Question Paper

General Section

Q1: A particle starts from the origin at t=0 with a velocity of 10.0 j m/s and moves in the x-y plane with a constant acceleration of (8.0 i + 2.0 j) m/s. At what time is the x-coordinate of the particle 16 m?

   A. 1 s

   B. 2 s

   C. 3 s

   D. 4 s

Q2: A block of mass 2 kg rests on a rough inclined plane making an angle of 30 degrees with the horizontal. The coefficient of static friction between the block and the plane is 0.7. The frictional force on the block is (g = 10 m/s):
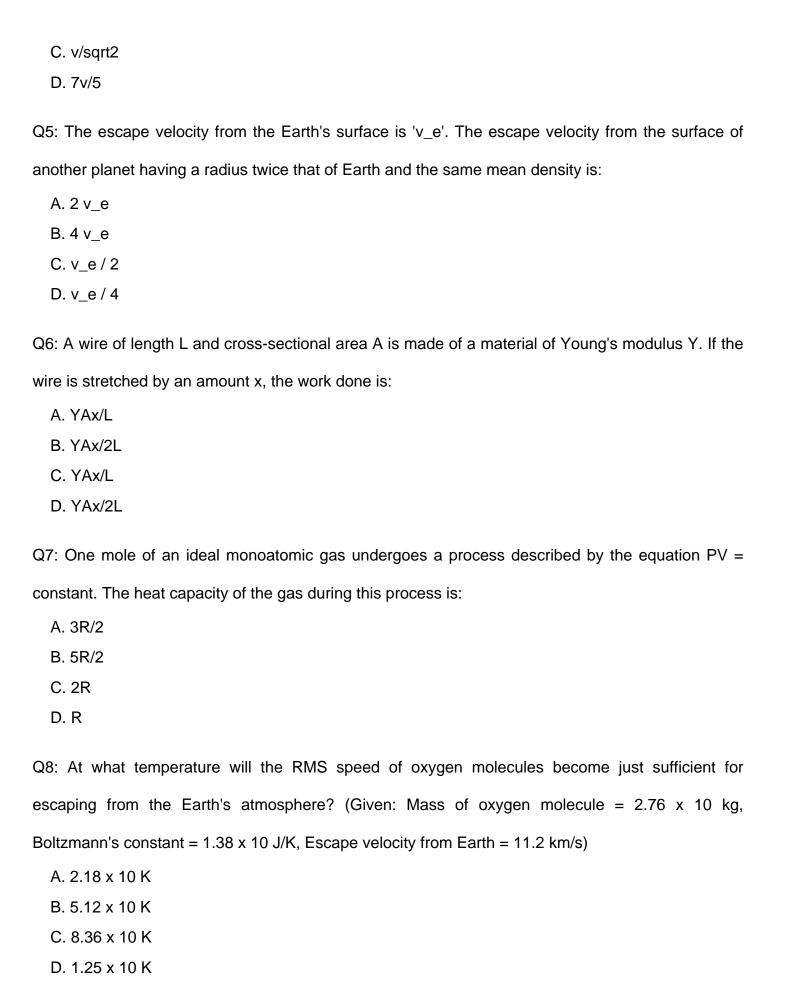
   A. 9.8 N

   B. 0.7 x 9.8 x sqrt3 N

   C. 9.8 x sqrt3 N

   D. 10 N

Q3: A body of mass 1 kg is thrown upwards with a velocity of 20 m/s. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? (g = 10 m/s)
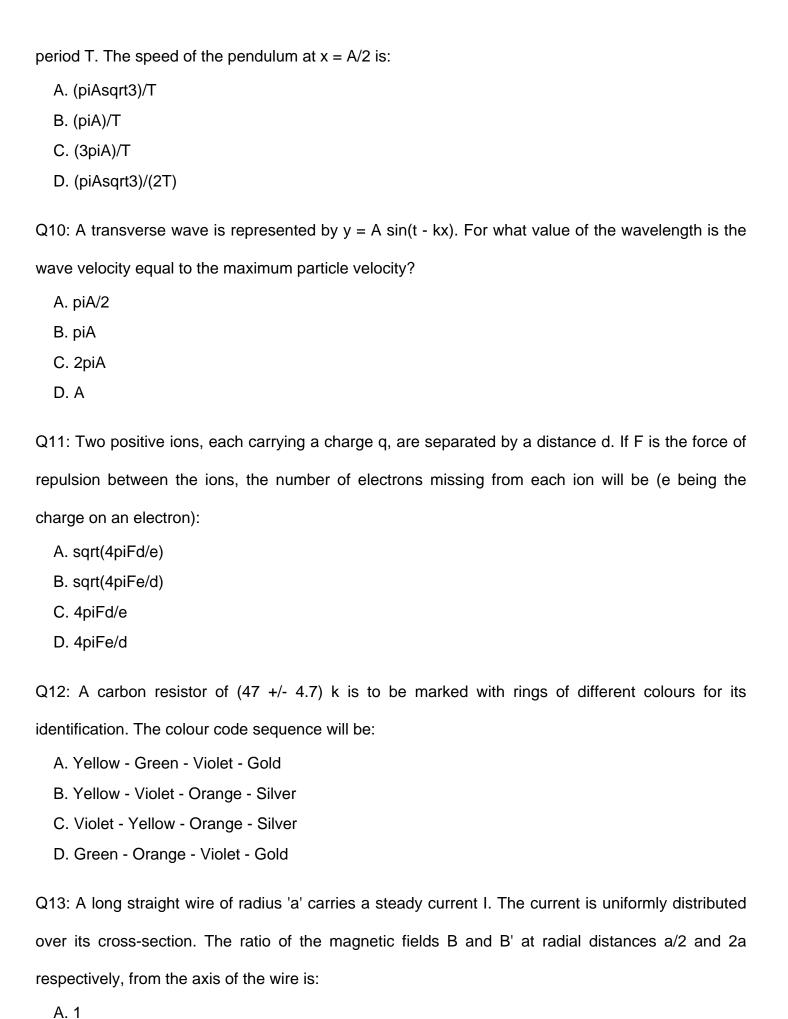
   A. 20 J

   B. 30 J

   C. 40 J

   D. 10 J

Q4: A solid sphere is rolling on a frictionless surface, without slipping, with a translational velocity v. It collides head-on with a stationary identical sphere. After the collision, the first sphere comes to rest. What is the velocity of the second sphere?

   A. v

   B. 2v

C. v/sqrt2

D. 7v/5

Q5: The escape velocity from the Earth's surface is 'v_e'. The escape velocity from the surface of another planet having a radius twice that of Earth and the same mean density is:

A. 2 v_e

B. 4 v_e

C. v_e / 2

D. v_e / 4

Q6: A wire of length L and cross-sectional area A is made of a material of Young's modulus Y. If the wire is stretched by an amount x, the work done is:

A. YAx/L

B. YAx/2L

C. YAx/L

D. YAx/2L

Q7: One mole of an ideal monoatomic gas undergoes a process described by the equation PV = constant. The heat capacity of the gas during this process is:

A. 3R/2

B. 5R/2

C. 2R

D. R

Q8: At what temperature will the RMS speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere? (Given: Mass of oxygen molecule = 2.76 x 10 kg, Boltzmann's constant = 1.38 x 10 J/K, Escape velocity from Earth = 11.2 km/s)

A. 2.18 x 10 K

B. 5.12 x 10 K

C. 8.36 x 10 K

D. 1.25 x 10 K

Q9: A simple pendulum performs simple harmonic motion about x = 0 with an amplitude A and time

period T. The speed of the pendulum at x = A/2 is:

   A. (piAsqrt3)/T

   B. (piA)/T

   C. (3piA)/T

   D. (piAsqrt3)/(2T)

Q10: A transverse wave is represented by y = A sin(t - kx). For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

   A. piA/2

   B. piA

   C. 2piA

   D. A

Q11: Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron):

   A. sqrt(4piFd/e)

   B. sqrt(4piFe/d)

   C. 4piFd/e

   D. 4piFe/d

Q12: A carbon resistor of (47 +/- 4.7) k is to be marked with rings of different colours for its identification. The colour code sequence will be:

   A. Yellow - Green - Violet - Gold

   B. Yellow - Violet - Orange - Silver

   C. Violet - Yellow - Orange - Silver

   D. Green - Orange - Violet - Gold

Q13: A long straight wire of radius 'a' carries a steady current I. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B' at radial distances a/2 and 2a respectively, from the axis of the wire is:

   A. 1

B. 4

C. 1/4

D. 1/2

Q14: The magnetic susceptibility of a material is -0.5. The material is:

   A. Paramagnetic

   B. Diamagnetic

   C. Ferromagnetic

   D. Antiferromagnetic

Q15: A circular coil of radius 10 cm, 500 turns and resistance 2 is placed with its plane perpendicular to the horizontal component of the Earth's magnetic field. It is rotated about its vertical diameter through 180 degrees in 0.25 s. Estimate the magnitude of the EMF induced. (Horizontal component of Earth's magnetic field at the place is 3.0 x 10 T)

   A. 1.9 x 10 V

   B. 3.8 x 10 V

   C. 5.2 x 10 V

   D. 2.5 x 10 V

Q16: In a series LCR circuit, the voltage across R is 100 V and R = 1 k, C = 2 F. The resonant frequency is 200 rad/s. At resonance, the voltage across L is:

   A. 2.5 x 10 V

   B. 25 V

   C. 250 V

   D. 40 V

Q17: The speed of electromagnetic waves in a medium of dielectric constant 2.25 and relative permeability 4 is:

   A. 1 x 10 m/s

   B. 2.5 x 10 m/s

   C. 3 x 10 m/s

   D. 1.5 x 10 m/s

Q18: A biconvex lens has a radius of curvature of magnitude 20 cm. Which one of the following options describe best the image formed of an object of height 2 cm placed 30 cm from the lens? (Refractive index of lens material = 1.5)

A. Real, inverted, height = 1 cm

B. Virtual, upright, height = 0.5 cm

C. Real, inverted, height = 4 cm

D. Virtual, upright, height = 1 cm

Q19: In a Young's double-slit experiment, the slit separation is 0.5 mm and the screen is 1.5 m away. It is observed that the 8th bright fringe is at a distance of 12.4 mm from the central bright fringe. The wavelength of light used is:

A. 517 nm

B. 620 nm

C. 413 nm

D. 589 nm

Q20: When the light of frequency 2 (where is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v. When the frequency of the incident radiation is increased to 5, the maximum velocity of electrons emitted from the same plate is v. The ratio of v to v is:

A. 1:2

B. 1:4

C. 4:1

D. 2:1

Q21: A ball is thrown vertically downwards with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s. The height of the tower is (in m). (g = 10 m/s)

Q22: A pump is required to lift 600 kg of water per minute from a well 25 m deep and to eject it with a speed of 50 m/s. The power required to perform the above task is (in kW). (g = 10 m/s)

Q23: A flywheel rotating at 420 rpm slows down at a constant rate of 2 rad/s. The time required to

stop the flywheel is (in seconds). (Take pi = 22/7)

Q24: A Carnot engine, having an efficiency of = 1/10 as a heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is (in J).

Q25: In a meter bridge, the balancing length from the left end (when standard resistance of 1 is in the right gap) is found to be 20 cm. The value of the unknown resistance (in) is:

Q26: A proton enters a magnetic field of 5 T with a velocity of 4 x 10 m/s at an angle of 30 degrees with the field. The force on the proton is x * 10 N. The value of x is:

Q27: An inductor of 20 mH, a capacitor of 50 F and a resistor of 40 are connected in series across a source of emf V = 10 sin(500t). The power loss in the AC circuit is (in W).

Q28: The refractive index of the material of a prism is sqrt2 and its refracting angle is 60 degrees. The angle of minimum deviation of the prism is (in degrees).

Q29: The ratio of the wavelengths of the last line of the Balmer series and the last line of the Lyman series is:

Q30: The current gain (beta) of a transistor is 100. If the base current changes by 20 A, the change in collector current is (in mA).

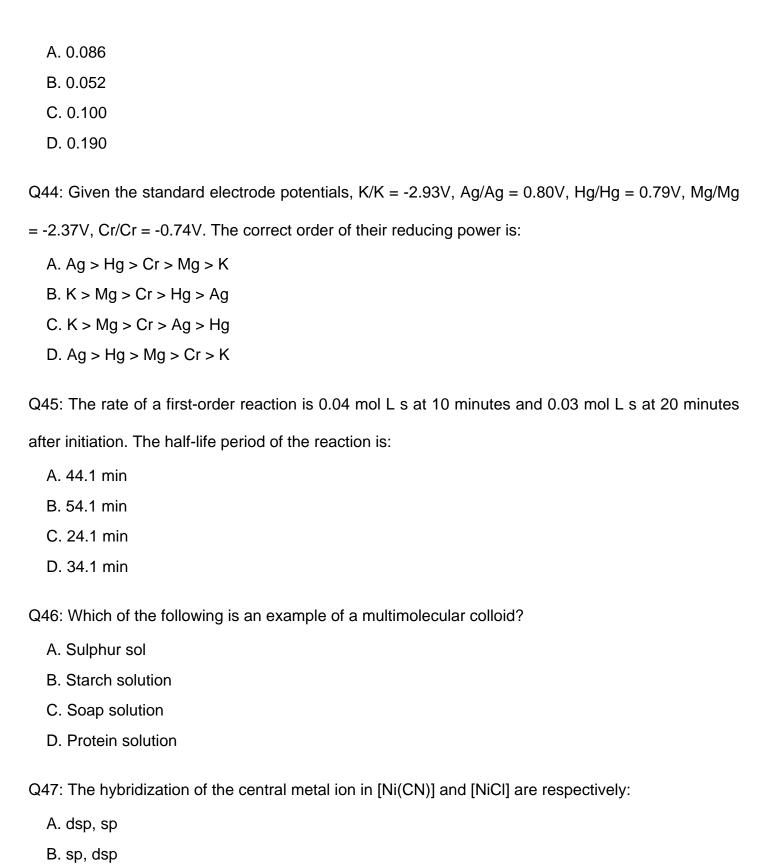Q31: The number of atoms in 0.1 mol of a triatomic gas is (N is the Avogadro constant):
   A. 0.1 N
   B. 0.3 N
   C. N
   D. 3 N

Q32: The number of angular nodes and radial nodes in a 3p orbital are, respectively:
   A. 1, 1
   B. 1, 0

C. 2, 1

D. 1, 2

Q33: Which of the following species has a bond order of 2.5?

A. O

B. N

C. O

D. CN

Q34: For the reaction, 2Cl(g) Cl(g), what are the signs of deltaH and deltaS?

A. deltaH > 0, deltaS > 0

B. deltaH < 0, deltaS < 0

C. deltaH > 0, deltaS < 0

D. deltaH < 0, deltaS > 0

Q35: The correct statement regarding the equilibrium of the reaction H(g) + I(g) 2HI(g) is:

A. Kp is not equal to Kc

B. The equilibrium constant is independent of temperature

C. The addition of an inert gas at constant volume will not affect the equilibrium

D. The addition of a catalyst will increase the equilibrium yield of HI

Q36: The solubility product of AgCl is 1.8 x 10 at 298 K. The solubility of AgCl in 0.1 M KCl solution

in mol/L is:

A. 1.8 x 10

B. 1.34 x 10

C. 1.8 x 10

D. 1.0 x 10

Q37: The oxidation number of Cr in KCrO is:

A. +3

B. +5

C. +6

D. +7

Q38: Which of the following alkali metal chlorides forms a dihydrate salt (MCl2HO)?

A. LiCl

B. NaCl

C. KCl

D. CsCl

Q39: Which of the following is the most powerful oxidizing agent?

A. F

B. Cl

C. Br

D. I

Q40: The IUPAC name of the compound CH-CH(CH)-CH-C(CH) is:

A. 2-Ethyl-4,4-dimethylpentane

B. 3,5,5-Trimethylhexane

C. 4-Ethyl-2,2-dimethylpentane

D. 2,2,4-Trimethylhexane

Q41: Ozonolysis of 2-methylbut-2-ene yields:

A. Propanal and Methanal

B. Propan-2-one and Ethanal

C. Propan-2-one and Methanal

D. Butan-2-one and Methanal

Q42: A compound is formed by two elements M and N. The element N forms ccp and atoms of M occupy 1/3rd of tetrahedral voids. What is the formula of the compound?

A. MN

B. MN

C. MN

D. MN

Q43: A 5.2 molal aqueous solution of methyl alcohol, CHOH, is supplied. What is the mole fraction of methyl alcohol in the solution?

A. 0.086

B. 0.052

C. 0.100

D. 0.190

Q44: Given the standard electrode potentials, K/K = -2.93V, Ag/Ag = 0.80V, Hg/Hg = 0.79V, Mg/Mg

= -2.37V, Cr/Cr = -0.74V. The correct order of their reducing power is:

A. Ag > Hg > Cr > Mg > K

B. K > Mg > Cr > Hg > Ag

C. K > Mg > Cr > Ag > Hg

D. Ag > Hg > Mg > Cr > K

Q45: The rate of a first-order reaction is 0.04 mol L s at 10 minutes and 0.03 mol L s at 20 minutes

after initiation. The half-life period of the reaction is:

A. 44.1 min

B. 54.1 min

C. 24.1 min

D. 34.1 min

Q46: Which of the following is an example of a multimolecular colloid?

A. Sulphur sol

B. Starch solution

C. Soap solution

D. Protein solution

Q47: The hybridization of the central metal ion in [Ni(CN)] and [NiCl] are respectively:

A. dsp, sp

B. sp, dsp

C. dsp, dsp

D. sp, sp

Q48: The reaction of acetaldehyde with HCN followed by hydrolysis gives a compound which

shows:

A. Geometrical isomerism

B. Optical isomerism

C. Tautomerism

D. Metamerism

Q49: Which of the following amines is the most basic in an aqueous solution?

A. Aniline

B. Methylamine

C. Dimethylamine

D. Trimethylamine

Q50: Which of the following is a non-reducing sugar?

A. Glucose

B. Sucrose

C. Maltose

D. Lactose

Q51: A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO. The empirical formula of the hydrocarbon is CH. The value of x + y is:

Q52: For the reaction N(g) + 3H(g) 2NH(g) at 400 K, Kp = 41 atm. The value of Kp for the reaction 2NH(g) N(g) + 3H(g) will be approximately (in atm x 10).

Q53: The limiting molar conductivities (degreesm) for NaCl, HCl, and CHCOONa are 126.4, 425.9, and 91.0 S cm mol respectively. The limiting molar conductivity for CHCOOH is (in S cm mol).

Q54: The decomposition of a substance follows first-order kinetics. If 75% of the substance decomposes in 120 minutes, the time taken for 93.75% decomposition is (in minutes).

Q55: In the disproportionation reaction: P + 3NaOH + 3HO PH + 3NaHPO, the change in oxidation state for the phosphorus atom that gets oxidized is:

Q56: The spin-only magnetic moment of [Fe(HO)] ion is (in Bohr Magnetons, rounded to the nearest

integer).

Q57: How many of the following compounds will give a positive iodoform test? Acetone, Propanal, Butan-2-one, Pentan-3-one, Acetaldehyde, Ethanol, Propan-2-ol.

Q58: The number of isomeric primary amines possible for the molecular formula CHN is:

Q59: A solution containing 10 g per dm of urea (molar mass = 60 g mol) is isotonic with a 5% (w/v) solution of a non-volatile solute. The molar mass of this non-volatile solute is (in g mol).

Q60: The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are -890.3 kJ mol, -393.5 kJ mol and -285.8 kJ mol respectively. The magnitude of enthalpy of formation of methane will be (in kJ mol).

Q61: Let A = {x, y, z} and B = {1, 2, 3}. The number of bijective functions from A to B is:
  A. 3
  B. 6
  C. 9
  D. 1

Q62: If z is a complex number such that |z - 4| < |z - 2|, its solution is given by:
  A. Re(z) > 0
  B. Re(z) < 3
  C. Re(z) > 3
  D. Re(z) > 2

Q63: If A is a 3x3 non-singular matrix such that AA = AA and B = AA, then BB equals:
  A. I
  B. B
  C. A
  D. A

Q64: The number of ways in which 6 men and 5 women can dine at a round table if no two women

are to sit together is given by:

A. 6! x 5!

B. 30

C. 5! x P

D. 5! x P

Q65: The coefficient of x in the expansion of (1 - x - x + x) is:

A. 144

B. -132

C. -144

D. 132

Q66: If the sum of n terms of an A.P. is given by S = 3n + 5n, then its 27th term is:

A. 164

B. 167

C. 161

D. 170

Q67: The reflection of the point (4, -13) about the line 5x + y + 6 = 0 is:

A. (1, -14)

B. (-1, -14)

C. (1, 14)

D. (-1, 14)

Q68: The equation of the circle passing through the points (1, 0) and (0, 1) and having its center on

the line x + y = 1 is:

A. x + y - x - y = 0

B. x + y + x + y = 0

C. x + y - 2x - 2y + 1 = 0

D. x + y + x - y = 0

Q69: The equation of the directrix of the parabola y + 4y + 4x + 2 = 0 is:

A. x = -1/2

B. x = 3/2

C. x = 1

D. x = -1

Q70: The value of the limit: lim (x0) [(sqrt(1+x) - 1) / x] is:

A. 1

B. 0

C. 1/2

D. 2

Q71: If y = log(log(log x)), then dy/dx is:

A. 1 / (x log x log(log x))

B. 3 / (x log x log(log x))

C. 1 / (x log(log x))

D. 3 / (x log x)

Q72: The interval in which the function f(x) = 2x - 9x + 12x + 15 is decreasing is:

A. (-infinity, 1)

B. (2, infinity)

C. (1, 2)

D. (-infinity, 1) U (2, infinity)

Q73: The integral of (x e) / (1+x) dx is equal to:

A. e / (1+x) + C

B. e (1+x) + C

C. -e / (1+x) + C

D. e / (1+x) + C

Q74: The value of the definite integral x(1-x) dx is:

A. 1 / (n+1)

B. 1 / (n+2)

C. 1 / ((n+1)(n+2))

D. n / (n+1)

Q75: The area of the region bounded by the parabola y = x and the line y = 4 is (in square units):

A. 16/3

B. 32/3

C. 8

D. 64/3

Q76: The general solution of the differential equation dy/dx = (x+y) is:

A. tan(x+y) = x + C

B. cot(x+y) = x + C

C. tan(x+y) = y + C

D. cot(x+y) = y + C

Q77: If a, b, c are three non-coplanar vectors, then the value of (a+b+c) [(a+b) x (a+c)] is:

A. 0

B. [a b c]

C. 2[a b c]

D. -[a b c]

Q78: The distance of the point (1, -5, 9) from the plane x - y + z = 5 measured parallel to the line x =

y = z is:

A. 10sqrt3

B. 10/sqrt3

C. 5sqrt3

D. 20/3

Q79: A fair die is thrown three times. The probability of getting a sum of 15 is:

A. 5/216

B. 1/18

C. 5/108

D. 1/12

Q80: The value of sin(pi/18) sin(5pi/18) sin(7pi/18) is:

A. 1/2

B. 1/4

C. 1/8

Q81: If the system of linear equations x + y + z = 5, x + 2y + 2z = 6, x + 3y + z = u has infinitely many solutions, then the value of + u is:

Q82: Let a, a, a, ... be in harmonic progression with a = 5 and a = 25. The least positive integer n for which a < 0 is:

Q83: If the 2nd, 3rd, and 4th terms in the binomial expansion of (x+a) are 240, 720, and 1080 respectively, then the value of n is:

Q84: If lim (xinfinity) [(x+x+1)/(x+1) - ax - b] = 4, then the value of a + b is:

Q85: The minimum value of the function f(x) = 3x - 8x - 6x + 24x on the interval [0, 3] is:

Q86: The value of the integral ^(pi/2) (sqrtcotx)/(sqrtcotx + sqrttanx) dx is kpi. The value of k is:

Q87: Let a = 2i+j-2k and b = i+j. If c is a vector such that a.c = |c|, |c-a| = 2sqrt2 and the angle between (a x b) and c is 30 degrees, then the value of |(a x b) x c| is:

Q88: Let vector a = i+j+k, b = i-j+k and c = i-j-k. Let v be a vector in the plane of a and b, whose projection on c is 1/sqrt3. If v also has the minimum possible length, then v.v is:

Q89: The distance of the point (1, 2, 3) from the line (x-6)/3 = (y-7)/2 = (z-7)/-2 is:

Q90: Two integers are selected at random from the set {1, 2, ..., 11}. Given that the sum of selected numbers is even, the conditional probability that both the numbers are even is: