C) $V_B < V_C < V_A$ (D) $V_C < V_B < V_A$

37. The pressure P of an ideal gas is related to mean squared speed $\overline{V}^2$ by the relation, $P = \frac{1}{3} n m \overline{V}^2$.

Where n is the number density and m is the mass of a molecule of the gas. For a mixture of non-reactive ideal gases 1,2, ---------- this equation becomes

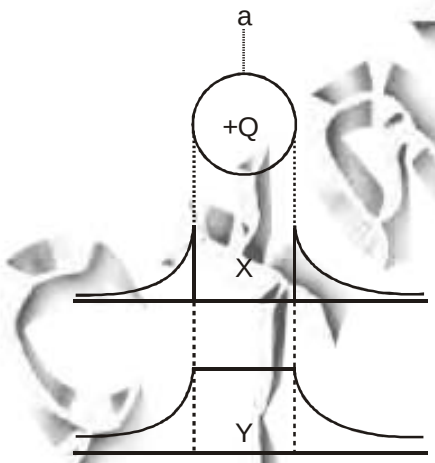
(A) $P = \frac{1}{3} (n_1 + n_2 + ----) (m_1 + m_2 + -----) \overline{V}^2$

(B) $P = \frac{1}{3} (n_1 m_1 + n_2 m_2 + -----) \overline{V}^2$

(C) $P = \frac{1}{3} (n_1 m_1 + n_2 m_2 + ------) \left(\overline{V}_1^2 + \overline{V}_2^2 + ...\right)$

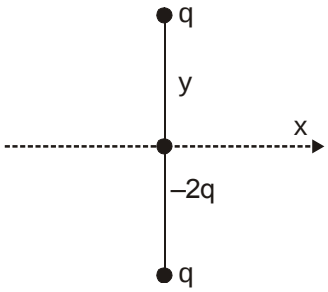
(D) $P = \frac{1}{3} n_1 m_1 \overline{V}_1^2 + \frac{1}{3} n_2 m_2 \overline{V}_2^2 + ----$

38. Figure shows two graphs (X) and (Y) related to a charged conducting sphere of radius a and charge Q



(A) X represents potential versus distance (from the centre) graph while Y represents electric field versus distance graph.
(B) Y represents potential versus distance graph while X represents electric field versus distance graph
(C) Both graphs show that potential and electric field are continuous throughout.
(D) Both graphs show that potential and electric field have continuous first order derivatives.

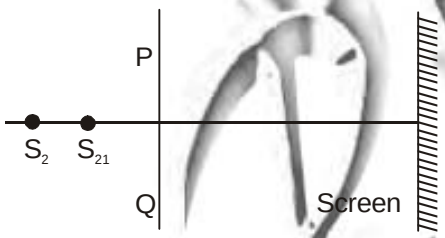
39. Figure below show a charge disribution of three charge q, –2q and q located along the y-axis with the charge –2q at centre and the other charges symetrically placed about it :



The electric field along the x axis. for large x compared to the size of the distribution, varies as :

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

40. In a double silt experiment, two identical point sources S_1 and S_2 are placed on the line perpendicular to the two slits P and Q as shown. (The figure is not to scale). The screen is placed for away compared to the distance between the slits).



When only S_1 is switched on, there is an interference pattern with a peak intensity I_i. When only S_2 is switched on, there is an interference pattern with peak intensity I_2 ($I_2 < I_1$). When both S_1 and S_2 are switched on.

(A) there will be a uniform intensity on the screen

(B) the intensity on the screen will vary from $I_1 < I_2$ to $I_1 + I_2$

(C) the intensity on the screen will vary from 0 to $(\sqrt{I_1} + \sqrt{I_2})^2$.

(D) the intensity on the screen will vary from 0 to $(I_1 + I_2)$.

CHEMISTRY

41. The pH of a 0.1M solution of a weak monocrotic acid having a degree of dissociation of 0.1 in water, is-

(A) 4.4 (B) 4.0 (C) 2.4 (D) 2.0

42. An ambidenate ligand is -

(A) NO_2 (B) ClO_4 (C) NO_2^- (D) NH_3

43. A molecule with a trigonal pyramidal structure is -

(A) H_3O^+ (B) NH_4^+ (C) BF_3 (D) CO_3^{2-}

44. A molecule whose molar specific heat at high temperature assuming ideal behaviour is 9R. is

(A) C_6H_6 (B) NH_3 (C) B_2H_6 (D) CH_4

45. The solubility of the hydroxide of Be, Mg, Ba and Ca in water follows the order

(A) Be > Mg > Ca > Ba (B) Mg > Be > Ca > Ba

(C) Ca > Ba > Mg > Be (D) Ba > Ca > Mg > Be

46. The energy required to remove an electron from an isolated atom in the gas phase follows the order.
(A) C > B > Be > Li (B) C > Be > B > Li (C) B > C > Be > Li (D) Be > Li > B > C

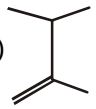
47. The dipole moment of BeF_2 is **-**
(A) 1.5 D (B) 1.0 D (C) 0.0 D (D) 1.8 D

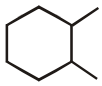
48. A non-planar compound is -
(A) $[Ni(CN)_4]^{2-}$ (B) $[NiCl_4]^{2-}$ (C) $[PtCl_4]^{2-}$ (D) BCl_3

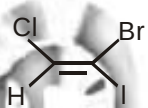
49. Mass of a liquid is weighed correct to three decimal place and its volume is measured correct to one decimal place. The density of the liquid calculated from the above data will be correct to
(A) three decimal place (B) two decimal place (C) one decimal place (D) four decimal place

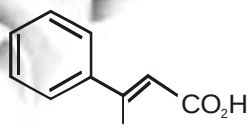
50. According to Bohr's theory, the angular momentum of the electron in the ground state of the hydrogen atom is -
(A) 0 (B) 1 (C) 2 (D) 3

51. Geometrical isomerism is not exhibited by -

(A) 

(B) 

(C) 

(D) 

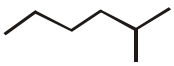
52. The acid strength of o-nitrophenol (I), m-nitrophenol (II) and p-nitrophenol (III) follows the order.
(A) I < II = III (B) II < I < III (C) III < I < II (D) I < II < III

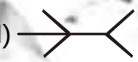
53. In the polymerization of alkene by Zieglar-Natta reaction. The catalyst and the co-catalyst, respectively, are -
(A) $TiCl_4$ and $AlCl_3$ (B) Ti (III) and Et_3Al (C) $Ti(Et)_4$ and Al(III) (D) $TiCl_2$ and Et_3Al

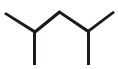
54. Saponification of oils gives
(A) Glycerol and alkali salts of fatty acids (B) Glyceraldehyde and alkali salts of fatty acids
(B) Glyceric acid and long chain alcohols (D) Ethylene glycol and alkali salts of fatty acids

55. The expected order of boiling points of I - IV would be -

(I) 

(II) 

(III) 

(IV) 

(A) I < II < IV < III (B) III < IV < II < I
(C) IV < III < II < I (D) IV < II < III < I

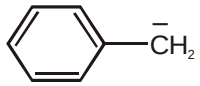
56. Azobenzene will be obtained as a major product when nitrobenzene is treated with
(A) Sn and HCl (B) Raney Nickel/H_2 (C) Zn/NaOH (D) Pb-C/H_2

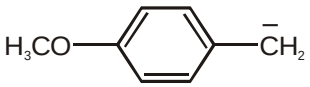
57. The order of nucleophilicity of halides is :
(A) $I^- > Br^- > Cl^- > F^-$ (B) $F^- > Br^- > Cl^- > I^-$
(C) $Cl^- > Br > I^- > F^-$ (D) $F^- > Cl^- > Br^- > I^-$

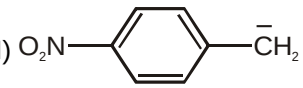
58. The compound that will give lactide on heating is -
(A) $CH_3CH_2CH(OH)COOH$ (B) $CH_3CH_2CH(NH_2)COOH$
(C) $CH_3CH(OH)CH_2COOH$ (D) $CH_3CH(NH_2)CH_2COOH$

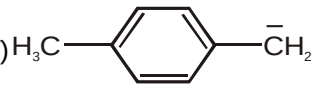
59. A compound that shows a distinct colour change on treatment with alcoholic ferric chloride is -
(A) Anisole (B) Aspirin (C) Salicylic acid (D) Methyl benzoate

60. The order of increasing stability of carbanions in compound I-IV is -

(I) 

(II) 

(III) 

(IV) 

(A) III, IV, I, II (B) IV, II, I, III (C) III, I, IV, II (D) II, IV, I, III

BIOLOGY

61. Excision of the thymus, the primary lymphoid organs in mammals, results in severe immunodeficiency. This due to the absence of the following in the peripheral circulation.
(A) All nature leucocytes (B) Mature T and B cells
(C) Mature T cells (D) Mature B cells

62. Which of the following organelle of a mammalian cell has the genetic material transferred only from the mother to her offspring ?
(A) Nucleus (B) Mitochondria
(C) Endoplasmic reticulum (D) Centrosome

63. Water contaminated with Vibrio cholerae can be made potable
(A) By boiling alone (B) By passing through filter
(C) By treating with chloride (D) By freezing the water

64. A patient suffering from splenomegaly undergoes splenectomy. Which of the following processes will be affected ?
(A) RBC production will be stopped (B) Removal of old RBC will be impaired
(C) Decreases in antibody production (D) Generation of B cells will be stopped

65. During exercise when body temperature rises, the skin capillaries dilate and receive more blood resulting in increased heat loss. Which of the following is NOT associated with the maintenance of the body temperature in general ?
(A) Eccrine and apocrine sweat glands.
(B) Release of bradykinin, a potent vasodilating peptide
(C) Sebum secretion from sebaceous glands
(D) Sub-cutancous fat

66. In which of the following digestive juice are DNase and RNase found ?
(A) Gastric juice (B)Intestinal juice (C) Saliva (D) Pancreatic juice

67. Which of the following is NOT considered as a function of Liver ?
(A) Synthesis of vitamins (B) Production of heat
(C) Regulation of blood sugar (D) Stimulation of peristalsis

68. The hypersensitive reaction in response to a type I allergen which produces characteristic symptoms is described as allergic response. Which of the following immunoglobulin is mostly involved in this type of cellular response ?
(A) IgA (B) IgM (C) IgD (D) IgE

69. Which of the following is NOT considered as a cause of lung carcinoma ?
(A) Cigarette smoking (B) Atmospheric pollution
(C) Vitamin A deficiency (D) Airborne pollens

70. If the blood group of father is 'A' and that of mother is 'B' . The blood group of their child could be -
(A) A or B or AB (B) AB only (C) A or B or AB or O (D) A or B only

71. Certain gases in the atmosphere known as 'green house gas' which absorbs and emits heat and contribute to global warming. Which of the following gases is not considered in the list of gases known to have 'green house effect' ?
(A) Carbon dioxide (CO_2) (B) Chlorofluorocarbons (CFC)
(C) Ozone (O_3) (D) Nitrous oxide (NO)

72. Which of the following hormones would suppress inflammation caused by injury ?
(A) Glucocorticoid (B) Progesterone (C) Thyroxin (D) Insulin

73. Many aquatic plants float on water during day time but sink during night because -
(A) During day evaporation of water increases the density of the impure water of the reservoir whereas during night condensation of atmosphere moisture into the reservoir decreases the density of water.
(B) Accumulation of gaseous oxygen in plants makes them buoyant during day time. The oxygen is used up during night making them heavier
(C) Lipid synthesis increases during dar time making them buoyant and the lipids are used up during the night.
(D) Accumulation of starch by the end of the day makes them heavier and they sink into the water during night time.

74. If the husband is Rh' and the wife is Rh'.
(A) The couple cannot be children
(B) The couple's first child may be born but they are not likely to have their second child without medical intervention.
(C) Their first foetus will not survive but the subsequent ones will
(D) The couple's reproductive life will be normal

75. Maximal level of DNA replication in a mammalian cell occurs during.
(A) GI phase (B) M phase (C) S phase (D) G2 phase

76. Many blue green algae can be used as bio-fertilizers because .
(A) Their photosynthetic ability results in production of hydrocarbons used by the plant
(B) They reduce atmospheric nitrogen to nitrogenous compounds
(C) They serve as food for the beneficial microorganisms in soil
(D) They are toxic to the plant pests

77. Which of the following oxidizes ammonia to nitrogen ?
(A) Nitrosomanas during day and night
(B) Nitosomonas only during day
(C) Rhizobium during day and night
(D) Rhizobium only during day

78. Bioluminescence involves the emission of light from biological systems. The energy source for this light is primarily.
(A) Heat (B) Chemical (C) Magnetic (D) Photosynthesis

79. The volume of blood pumped out by ventricle during each beat is known as stroke volume. If a healthy adult has a pulse rate of 72 and stroke volume of 70 ml, then the cardiac output is.
(A) 70 ml/min. (B) 72 ml/min (C) 5040 ml/min (D) 140 ml/min

80. Fats provide more energy than carbohydrates because -
(A) Fats contain higher percentage of C and H and lower percentage of O than carbohydrates
(B) Fats gets readily oxidized than carbohydrates
(C) Fats contain higher percentage of O than C
(D) Fats can be absorbed readily by our bodies than carbohydrates

MATHEMATICS

81. If a, b, and c are nonzero real numbers such that ab = 2 (a + b), bc = 3(b + c) and ca = 4 (c + a) then the value of 5a + 7b + c is :
(A) 18 (B) 72 (C) 108 (D) 120

82. Let x α and β be nonzero real roots of the quadratic equation $x^2 + ax + b = 0$ and $\alpha + \beta$, $\alpha - \beta$ and $-\alpha - \beta$ be the roots of the equation $x^4 + ax^3 + cx^2 + dx + e = 0$. Then which of the following statement is false?
(A) a = 0 (B) c = 0 (C) d = 0 (D) e = 0

83. A point P lies on the line y = 2x in the first quadrant. Another point Q lies on the line y = 3x in the first quandrant. Suppose QP is perpendicular to the line y = 2x and QP = 5. The distance of P from the origin is :
(A) $7\sqrt{5}$ (B) 25 (C) 35 (D) 39

84. In a triangle ABC, if b + c = 3a , then the value of $\cot\frac{B}{2}\cot\frac{C}{2}$ is :
(A) 2 (B) 1/2 (C) 1/3 (D) 3

85. Let ABCD be a square. E and F be points on AC such that AE = EF = FC = AC/3. Then tan ($\angle$EBF) equals :
(A) 3/4 (B) $1/\sqrt{3}$ (C)1/2 (D) 1/3

86. An open box is constructed by netting squares of side length x from each the corners and of a square sheet of side length equal to 2007. Then the sides are folded up to form a box. The volume of the resulting box is maximum when x equals :
(A) 669 (B) 669/2 (C) 2007/2 (D) 2007/4

87. The coordinates $(x_0.y_0)$ of the point on the line y = x + 2 which is closed to the parabola $y^2 = 4x$ is :
(A) (0, 2) (B) (1/2, 5/2) (C) (5/2, 9/2) (D) (1, 3)

88. A polynomial $p(x) = x^4 + ax^3 + bx^2 + cx + d$ has roots $\sqrt{2}$, e and π and no other roots. Let $I = \int_{\sqrt{2}}^{e} p(x)dx$ and $J = \int_{e}^{\pi} p(x)dx$. Then :

(A) *I* and J must have opposite signs
(B) *I* and J can be both positive but not both negative
(C) I and J can be both negative but not both positive
(D) we do not have enough information to compare the signs of *I* and J.

89. Let z_1, z_2 and z_3 be three complex numbers on the unit circle |z| =1. Then $|z_1z_2 + z_2z_3 + z_3z_1|$ equals :

(A) $\left|z_1^2 + z_2^2 + z_3^2\right|$ (B) $\left|z_1 + z_2 + z_3\right|$

(C) $\frac{1}{2}\left(|z_1||z_2 + z_3| + |z_2||z_3 + z_1| + |z_3||z_1 + z_2|\right)$ (D) $\frac{1}{2}\left|z_1^2 + z_2^2 + z_3^2 + z_1z_2 + z_2z_3 + z_3z_1\right|$

90. All the inner angles of a - 7 gon are obtuse, their sizes in degree being distinct integers divisible by 9. What is the sum (in degree) of the largest two angles ?
(A) 300 (B) 315 (C) 330 (D) 335

PHYSICS

91. A cylinder of mass M and the radius R has a radially dependent density. The cylinder starts from rest and rolls without slipping down an inclined plane of height H. At the bottom of the plane its translational speed is $(8gH/7)^{1/2}$. The rotational inertia of the cylinder is -

(A) $\frac{1}{2}$ MR^2 (B) $\frac{3}{4}$MR^2 (C) $\frac{7}{8}$MR^2 (D) MR^2

92. If a 66 cm long air column closed at one resonates at a frequency 625 Hz, the number of other possible frequencies for resonance less than 1 kHz will be :
(A) 8 (B) 5 (C) 7 (D) 3

93. A copper pendulum of period T_0 on the ground is taken down a mine shaft to a depth d. If the thermal expansion co-efficient of copper is α (ºC^{-1}) and the temperature in the mine is θºC higher than on the ground, the period changes to T. where the ratio $\frac{T}{T_0}$ is given (in te first order by)

(A) $\left(1+\frac{1}{2}\alpha\theta\right)\left(1-\frac{d}{R}\right)$ (B) $(1 + \alpha\theta)\left(1-\frac{d}{R}\right)$

(C) $(1 + \alpha\theta)\left(1+\frac{d}{R}\right)$ (D) $\left(1+\frac{1}{2}\alpha\theta\right)\left(1+\frac{d}{2R}\right)$

(R is radius of the earth Ignore variation in density of the earth's crust)

94. A parallel monochromatic beam of yellow light ($\lambda = 6 \times 10^{7}$m) Next to be central bright maximum, the angle of the first minimum in the diffraction pattern (with respect to the initial direction of the beam) is approximately.

(A) 17º (B) 37º (C) 0º (D) 8.5º

95. In an oscillating LC circuit with negligible resistance, at a certain instant, energy is fully stored in the capacitor. The least time it takes for the energy to be equally shared between the capacitor and the inductor is -

(A) $\frac{\sqrt{LC}}{4}$ (B) $\frac{1}{\sqrt{LC}}$ (C) $\frac{\pi\sqrt{LC}}{2}$ (D) $\frac{\pi\sqrt{LC}}{4}$

96. A parallel plate capacitor has a plate separation d and plate area A. An u charged metal salb of thickness a is inserted midway between the plates. The capacitance of the device is

(A) infinite (B) zero (C) $\frac{\varepsilon_0 A}{d}$ (D) $\frac{\varepsilon_0 A}{d-a}$

97. The vertical motion of a huge piston in a machine is approximately simple harmonic with a frequency f. A block of mass m is placed on the piston. The maximum amplitude A_{max} of the piston's simple harmonic motion that is possible, for the block and the piston to remain together, is given by (υ_{max} : maximum speed)

(A) $\frac{g}{4\pi^2 f^2}$ (B) $\frac{mg}{f^2}$ (C) $\frac{g}{f^2}$ (D) $\frac{\upsilon^2_{max}}{g}$

98. In a certain region of space, electric field is along the positive z direction throughout. The field is, however, non-uniform ; its magnitude increases uniformly along the positive z-direction at the rate of $10^5 NC^{-1}m^1$. The force and torque experienced by a system having a total dipole moment of 10^{-7} C × m in the negative z-direction are -

(A) 10^{-2} N in the negative z-direction ; torque = 0

(B) 10^{-2} N in the positive z-direction torque = 0

(C) Force = 0 ; torque = 10^{-2} Nm so as to decreases potential energy.

(D) Force = 10^{-2} N in the negative Z-direction, torque = 10^{-2} Nm so as to decrease the potential energy

99. In one model of an atom, a positively charged point nucleus of charge Ze is surrounded by a uniform density of negative charge up to a radius R. The atom as a whole is neutral. In this model the electric field at a distance r from the nuelus is given by -

(A) $E(r) = \frac{Ze}{4\pi\varepsilon_0}\frac{r}{R^3}$ r < R

$= \frac{Ze}{4\pi\varepsilon_0 r^2}$ r > R

(B) $E(r) = \frac{Zer}{4\pi\varepsilon_0 R^3}$ r < R

= 0 r > R

(C) $E(r) = \frac{Ze}{4\pi\varepsilon_0}\left(\frac{1}{r^2} - \frac{r}{R^3}\right)$ r < R

= 0 r > R

(D) $E(r) = \frac{Ze}{4\pi\varepsilon_0 r^2}\left(1 - \frac{r}{R}\right)$, for all r

100. A particular ideal gas is supplied 10.61 J of heat at a constant pressure of 1.01×10^5 Pa. If the volume of the gas increases by 3×10^{-5} m^3 , the gas consists of

(A) monatomic molecules.

(B) diatomic molecules.

(C) polyatomic molecules.

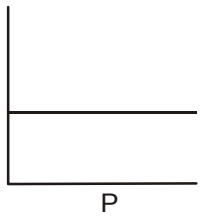
(D) a mixture of mono and diatomic molecules.

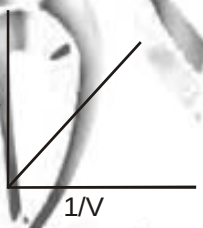
CHEMISTRY

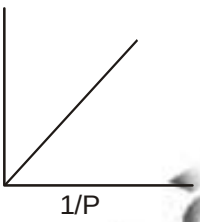
101. Optically pure 3-bromopent-1-ene upon addition of 1 mole of Br_2 produces a tribromo compound. The number of stereoisomers in the product is -

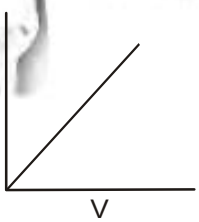
(A) 2 (B) 4 (C) 6 (D) 3

102. The plot that is not valid for an ideal gas where P is the pressure and V is the volume of the gas, is -

(A) 

(B) 

(C) 

(D) 

103. The volume of 0.1M acetic acid (pK_a = 4.76) that should be added to 10ml of 0.2M sodium acetate solution to prepare a buffer solution of pH 4.91 is -

(A) 14.2 ml (B) 4.0 ml (C) 20.0 ml (D) 70.0 ml

104. A hydrated salt of a bivalent metal when heated strongly produces a mixture of gases which when bubbled through $Ba(OH)_2$ solution produces a white solid. This solid on treatment with dilute HCl dissolves a part of the solid leaving another part insoluble which is filtered. The filtrate on treatment with Br_2 water slowly precipitates another white solid, which is not soluble in HCl. The gas mixtures are -

(A) CO_2 and CO (B) SO_3 and SO_2 (C) SO_3 and CO_2 (D) SO_2 and CO

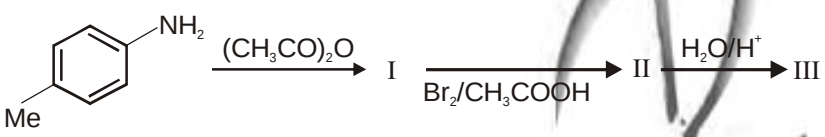
105. An electron is accelerated from rest through a potential (V) and then diffracted on a Ni crystal to measure its wavelength (λ). The wavelength is related to V as -

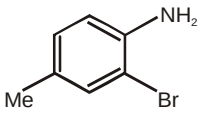
(A) $\lambda \alpha V$ (B) $\lambda \alpha 1/V$ (C) $\lambda \alpha V^{1/2}$ (D) $\lambda \alpha 1/V^{1/2}$

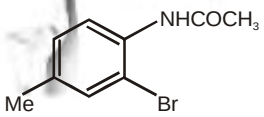
106. A dilute aqueous solution of a polymer of known molecular weight shows an elevation of boiling point of water by 0.052 K. The molar boiling point elevation constant of water is 0.52 K kg mol^{-1}. Using these data-
(A) it is possible to calculate the relative lowering of vapour pressure of water and the magnitude of freezing point depression, but not the osmotic pressure at 300 K.
(B) it is possible to calculate the relative lowering of vapour pressure of water, but neither the magnitude of freezing point depression nor the osmotic pressure at 300K.
(C) it is possible to calculate the relative lowering of vapour pressure but neither the magnitude of freezing point depression nor the osomotic pressure at 300 K.
(D) it is possible to calculate the relative lowering of vapour pressure and the osmotic pressure at 300K but not the magnitude of freezing point depression.

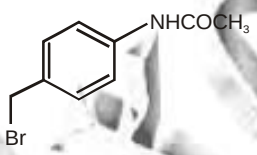
107. An organic compound fused with metallic sodium dissolves in water and the solution is divided into two parts. One part is treated with $FeSO_4$, boiled and filtered. In the filtrate addition of $FeCl_3$ does not produce any precipitate. To the other part, addition of sodium nitro prusside produces violet color. The organic compound contains.
(A) only nitrogen (B) both bromine and nitrogen
(C) only sulphur (D) both sulphur and nitrogen

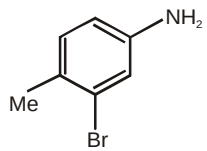
108. The main product III obtained in the following reaction sequence is -



(A) 

(B) 

(C) 

(D) 

109. A water droplet spreads on a clean gold surface. The droplet, however, does not spread onto a gold surface which is pre-treated with a dilute solution of hexanethiol [$CH_3 – (CH_2)_5$-SH] and washed with excess water. This is because -
(A) chemisorption of hexanethiol on gold surface renders it hydrophilic
(B) chemisorption of hexanethiol onto gold surface renders it hydrophobic
(C) physisorption of hexanethiol onto gold surface renders it hydrophobic
(D) physisorption of hexanethiol onto gold surface renders it hydrophilic.

110. Ir (CO)Cl (PPh_3) when reacts with O_2, the oxidation state and coordination number of Iridium, respectively, become.
(A) +1 and 5 (B) + 2 and 5' (C) + 4 and 6 (D) + 3and 6

BIOLOGY

111. If our body fluid were alcohol instead of water, which of the following would happen to our body temperature if everthing else in the body remains the same -
(A) Temperature control would be maintained as well as it happens now
(B) We will maintain a constant temperature of 37ºC
(C) Fluctutations of body temperature will be more since alcohol has a lower specific heat capacity
(D) We will feel feverish all the time

112. A gene has two alleles 'A' and 'a' with a frequency of p and q respectively the genotypic frequencies would have the proportion :
(A) $(p + q)^2 = 1$ (B) $p^2 – q^2 – 1$ (C) $pq = 1/2$ (D) $(p – q)^2 = 1$

113. At low concentrations sodium ions are good for the heart, but excess of the same results in hypertension or high blood pressure. This is because.
(A) The balance between Na and K ions is destroyed
(B) Blood becomes thicker with excess of Na^+ ions
(C) Na^+ ions narrow down the artery
(D) Water retention in kidneys increases with excess Na ions and heart requires to pump more

114. When Edward Jenner inoculated Joseph with the cow pox pustules from a milkmaid, the small boy did not get small pox because -
(A) Pustules contained lgG against small pox which gave passive immunity to Joseph
(B) Pustules contained IFNγ which killed the small pox virus
(C) Pustules contained cow pox virus which gave protection against small pox
(D) Pustules contained immune cell which gave protection against small pox

115. 'Camoulflage and Mimicry are adaptations in animals. Which of the following statement is NOT correct ?
(A) Camouflaging represents the ability of the animal to blend with surrounding.
(B) Mimicry means one specie imitates or resembles another species to gain some benefit.
(C) Mimicry helps to escape from predators
(D) Camouflaging is only meant for desert animals.

116. Heparin secreted by the mast cells present in the inner walls of the blood vessels is known to inhibit blood coagulation. Which of the following statement is NOT correct ?
(A) It help neutralizing the action of thrombin
(B) It prevents conversion of prothrombin to thrombin
(C) It prevents conversion of fibronogen to fibrin
(D) It was originally isolated from liver cells

117. During winter, frost often kills plants because.
(A) It leads to crystallization of cellular water
(B) Low temperature decreases the rates of catabolic pathways to an extent that the energy produced is inadequate to sustain life
(C) Low temperatures decreases the rate of anabolism to an extent that the rate of ATP production is far lower than the rate of ATP consumed
(D) The water in soil is frozen and the roots are unable to transport it to various parts of the plant

118. If the two genes 'A' and 'B' on a chromosome are located next to each other -
(A) Chances of crossing over between them are very low
(B) Chances of crossing over between them are very high
(C) The two genes serve as single unit when it comes to accumulation of mutations within them
(D) Then of the two genes one has to be nonfunctional gene for the crossover to occur in between the two

119. Contractile vacuoles in amoeba
(A) Accumulate water and burst upon fusion with the cell membrane releasing water from the cell
(B) Are organelles that accumulate nutrients
(C) Are responsible for locomotion of amoeba
(D) Provide a surface for attachment of ribosomes

120. During the course of intensive exercise, muscle fatigue occurs because.
(A) During exercise entire deposit of glucose is converted to CO_2 and H_2O
(B) O_2 deficiency results in accumulation of lactic acid in the muscles
(C) O_2 deficiency results in accumulation of citric acid in the muscles
(D) Excessive utilization of glucose result excessive production of acetyl Co A which is not fully utilized by the TCA cycle (Krebs cycle).