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Name.: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Date : 11/10/2015

Test No.: 0 9

Subject Code.: 1 1 1

Time : 3 Hrs. **M.M. : 360**

HORIZON TEST SERIES

for

Engineering Entrance Exam.

2016

[Test No. 9]

INSTRUCTIONS FOR STUDENTS

1. Read each question carefully.
2. It is mandatory to use Blue/Black Ball Point Pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should complete fill the circle.
4. Rough work must be done on the Question Paper, no additional sheet will be provided for this purpose.
5. Do not use white-fluid or any other rubbing material on answer sheet. No change in the answer once marked.
6. Student cannot use log tables and calculators or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Each correct answer carries four marks. One mark will be deducted for each incorrect answer from the total score.
9. Before handing over the answer sheet to the invigilator, candidate should check the particulars have been filled and marked correctly.
10. Immediately after the prescribed examination time is over, the answer sheet to be returned to the invigilator.
11. Use of Calculator and other Electronic device is not permitted.

Test No. 9

Topics of The Test

Physics	Work, Energy and Power.
Chemistry	Solutions.
Maths	Matrix and Determinants.

[PHYSICS]

1. An athlete in the Olympic games covers a distance of 100 m in 10s. His kinetic energy can be estimated to be in the range

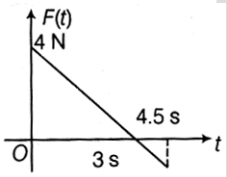
   (A) 200J – 500 J

   (B) 2×10^5J – 3×10^5 J

   (C) 20000 J – 50000 J

   (D) 2000 J – 5000 J

2. A block of mass 2 kg is free to move along the x-axis. It is at rest and from t = 0 onwards it is subjected to a time-dependent force F(t) in the x-direction. The force F(t) varies with t as shown in the figure. The kinetic energy of the block after 4.5 s is



   (A) 4.50 J (B) 7.50 J

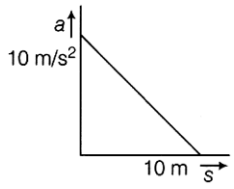
   (C) 5.06 J (D) 14.06 J

3. A juggler keeps four balls in air. He throws each ball vertically upwards with the same speed at equal interval of time. The maximum height attained by each ball is 20 m. Find kinetic energy of first ball when fourth ball is in hand. Assume that the mass of each ball is 10 g.

   (A) 0.5 J (B) 1 J

   (C) 1.5 J (D) 2.5 J

4. A block of mass 1 kg starts from rest on a straight road whose acceleration versus displacement graph is shown in the figure. Find the increase in kinetic energy if speed increases as it travels a distance 10m.



   (A) 30 J (B) 20 J

   (C) 40 J (D) 50 J

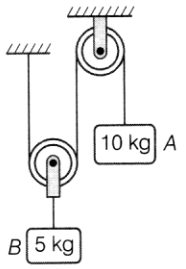
5. A force $\boldsymbol{F} = (5\hat{i} + 3\hat{j} + 2\hat{k})$ N is applied on a particle which displaces from its origin to the point $r = (2\hat{i} - \hat{j})m$. The work done on the particle in joule is

   (A) –7 (B) +7

   (C) +10 (D) +13

6. Consider the situation shown in the figure. The system is released from rest and the block A travels a distance 5 m in downward direction. Find the total work done by the tension on the system (block A + block B)

   (take, g = 10 m/s^2)

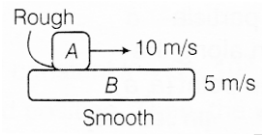
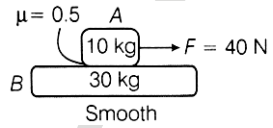


   (A) Zero (B) 116.67 J

   (C) 375 J (D) –375 J

Space for Rough Work

7. Match the Column-I and Column-II and select the correct option from the codes given below :

	Column-I		Column-II
(i)	In the uniform circular motion, work done by the net force is	(p)	zero
(ii)	 The work done by friction on block B is	(q)	non-zero positive
(iii)	 The work done by friction on the system (block A + block B) is	(r)	non-zero negative
(iv)	In non-uniform circular motion, work done by net force is	(s)	either non-zero positive or non-zero negative

Codes

	i	ii	iii	iv
(A)	p	q	p	s
(B)	p	q	r	s
(C)	q	p	s	r
(D)	p	r	q	s

8. When a rubber band is stretched by a distance x, it exerts a restoring force of magnitude $F = ax + bx^2$, where a and b are constants. The work done in stretching the unstretched rubber band by L is

(A) $aL^2 + bL^3$ (B) $\frac{1}{2}(aL^2 + bL^3)$

(C) $\frac{aL^2}{2} + \frac{bL^3}{3}$ (D) $\frac{1}{2}\left(\frac{aL^2}{2} + \frac{bL^3}{3}\right)$

9. A force $\left(\boldsymbol{F} = \frac{-ky}{\sqrt{x^2+y^2}}\hat{i} + \frac{kx}{\sqrt{x^2+y^2}}\hat{j}\right)N$ is applied on a block, whose position is P(x, y). The block moves on a circular path of radius R. Find the work done by the force **F** in a complete rotation.

(A) $2\pi Rk$ (B) πRk

(C) $4\pi Rk$ (D) Zero

10. The work done on a particle of mass m by a force

$$k\left[\frac{x}{(x^2+y^2)^{3/2}}\hat{i} + \frac{y}{(x^2+y^2)^{3/2}}\hat{j}\right]N$$

(k is a constant of appropriate dimensions), when the particle is taken from the point (a, 0) to the point (0, a) along a circular path of radius a about the origin in the XY-plane is

(A) $\frac{2k\pi}{a}$ (B) $\frac{k\pi}{a}$

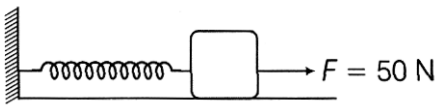
(C) $\frac{k\pi}{2a}$ (D) zero

11. A spring of constant $k = 5 \times 10^3$ N/m is stretched initially by 5 cm from the unstretched position. Then, the work required to stretch it further by another 5 cm is

(A) 12.50 N-m (B) 18.75 N-m

(C) 25.00 N-m (D) 6.25 N-m

12. A block of mass 1 kg is connected with a fixed wall through a light spring of constant k = 100 N/m. The surfaces are frictionless. Initially, spring is in relaxed position. A horizontal force F of 50 N is applied on the block. Find the maximum elongation of the spring.



(A) 1 m (B) 0.5 m

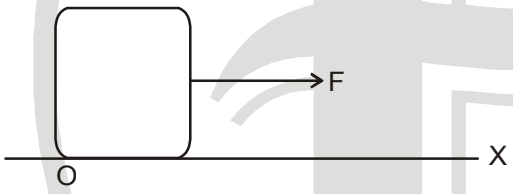
(C) 0.25 m (D) 0.1 m

Space for Rough Work

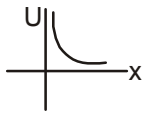
13. A 2 kg block slides on a horizontal floor with a speed of 4 m/s. It strikes a uncompressed spring and compresses it till the block becomes motionless. The kinetic friction force is 15 N and spring constant is 10000 N/m. The spring compresses by
(A) 5.5 cm (B) 2.5 cm
(C) 11.0 cm (D) 8.5 cm

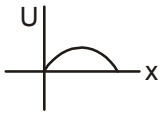
14. A particle having mass m is released from rest from origin in gravity free space. A force $\boldsymbol{F} = F_0\hat{k} + \boldsymbol{v} \times b\hat{j}$, where b is positive constant and *v* is instantaneous velocity of the particle, starts to act on the particle at t = 0. Find speed of the particle as a function of Z-coordinate.
(A) $\sqrt{\frac{F_0 z}{m}}$ (B) $\sqrt{\frac{2F_0 z}{m}}$
(C) $\sqrt{\frac{2bz}{m}}$ (D) $\sqrt{\frac{F_0 z}{mb}}$

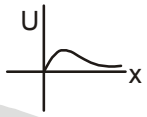
15. A block of mass m is initially at x = 0 is pulled along X-axis by applying the force F = b – cx, where b and c are positive constants.

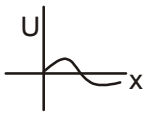


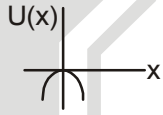
The maximum speed of the block during motion of the block is
(A) $\frac{b}{\sqrt{mc}}$ (B) $\frac{2b}{\sqrt{mc}}$
(C) $\frac{3b}{\sqrt{mc}}$ (D) $\frac{4b}{\sqrt{mc}}$

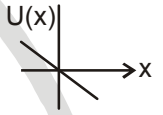
16. A particle which is constrained to move along the x-axis is subjected to a force in the same direction, which varies with the distance x of the particle from the origin as $F = \frac{b}{x^2}$, where b is positive constant. For $x \geq 0$, the functional form of the potential energy U(x) of the particle is
(A) 

(B) 

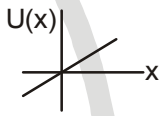
(C) 

(D) 

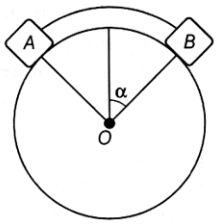
17. A particle is placed at the origin and a force F = kx is acting on it, (where, k is a positive constant). If U(0) = 0, the graph of U(x) versus x will be (where, U is the potential energy of function).
(A) 

(B) 

(C) 

(D) 

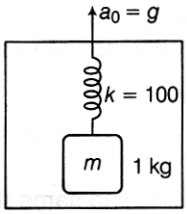
18. Two small blocks A of mass $\sqrt{3}\,kg$ and B of mass 1 kg are connected by a light string are placed on a smooth fixed sphere such that the system is in equilibrium for $< AOB = \frac{\pi}{2}$. Then,



(A) the value of $\alpha = \frac{\pi}{3}$ and equilibrium is stable
(B) the value of $\alpha = \frac{\pi}{3}$ and equilibrium is unstable
(C) the value of $\alpha = \frac{\pi}{6}$ and equilibrium is stable
(D) the value of $\alpha = \frac{\pi}{6}$ and equilibrium is unstable

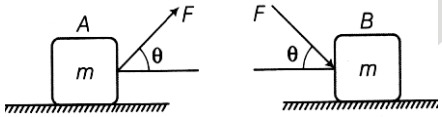
Space for Rough Work

19. The elastic energy stored in the spring in the equilibrium position of block is



(A) zero (B) 0.5 J
(C) –0.5 J (D) 2 J

20. Two blocks are displaced through same distance along rough horizontal surface by applying the forces as shown in the given figure.



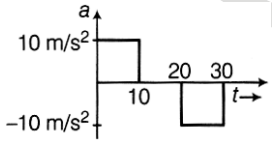
(A) Block A takes more time than block B
(B) The net work done on both blocks are same
(C) The work done by applied force F on block A is more than that of on block B
(D) The average power supplied by the force F on the block A is more than that of block B

21. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2 r t^2$, where k is a constant. The power delivered to the particle by the force acting on it is

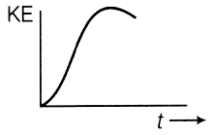
(A) $2\pi mk^2r^2$ (B) mk^2r^2t
(C) $\frac{(mk^4r^2t^5)}{3}$ (D) zero

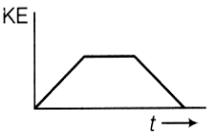
22. A block of mass *m* starts from rest with an acceleration.

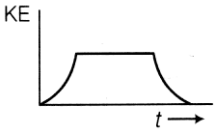
The acceleration-time graph of the block is shown in the figure below

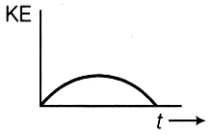


The kinetic energy versus time graph is

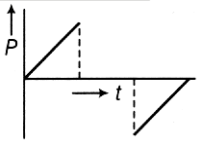
(A) 

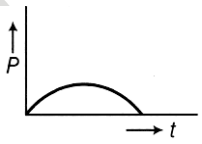
(B) 

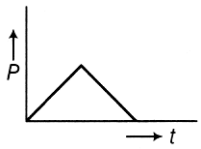
(C) 

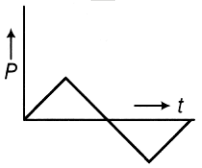
(D) 

23. The power versus time graph for the given graph in question 22. is

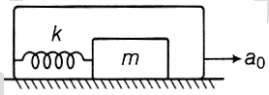
(A) 

(B) 

(C) 

(D) 

24. A block of mass m is connected with the wall of a toy car through a light spring of constant k. The toy car is moving with constant acceleration a_0 (neglect friction). The block is stationary with respect to car. Now, car is abruptly stopped. Then, maximum velocity of the block after stopping the car is



(A) zero (B) $\sqrt{\frac{k}{m}}a_0$
(C) $\sqrt{\frac{m}{k}}a_0$ (D) $\sqrt{\frac{m}{2k}}a_0$

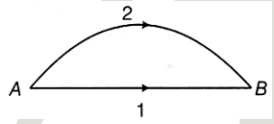
Space for Rough Work

25. A uniform chain of length 2 m is kept on a table, such that a length of 60 cm hangs freely from the edge of the table. The total mass of chain is 4 kg. What is the work done is pulling the entire chain on the table ?

(A) 7.2 J (B) 3.6 J

(C) 120 J (D) 1200 J

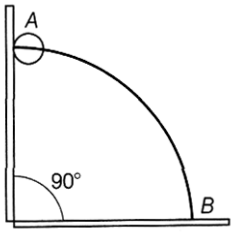
26. For the situation shown in the given figure one direct path 1 and other curve path 2. Along direct path only a conservative force F_1 acts on the particle. Along curve path, both F_1 and kinetic friction acts on the particle. The change in mechanical energy along direct path is 20 J and that of on curve path is 16 J. The work done by kinetic friction is



(A) – 16 J (B) – 4 J

(C) – 36 J (D) No sufficient information

27. A wire, which passes through the hole in a small bead, is bent in the form of quarter of a circle. The wire is fixed vertically on ground as shown in the figure. The bead is released from near to top of the wire and it slides along the wire without friction. As, the bead moves from A to B, the force it applies on the wire is



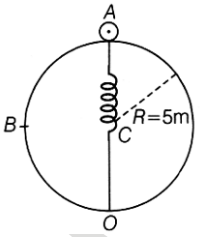
(A) always radially outwards

(B) always radially inwards

(C) radially outwards initially and radially inwards later

(D) radially inwards initially and radially outwards later

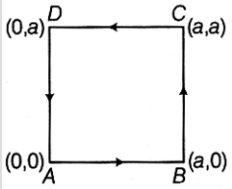
28. A light spring of constant k = (2 + $\sqrt{2}$) N/m and natural length $\sqrt{2}R$ is fixed at a point O. A sleeve of mass m = 1 kg is attached to other end of spring. The sleeve starts from rest from point A and moves along a vertical fixed smooth circular wire of radius R = 5 m. Find the normal reaction on sleeve at the point B.



(A) 10 N (B) 20 N

(C) 30 N (D) 40 N

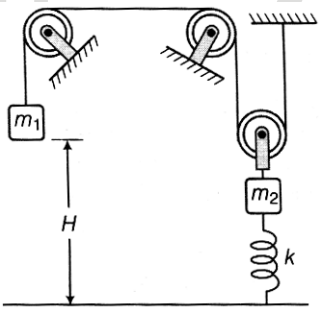
29. The work done by the force $\boldsymbol{F} = bx\hat{i} + by\hat{j}$ around the path shown in the given figure, is



(A) zero (B) $\frac{2}{3}a^3b$

(C) a^3b (D) $\frac{4}{3}a^3$

30. In the situation shown in the figure, $m_1 = m_2 = 10$ kg, H = 0.04 m and spring constant is k = 200 N/m. The system is initially in equilibrium, what work perform to bring m_1 on floor slowly.



(A) 0.1 J (B) 0.2 J

(C) 0.3 J (D) 0.4 J

Space for Rough Work

[CHEMISTRY]

31. Two elements A and B form compounds AB_2 and AB_4 (both are non-volatile and non-electrolyte) when dissolved in 20.0 g benzene, 1 g of AB_2 lowers the freezing point of benzene by 2.3 K, whereas 1.0 g of AB_4 lowers it by 1.3 K [K_f(benzene) = 5.5 K mol^{-1} kg]. Thus, atomic masses of A and B respectively, are
(A) 120, 212 (B) 96, 28
(C) 212, 120 (D) 28, 46

32. Vapour pressure of pure water at 298 K is 23.8 mm. Thus, vapour pressure of 20% glucose solution (weight/volume of solution) is (density of solution is 0.9971 g/cc)
(A) 23.332 mm (B) 23.169 mm
(C) 23.334 mm (D) 23.217 mm

33. Mass of methyl alcohol (CH_3OH) which when dissolved in 100 g of water would just prevent formation of ice at –9.3°C is [$K_f(H_2O)$ = 1.860° mol^{-1} kg]
(A) 20.0 g (B) 17.20 g
(C) 9.3 g (D) 16.00 g

34. At 27°C, an aqueous solution of a carbohydrate containing 18 g per 100 mL of the solution is found to be isotonic with aqueous solution containing 2.925 g NaCl per 100 mL of the solution. Thus, molar mass of the carbohydrate is (assume NaCl is completely ionised)
(A) 360.0 g mol^{-1} (B) 180.0 g mol^{-1}
(C) 90.0 g mol^{-1} (D) 58.5 g mol^{-1}

35. The partial molar volumes of propanone (CH_3COCH_3) and butanone ($CH_3COCH_2CH_3$) in a mixture in which mole fraction of propanone is 0.4 are 75 cm^3 mol^{-1} and 80 cm^3 mol^{-1}. Thus, the total volume of solution of total mass 1 kg is
(A) 1175 cm^3 (B) 1000 cm^3
(C) 972 cm^3 (D) 1200 cm^3

36. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mole of sodium sulphate is dissolved in 1 kg of water is [$K_f(H_2O)$ = 1.86° mol^{-1} kg]
(A) 0.0372° (B) 0.0558°
(C) 0.0744° (D) 0.0186°

37. 122 g of benzoic acid is dissolved in 1000 g of benzene at 10°C at which vapour pressure of benzene is 66.6 cm of Hg. If benzoic acid is completely dimerised in benzene, then vapour pressure of the solution of the benzoic acid in benzene is
(A) 66.20 cm of Hg (B) 66.00 cm of Hg
(C) 64.10 cm of Hg (D) 65.92 cm of Hg

38. A beaker containing 0.010 mol of $C_{12}H_{22}O_{11}$ in 100 g H_2O and a beaker containing 0.020 mol of $C_{12}H_{22}O_{11}$ in 100 g H_2O are placed in a chamber and allowed to equilibrate. Thus, mole fraction of $C_{12}H_{22}O_{11}$ in both solutions is
(A) 0.00269, 0.00269
(B) 0.00269, 0.00172
(C) 0.00172, 0.00269
(D) 0.00172, 0.00172

39. Henry's law constant for CO_2 in water is 1.67×10^8 Pa at 298 K. CO_2 gas is packed in 500 mL H_2O at 298 K under a pressure of 2.5 atm. Thus, quantity of CO_2 in 500 mL H_2O is
(A) 0.00152 mol (B) 0.171 mol
(C) 0.012 mol (D) 0.042 mol

40. Consider the separate solutions of
0.500 M C_2H_5OH (aq)
0.100 M $Mg_3(PO_4)_2$(aq)
0.250 M KBr(aq)
0.125 M Na_3PO_4(aq)
each at 25°C.
Which statement is true about these solutions assuming all salts to be strong electrolytes?
(A) They all have same osmotic pressure
(B) 0.100 M $Mg_3(PO_4)_2$ (aq) has the highest osmotic pressure
(C) 0.125 M Na_3PO_4 (aq) has the highest osmotic pressure
(D) 0.500 M C_2H_5OH(aq) has the highest osmotic pressure

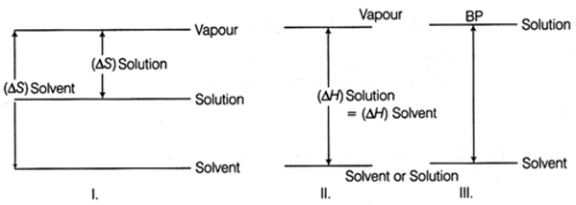
Space for Rough Work

41. Mole fraction of non-electrolyte (A) in aqueous solution is 0.07. One molal urea solution freezes at –1.86°. Thus depression in freezing point of the non-electrolyte A is

(A) 0.26° (B) 1.86°

(C) 0.13° (D) 7.78°

42. Which represents correct difference ?



(A) I, II, III (B) I, III

(C) II, III (D) I, II

43. 60 g of urea is dissolved in 1100 g of solution in water. To keep $\Delta T_f / K_f$ as 1 mol kg^{-1}, water separated in the form of ice is

(A) 40 g (B) 60 g

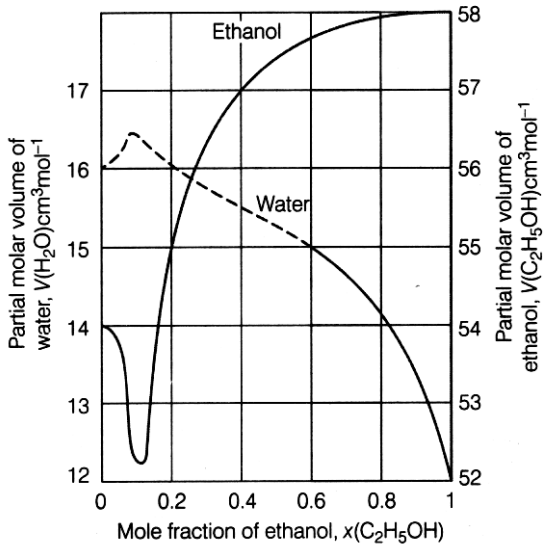
(C) 100 g (D) 200 g

44. Two moles of the complex $[(Cu(NH_3)_3Cl]Cl$ are dissolved in 3 moles of H_2O. Relative decrease in vapour pressure was found to be 0.50. If this solution is treated with aq. $AgNO_3$ solution, then there is formation of

(A) 1.0 mole AgCl (B) 0.25 mole AgCl

(C) 0.40 mole AgCl (D) 2.0 mole AgCl

45. Total volume of a mixture of 46 g ethanol (C_2H_5OH) and 72 g water (H_2O) based on the given figure is



(A) 69.0 cm^3 (B) 22.2 cm^3

(C) 111.0 cm^3 (D) 234.0 cm^3

46. Water is purified by ion-exchange resin (RH_2) in which Ca^{2+} in hard water is replaced by H^+

$$RH_2 + Ca^{2+} \longrightarrow RCa + 2H^+$$

Water coming out of ion-exchange has pH2. Hence, hardness in ppm of Ca^{2+} ion is

(A) 50 (B) 100

(C) 125 (D) 200

47. A sample of drinking water is contaminated with $CHCl_3$ to the level of 15 ppm by mass. Thus mass percentage and molality, respectively are

	Mass%	Molality
(A)	15×10^{-4}	1.255×10^{-4}
(B)	15×10^{-2}	1.502×10^{-4}
(C)	15×10^{-6}	1.255×10^{-5}
(D)	15×10^{-3}	1.255×10^{-6}

Space for Rough Work

48. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1.0 M $AgNO_3$ solution when titrated using K_2CrO_4 as an indicator. Thus, depression in freezing point of KCl solution with 100% ionisation will be
[$K_f(H_2O)$ = 2.0° mol^{-1} kg, molarity = molality]
(A) 5.0° (B) 3.2°
(C) 1.6° (D) 0.8°

49. A 0.001 molal solution of $[Pt(NH_3)_4Cl_4]$ in water had a depression in freezing point of 0.0054°. $K_f(H_2O)$ = 1.86° mol^{-1} kg (assume 100% ionisation). Thus, complex is
(A) $[Pt(NH_3)_3Cl_3]Cl{\cdot}NH_3$
(B) $[Pt(NH_3)_4Cl_3]Cl$
(C) $[Pt(NH_3)_4Cl_2]Cl_2$
(D) $[Pt(NH_3)_4Cl_4]$

50. The complete combustion of 2.40 g of a compound of carbon, hydrogen and oxygen yielded 5.46 g of CO_2 and 2.23 g of H_2O. When 8.69 g of the compound was dissolved in 281g of water, the freezing point depression was found to be 0.97°C. Thus, molecular formula of the organic compound is [$K_f(H_2O)$ = 1.86° mol^{-1} kg]
(A) $C_2H_4O_2$ (B) C_2H_6O
(C) $C_6H_{12}O_6$ (D) C_3H_6O

51. Consider the separate solution of 0.500 M C_2H_5OH (aq), 0.100 M $Mg_3(PO_4)_2$(aq), 0.250 M KBr(aq) and 0.125 M Na_3PO_4(aq) at 25°C. Which statement is true about these solutions, assuming all salts to be strong electrolytes ?
(A) They all have same osmotic pressure
(B) 0.100 M $Mg_3(PO_4)_2$ (aq) has the highest osmotic pressure
(C) 0.125 M Na_3PO_4 (aq) has the highest osmotic pressure
(D) 0.5000 M C_2H_5OH (aq) has the highest osmotic pressure

52. K_f for water is 1.86 K kg mol^{-1}. If your automobile radiator holds 1.0 kg of water, then how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to –2.8°C ?
(A) 72 g (B) 93 g
(C) 39 g (D) 27 g

53. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at –6°C will be (K_f for water = 1.86 K kg mol^{-1} and molar mass of ethylene glycol = 62 g mol^{-1})
(A) 804.32 g (B) 204.30 g
(C) 400.00 g (D) 304.60 g

54. The degree of dissociation (α) of weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression
(A) $\alpha = \frac{i-1}{(x+y-1)}$ (B) $\alpha = \frac{i-1}{x+y+1}$
(C) $\alpha = \frac{x+y-1}{i-1}$ (D) $\alpha = \frac{x+y+1}{i-1}$

55. On mixing, heptane and octane form an ideal solution. at 373 K, the vapour pressure of the two liquid components (heptane and octane) are 105 kPa and 45 kPa respectively. Vapour pressure of the solution obtained by mixing 25 g of heptane and 35 g of octane will be (molar mass of heptane = 100 g mol^{-1} and of octane = 114 g mol^{-1})
(A) 72.0 kPa (B) 75.0 kPa
(C) 52.5 kPa (D) 45.0 kPa

56. A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements is correct regarding the behavior of the solution ?
(A) The solution formed is an ideal solution
(B) The solution is non-ideal showing positive deviation from Raoult's law
(C) The solution is non-ideal, showing negative deviation from Raoult's law
(D) n-heptane shows positive deviation while ethanol show negative deviation from Raoult's law

Space for Rough Work

57. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6 , its vapour pressure (in mm) at the same temperature will be

(A) 350 (B) 300

(C) 700 (D) 360

58. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H_3PO_3), the volume of 0.1 M aqueous KOH solution required is

(A) 10 mL (B) 20 mL

(C) 40 mL (D) 60 mL

59. If liquid A and B form an ideal solution, the

(A) enthalpy of mixing is zero

(B) entopy of mixing is zero

(C) free energy of mixing is zero

(D) free energy as well as the entropy of mixing are each zero

60. Which of the following concentration factor is affected by change in temperature?

(A) Molarity (B) Molality

(C) Mole fraction (D) Weight fraction

[MATHEMATICS]

61. The number of 3 × 3 non-singular matrices, with four entries as 1 and all other entries as 0, is

(A) less than 4 (B) 5

(C) 6 (D) at least 7

62. Let A be a 2 × 2 matrix with non-zero entries and let $A^2 = I$, where I is 2 × 2 identity matrix.
Define Tr(A) = sum of diagonal elements of A and |A| = determinant of matrix A.
Statement I : Tr (A) = 0
Statement II : |A| = 1.

(A) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I

(B) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I

(C) Statement I is true, Statement II is false

(D) Statement I is false, Statement II is true.

63. If X and Y are 2 × 2 matrices such that 2X + 3Y = O and X + 2Y = I, where O and I denote the 2 × 2 zero matrix and the 2 × 2 identity matrix, then X is equal to

(A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$ (D) $\begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$

64. If $f(x) = x^2 - 5x$, $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, then *f*(A) is equal to

(A) $\begin{bmatrix} -7 & 0 \\ 0 & -7 \end{bmatrix}$ (B) $\begin{bmatrix} 0 & -7 \\ -7 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 7 \\ 7 & 0 \end{bmatrix}$

65. If A and B are square matrices of size n × n such that $A^2 - B^2 = (A - B)(A + B)$, then which of the following will be always true ?

(A) AB = BA

(B) either of A or B is a zero matrix

(C) either of A or B is an identity matrix

(D) A = B

66. Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ *and* $B = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$, $a, b \in N$. Then

(A) there exist more than one but finite number of B's such that AB = BA

(B) there exists exactly one B such that AB = BA

(C) there exists infinitely many B's such that AB=BA

(D) there cannot exist any B such that AB = BA

Space for Rough Work

67. If A is a non-singular matrix such that $A^3 = A + I$, then the inverse of $B = A^6 - A^5$ is

(A) A (B) A^{-1}

(C) $-A$ (D) $-A^{-1}$

68. If $A = \begin{bmatrix} ab & b^2 \\ -a^2 & -ab \end{bmatrix}$, then A is equal to

(A) idempotent (B) involutary

(C) nilpotent (D) scalar

69. If $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$, I is the unit matrix of order 2 and a, b are arbitrary constants, then $(aI + bA)^2$ is equal to

(A) $a^2I - abA$ (B) $a^2I + 2abA$

(C) $a^2I + b^2A$ (D) None of the above

70. If A and B are two matrices such that both A + B and AB are defined, then

(A) A and B are of same order

(B) A is of order m × m and B is of order n × n

(C) both A and B are of same order n × n

(D) A is of order m × n and B is of order n × m

71. Let a, b, c be such that $(b + c) \neq 0$ and

$$\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix} + \begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^n c \end{vmatrix} = 0.$$

Then the value of n is

(A) zero

(B) any even integer

(C) any odd integer

(D) any integer

72. If $\begin{vmatrix} a+b & b+c & c+a \\ b+c & c+a & a+b \\ c+a & a+b & b+c \end{vmatrix} = k \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$, then k is equal to

(A) 4 (B) 3

(C) 2 (D) 1

73. The value of $\begin{vmatrix} \log_5 729 & \log_3 5 \\ \log_5 27 & \log_9 25 \end{vmatrix} \begin{vmatrix} \log_3 5 & \log_{27} 5 \\ \log_5 9 & \log_5 9 \end{vmatrix}$ is equal to

(A) 1 (B) 6

(C) $\log_5 9$ (D) $\log_3 5 \cdot \log_5 81$

74. The sum of the products of the elements of any row of a determinant A with the cofactors of the corresponding elements is equal to

(A) 1 (B) 0

(C) |A| (D) $\frac{1}{2}|A|$

75. If matrix $\begin{bmatrix} 0 & 1 & -2 \\ -1 & 0 & 3 \\ \lambda & -3 & 0 \end{bmatrix}$ is singular, then λ is equal to

(A) –2 (B) –1

(C) 1 (D) 2

76. If $D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$ for $x \neq 0$, $y \neq 0$, then D is

(A) divisible by neither x nor y

(B) divisible by both x and y

(C) divisible by x but not y

(D) divisible by y but not x

77. If $c = 2\cos\theta$, then the value of the determinant

$$\Delta = \begin{vmatrix} c & 1 & 0 \\ 1 & c & 1 \\ 6 & 1 & c \end{vmatrix}$$ is

(A) $\frac{\sin 4\theta}{\sin\theta}$

(B) $\frac{2\sin^2 2\theta}{\sin\theta}$

(C) $4\cos^2\theta(2\cos\theta - 1)$

(D) none of these

Space for Rough Work

78. The value of $\begin{vmatrix} x & p & q \\ p & x & q \\ p & q & x \end{vmatrix}$ is

(A) x (x – p) (x – q)
(B) (x – p) (x – q) (x + p + q)
(C) (p – q) (x – q) (x – p)
(D) pq (x – p) (x – q)

79. If $\begin{vmatrix} -12 & 0 & \lambda \\ 0 & 2 & -1 \\ 2 & 1 & 15 \end{vmatrix} = -360$, then the value of λ is

(A) –1 (B) –2
(C) –3 (D) 4

80. The value of $\begin{vmatrix} {}^{10}C_4 & {}^{10}C_5 & {}^{11}C_m \\ {}^{11}C_6 & {}^{11}C_7 & {}^{12}C_{m+2} \\ {}^{12}C_8 & {}^{12}C_9 & {}^{13}C_{m+4} \end{vmatrix} = 0$, when m is equal to

(A) 6 (B) 5
(C) 4 (D) 1

81. The value of $\begin{vmatrix} 441 & 442 & 443 \\ 445 & 446 & 447 \\ 449 & 450 & 451 \end{vmatrix}$ is

(A) 441 × 446 × 4510
(B) 0
(C) –1
(D) 1

82. $\begin{vmatrix} 1 & 2 & 3 \\ 1^3 & 2^3 & 3^3 \\ 1^5 & 2^5 & 3^5 \end{vmatrix}$ is equal to

(A) 1! 2! 3! (B) 1! 3! 5!
(C) 6! (D) 9!

83. If $a_1, a_2, ..., a_n, ...$, are in GP, then the determinant $\Delta = \begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix}$ is equal to

(A) 2 (B) 4
(C) 0 (D) 1

84. The value of the determinant $\begin{vmatrix} y+z & x & x \\ y & z+x & y \\ z & z & x+y \end{vmatrix}$ is equal to

(A) 6xyz (B) xyz
(C) 4xyz (D) xy + yz + zx

85. If $\begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = 0$, then x is equal to

(A) 0, 2a (B) a, 2a
(C) 0, 3a (D) none of these

86. If A is a non-singular matrix of order 3, then adj (adj A) is equal to

(A) A (B) A^{-1}
(C) $\frac{1}{|A|}A$ (D) |A| A

87. If A is a singular matrix, then A adj (A) is a

(A) scalar matrix
(B) zero matrix
(C) identity matrix
(D) orthogonal matrix

Space for Rough Work

88. The system of equations,

$x + y + z = 6$

$x + 2y + 3z = 10$

and $x + 2y + \lambda z = \mu$

has no solution, if

(A) $\lambda = 3, \mu = 10$ (B) $\lambda \neq 3, \mu = 10$

(C) $\lambda \neq 3, \mu \neq 10$ (D) $\lambda = 3, \mu \neq 10$

89. Let a, b, c be any real numbers. Suppose that there are real numbers x, y, z not all zero such that x = cy + bz, y = az + cx, and z = bx + ay have non-zero solution. Then, $a^2 + b^2 + c^2 + 2abc$ is equal to

(A) 1 (B) 2

(C) –1 (D) 0

90. If the system of linear equations x + 2ay + az = 0, x + 3by + bz = 0 and x + 4cy + cz = 0 has a non-zero solution, then a, b, c

(A) are in AP (B) are in GP

(C) are in HP (D) satisfy a + 2b + 3c = 0

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Space for Rough Work