Time : 3.00 Hrs.	AIEEE (Eng.)	

PHYSICS

1. Pick up the correct statements:
(A) Area under a-t graph gives velocity (B) Area under a-t graph gives change in velocity
(C) Path of projectile as seen by another projectile is a parabola,
(D) A body, whatever be its motion, is always at rest in a frame of reference fixed to the body itself.

2. A body is moving in a circle at a uniform speed υ. What is the magnitude of the change in velocity when the radius vector describes an angle θ:
(A) $\upsilon\cos\theta$ (B) $2\upsilon\cos\left(\frac{\theta}{2}\right)$ (C) $\upsilon\sin\theta$ (D) $2\upsilon\sin\left(\frac{\theta}{2}\right)$

3. What can be the possible velocity displacement (v – s) graph of a particle moving in a straight line under constant acceleration:
(A) straight line (B) parabola (C) ellipse (D) circle

4. Two forces, with equal magnitude F, act on a body and the magnitude of the resultant force is $\frac{F}{3}$.
The angle between the two forces is
(A) $\cos^{-1}\left(\frac{17}{18}\right)$ (B) $\cos^{-1}\left(-\frac{1}{3}\right)$ (C) $\cos^{-1}\left(\frac{2}{3}\right)$ (D) $\cos^{-1}\left(\frac{8}{9}\right)$

5. Two strings making an angle of 120^0 with respect to each other support an object at their bottom. Each string can withstand a tension of 20 N. The maximum weight that the object can have without breaking the string is:
(A) 10 N (B) 20 N (C) $20\sqrt{2}$ N (D) 40 N

6. Three concurrent forces of the same magnitude are in equilibrium. What is the angle between the forces? Also name the triangle formed by the forces as sides
(A) 60^0 equilateral triangle (B) 120^0 equilateral triangle
(C) 120^0, 30^0, 30^0 an isosceles triangle (D) 120^0 an obtuse angled triangle

7. A 1 kg block moving with a velocity of 4 ms^{-1} collides with a stationary 2 kg block. The lighter block comes to rest after the collision. The loss of kinetic energy of the system is
(A) 1 J (B) 2 J (C) 3 J (D) 4 J

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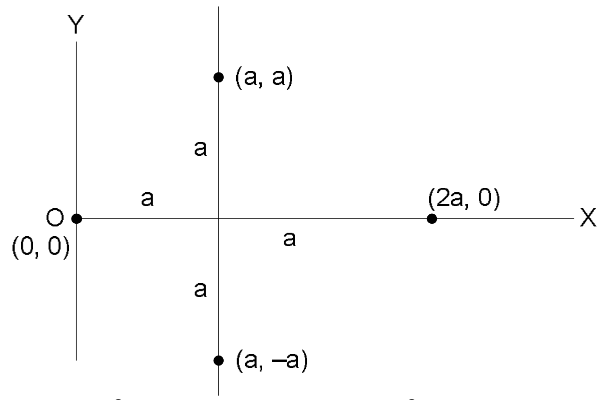
8. A body of mass 5 kg collides elastically with a stationary body of mass 2.5 kg. After the collision, the 2.5 kg body begins to move with a kinetic energy of 8 J. Assuming the collision to be one-dimensional, the kinetic energy of the 5 kg body before collision is

(A) 3 J (B) 6 J (C) 9 J (D) 11 J

9. A 1 kg block is attached (and held at rest with outside support) to the free end of a vertically hanging spring of force constant 10 N cm^{-1}. When the block is released, what maximum extension does it cause when it comes to rest instantaneously? [g = 10 ms^{-2}]

(A) 1 cm (B) 2 cm (C) 3 cm (D) 4 cm

10. Four point masses are arranged in the X-Y plane. The moment of inertia of this array of masses about Y-axis is



(A) ma^2 (B) $2ma^2$ (C) $4ma^2$ (D) $6ma^2$

11. A mass m is moving with a constant velocity parallel to the x-axis. Its angular momentum w.r.t. the origin

(A) remains constant (B) goes on increasing (C) goes on decreasing (D) is zero

12. A tangential force F acts at the rim of a ring of radius R and causes the ring to turn through an angle θ. The work done by the force will be

(A) $\frac{FR}{\theta}$ (B) FR θ (C) $FR-\frac{1}{\theta}$ (D) $FR - \theta$

13. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force of attraction between planet and star is proportional to $R^{\frac{5}{2}}$, then T^2 is proportional to

(A) R^3 (B) $R^{7/2}$ (C) $R^{5/2}$ (D) $R^{3/2}$

14. The magnitudes of the gravitational force at distances r_1 and r_2 from the centre of a uniform sphere of radius R and mass M are F_1 and F_2 respectively. Then

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(A) $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 < R$ and $r_2 < R$ (B) $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $r_1 > R$ and $r_2 < R$

(C) $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 > R$ and $r_2 > R$ (D) $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $r_1 < R$ and $r_2 < R$

15. A mass M is split into two parts, m and (M–m), which are then separated by a certain distance. What ratio of m/M maximizes the gravitational force between the two parts
(A) 1/3 (B) 1/2 (C) 1/4 (D) 1/5

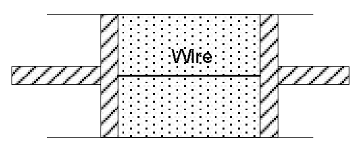
16. The equation of motion of a particle is $\frac{d^2y}{dt^2} + Ky = 0$, where K is positive constant. The time period of the motion is given by
(A) $\frac{2\pi}{K}$ (B) $2\pi K$ (C) $\frac{2\pi}{\sqrt{K}}$ (D) $2\pi\sqrt{K}$

17. A particle executes S.H.M. in a line 4 cm long. Its velocity when passing through the centre of line is 12 cm/s. The period will be
(A) 2.047 s (B) 1.047 s (C) 3.047 s (D) 0.047 s

18. A simple harmonic wave having an amplitude a and time period T is represented by the equation $y = 5 \sin \pi (t + 4)$m. Then the value of amplitude (a) in (m) and time period (T) in second are
(A) a = 10, T = 2 (B) a = 5, T = 1 (C) a = 10, T = 1 (D) a = 5, T = 2

19. A mono atomic gas is supplied the heat Q very slowly keeping the pressure constant. The work done by the gas will be
(A) $\frac{2}{3}Q$ (B) $\frac{3}{5}Q$ (C) $\frac{2}{5}Q$ (D) $\frac{1}{5}Q$

20. A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless pistons. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is P_0 and temperature is T_0,



atmospheric pressure is also P_0. Now the temperature of the gas is increased to $2T_0$, the tension in the wire will be
(A) $2P_0A$ (B) P_0A (C) $\frac{P_0A}{2}$ (D) $4P_0A$

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21. The molar heat capacity in a process of a diatomic gas if it does a work of Q/4 when a heat of Q is supplied to it is

(A) $\frac{2}{5}R$ (B) $\frac{5}{2}R$ (C) $\frac{10}{3}R$ (D) $\frac{6}{7}R$

22. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that of B but uncharged is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is

(A) F / 4 (B) 3F / 4 (C) F / 8 (D) 3F / 8

23. The ratio of electrostatic and gravitational forces acting between electron and proton separated by a distance 5×10^{-11}m, will be (Charge on electron = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg, mass of proton = 1.6×10^{-27} kg, G = 6.7×10^{-11} Nm^2/kg^2)

(A) 2.36×10^{39} (B) 2.36×10^{40} (C) 2.34×10^{41} (D) 2.34×10^{42}

24. Two equally charged, identical metal spheres A and B repel each other with a force 'F'. The spheres are kept fixed with a distance 'r' between them. A third identical, but uncharged sphere C is brought in contact with A and then placed at the mid-point of the line joining A and B. The magnitude of the net electric force on C is

(A) F (B) 3F/4 (C) F/2 (D) F/4

25. Every atom makes one free electron in copper. If 1.1 ampere current is flowing in the wire of copper having 1 mm diameter, then the drift velocity (approx.) will be (Density of copper = 9×10^3 kg m^{-3} and atomic weight = 63)

(A) 0.3 mm/sec (B) 0.1 mm/sec (C) 0.2 mm/sec (D) 0.2 cm/sec

26. On increasing the temperature of a conductor, its resistance increases because

(A) Relaxation time decreases (B) Mass of the electrons increases
(C) Electron density decreases (D) None of the above

27. The resistance of a wire is 10Ω. Its length is increased by 10% by stretching. The new resistance will now be

(A) 12 Ω (B) 1.2 Ω (C) 13 Ω (D) 11 Ω

28. A plane mirror reflecting a ray of incident light is rotated through an angle θ about an axis through the point of incidence in the plane of the mirror perpendicular to the plane of incidence, then

(A) The reflected ray does not rotate (B) The reflected ray rotates through an angle θ
(C) The reflected ray rotates through an angle 2θ
(D) The incident ray is not fixed

29. Image formed by a concave mirror of focal length 6 cm, is 3 times of the object, then the distance of

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object from mirror is
(A) –4 cm (B) 8 cm (C) 6 cm (D) 12 cm

30. How much water should be filled in a container 21 cm in height, so that it appears half filled when viewed from the top of the container (given that ${}_{a}\mu_{w} = 4/3$)
(A) 8.0 cm (B) 10.5 cm (C)12.0 cm (D) None of these

CHEMISTRY

31. An aqueous solution of 6.3 *g* of oxalic acid dihydrate is made up of to 250 *ml*. The volume of 0.1 $N\ NaOH$ required to completely neutralise 10 *ml* of this solution is
(A) 40 *ml* (B) 20 *ml* (C) 10 *ml* (D) 4 *ml*

32. The normality of orthophosphoric acid having purity of 70% by weight and specific gravity 1.54 would be
(A) 11*N* (B) 22*N* (C) 33*N* (D) 44*N*

33. Which of the following is not correct for electron distribution in the ground state

	4s		3d				
(A) $Co(Ar)$	↑↓	↑↓	↑↓	↑	↑	↑	
(B) $Ni(Ar)$	↑↓	↑↓	↑↓	↑↓	↑	↑	
(C) $Cu(Ar)$	↑↓	↑↓	↑↓	↑↓	↑↓	↑	
(D) $Zn(Ar)$	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	

34. If electron, hydrogen, helium and neon nuclei are all moving with the velocity of light, then the wavelengths associated with these particles are in the order
(A) Electron > hydrogen > helium > neon (B) Electron > helium > hydrogen > neon
(C) Electron < hydrogen < helium < neon (D) Neon < hydrogen < helium < electron

35. Which one in the following contains ionic as well as covalent bond
(A) CH_4 (B) H_2 (C) KCN (D) KCl

36. The solution of sugar in water contains
(A) Free atoms (B) Free molecules
(C) Free ions (D) Free atoms and free molecules

37. To $5.85\,gm$ of $NaCl$ one kg of water is added to prepare of solution. What is the strength of $NaCl$ in this solution (mol. wt. of $NaCl = 58.5$)
(A) 0.1 Normal (B) 0.1 Molal (C) 0.1 Molar (D) 0.1 Formal

38. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution containing 14*g* of the salt per 200*g* of water $100^{o}C$ is 70 percent. If the vapour pressure of water at $100^{o}C$ is 760 *cm*. Calculate the vapour pressure of the solution

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(A) 746.3 *mm* of *Hg* (B) 757.5 *mm* of *Hg* (C) 740.9 *mm* of *Hg* (D) 750 *mm* of *Hg*

39. In zinc blende structure, zinc atom fill up
(A) All octahedral holes (B) All tetrahedral holes
(C) Half number of octahedral holes (D) Half number of tetrahedral holes

40. Which ion has the lowest radius from the following ions
(A) Na^{+} (B) Mg^{2+} (C) Al^{3+} (D) Si^{4+}

41. The root mean square speeds at STP for the gases H_2, N_2, O_2 and *HBr* are in the order
(A) $H_2 < N_2 < O_2 < HBr$ (B) $HBr < O_2 < N_2 < H_2$ (C) $H_2 < N_2 = O_2 < HBr$ (D) $HBr < O_2 < H_2 < N_2$

42. By what ratio the average velocity of the molecule in gas change when the temperature is raised from 50 to 200^oC
(A) 1.21 / 1 (B) 1.46 / 1 (C) 1.14 / 1 (D) 4 / 1

43. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$; $\frac{K_p}{K_c}$ is equivalent to
(A) 1 (B) RT (C) $\frac{1}{\sqrt{RT}}$ (D) $(RT)^{1/2}$

44. $2\underset{(g)}{N_2O_5} \rightarrow 4\underset{(g)}{NO_2} + \underset{(g)}{O_2}$ what is the ratio of the rate of decomposition of N_2O_5 to rate of formation of NO_2
(A) $1:2$ (B) $2:1$ (C) $1:4$ (D) $4:1$

45. The *p*H of 0.1 *M* solution of the following salts increases in the order
(A) $NaCl < NH_4Cl < NaCN < HCl$ (B) $HCl < NH_4Cl < NaCl < NaCN$
(C) $NaCN < NH_4Cl < NaCl < HCl$ (D) $HCl < NaCl < NaCN < NH_4Cl$

46. The degree of hydrolysis in hydrolytic equilibrum
$A^- + H_2O \rightleftharpoons HA + OH^-$ at salt concentration of 0.001 *M* is
$(K_a = 1 \times 10^{-5})$
(A) 1×10^{-3} (B) 1×10^{-4} (C) 5×10^{-4} (D) 1×10^{-6}

47. Molar heat capacity of water in equilibrium with ice at constant pressure is
(A) Zero (B) Infinity (∞) (C) $40.45\, kJ\, K^{-1} mol^{-1}$ (D) $75.48\, J\, K^{-1}$

48. Internal energy does not include
(A) Nuclear energy (B) Rotational energy
(C) Vibrational energy (D) Energy arising by gravitational pull

49. The minimum energy required for molecules to enter into the reaction is called
(A) Potential energy (B) Kinetic energy (C) Nuclear energy (D) Activation energy

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50. The minimum energy necessary to permit a reaction is
(A) Internal energy (B) Threshold energy (C) Activation energy (D) Free energy

51. Electrolytes when dissolved in water dissociates into ions because
(A) They are unstable
(B) The water dissolves it
(C) The force of repulsion increases
(D) The forces of electrostatic attraction are broken down by water

52. Electrolyte can conduct electricity because
(A) Their molecules contain unpaired electrons, which are mobile
(B) Their molecules contain loosely held electrons which get free under the influence of voltage
(C) The molecules break up into ions when a voltage is applied
(D) The molecules are broken up into ions when the electrolyte is fused or is dissolved in the solvent

53. In the reaction between ozone and hydrogen peroxide, H_2O_2 acts as
(A) Oxidising agent
(B) Reducing agent
(C) Bleaching agent
(D) Both oxidising and bleaching agent

54. The oxidation state of each oxygen atom in Na_2O_2 is
(A) – 2 each (B) – 2 and zero (C) – 1 each (D) None of the above

55. Peptising agent is
(A) Always an electrolyte
(B) Always a non-electrolyte
(C) Electrolyte or non-electrolyte
(D) A lyophilic colloid

56. The catalyst used in the manufacture of methanol from water gas is
(A) V_2O_5 (B) *Ni* + *Mo* (C) *ZnO* + Cr_2O_3 (D) *Pt* + *W*

57. Which of the following elements are analogous to the lanthanides
(A) Actinides (B) Borides (C) Carbides (D) Hydrides

58. Which of the order for ionisation energy is correct
(A) $Be > B > C > N > O$ (B) $B < Be < C < O < N$ (C) $B < Be < C < N < O$ (D) $B < Be < N < C < O$

59. Which of the following ions, will have maximum hydration energy
(A) Sr^{2+} (B) Ba^{2+} (C) Ca^{2+} (D) Mg^{2+}

60. When orthophosphoric acid is heated to $600^o C$, the product formed is
(A) Phosphine, PH_3
(B) Phosphorus pentoxide, P_2O_5
(C) Phosphorus acid, H_3PO_3
(D) Metaphosphoric acid,

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MATHEMATICS

61. Let $A = \{1, 2, 3\}$. The total number of distinct relations that can be defined over A is
(A) 2^9 (B) 6 (C) 8 (D) None of these

62. Let $P = \{(x,y) | x^2 + y^2 = 1, x, y \in R\}$. Then P is
(A) Reflexive (B) Symmetric (C) Transitive (D) Anti-symmetric

63. If R is a relation from a finite set A having m elements to a finite set B having n elements, then the number of relations from A to B is
(A) 2^{mn} (B) $2^{mn} - 1$ (C) $2mn$ (D) m^n

64. For all complex numbers z_1, z_2 satisfying $|z_1| = 12$ and $|z_2 - 3 - 4i| = 5$, the minimum value of $|z_1 - z_2|$ is
(A) 0 (B) 2 (C) 7 (D) 17

65. If P, Q, R, S are represented by the complex numbers $4 + i, 1 + 6i, -4 + 3i, -1 - 2i$ respectively, then $PQRS$ is a
(A) Rectangle (B) Square (C) Rhombus (D) Parallelogram

66. The points $1 + 3i, 5 + i$ and $3 + 2i$ in the complex plane are
(A) Vertices of a right angled triangle (B) Collinear
(C) Vertices of an obtuse angled triangle (D) Vertices of an equilateral triangle

67. The sixth term of an A.P. is equal to 2, the value of the common difference of the A.P. which makes the product $a_1 a_4 a_5$ least is given by
(A) $x = \frac{8}{5}$ (B) $x = \frac{5}{4}$ (C) $x = 2/3$ (D) None of these

68. If $y = x + x^2 + x^3 + ... \infty$, then $x =$
(A) $\frac{y}{1+y}$ (B) $\frac{1-y}{y}$ (C) $\frac{y}{1-y}$ (D) None of these

69. Sum of n terms of series $12 + 16 + 24 + 40 + ...$ will be
(A) $2(2^n - 1) + 8n$ (B) $2(2^n - 1) + 6n$ (C) $3(2^n - 1) + 8n$ (D) $4(2^n - 1) + 8n$

70. If the roots of the equation $ax^2 + x + b = 0$ be real, then the roots of the equation $x^2 - 4\sqrt{ab}\,x + 1 = 0$ will be
(A) Rational (B) Irrational (C) Real (D) Imaginary

71. If one of the roots of the equation $x^2 + ax + b = 0$ and $x^2 + bx + a = 0$ is coincident, then the numerical value of $(a + b)$ is
(A) 0 (B) – 1 (C) 2 (D) 5

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72. If a man and his wife enter in a bus, in which five seats are vacant, then the number of different ways in which they can be seated is
(A) 2 (B) 5 (C) 20 (D) 40

73. If the letters of the word *SACHIN* arranged in all possible ways and these words are written out as in dictionary, then the word *SACHIN* appears at serial number
(A) 603 (B) 602 (C) 601 (D) 600

74. If x^4 occurs in the r^{th} term in the expansion of $\left(x^4+\frac{1}{x^3}\right)^{15}$, then $r=$
(A) 7 (B) 8 (C) 9 (D) 10

75. The first 3 terms in the expansion of $(1+ax)^n \quad (n \neq 0)$ are 1, 6x and 16x^2. Then the value of *a* and *n* are respectively
(A) 2 and 9 (B) 3 and 2 (C) 2/3 and 9 (D) 3/2 and 6

76. If $a+b+c=0$, then the solution of the equation $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix}=0$ is
(A) 0 (B) $\pm\frac{3}{2}(a^2+b^2+c^2)$ (C) $0, \pm\sqrt{\frac{3}{2}(a^2+b^2+c^2)}$ (D) $0, \pm\sqrt{a^2+b^2+c^2}$

77. $\begin{vmatrix} 1+i & 1-i & i \\ 1-i & i & 1+i \\ i & 1+i & 1-i \end{vmatrix}=$
(A) $-4-7i$ (B) $4+7i$ (C) $3+7i$ (D) $7+4i$

78. In a skew symmetric matrix, the diagonal elements are all
(A) Different from each other (B) Zero
(C) One (D) None of these

79. If *A* is a square matrix of order *n* and $A=k\,B$, where *k* is a scalar, then |A|=
(A) |*B*| (B) $k|\ B|$ (C) k^n |*B*| (D) $n|\ B|$

80. $\cos^2 76^o + \cos^2 16^o - \cos 76^o \cos 16^o =$
(A) – 1/4 (B) ½ (C) 0 (D) 3/4

81. $\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}=$
(A) 0 (B) $\frac{1}{2}$ (C) $\frac{1}{4}$ (D) $-\frac{1}{8}$

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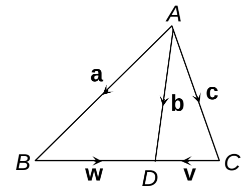
82. The solution of the equation $4\cos^2 x + 6\ \sin^2 x = 5$

(A) $x = n\pi \pm \frac{\pi}{2}$ (B) $x = n\pi \pm \frac{\pi}{4}$ (C) $x = n\pi \pm \frac{3\pi}{2}$ (D) None of these

83. In the figure, a vector **x** satisfies the equation $\mathbf{x} - \mathbf{w} = \mathbf{v}$. Then **x** =



(A) $2\mathbf{a} + \mathbf{b} + \mathbf{c}$ (B) $\mathbf{a} + 2\mathbf{b} + \mathbf{c}$

(C) $\mathbf{a} + \mathbf{b} + 2\mathbf{c}$ (D) $\mathbf{a} + \mathbf{b} + \mathbf{c}$

84. If the sum of the squares of the distance of a point from the three co-ordinate axes be 36,then its distance from the origin is

(A) 6 (B) $3\sqrt{2}$ (C) $2\sqrt{3}$ (D) None of these

85. If $f(x) = 4x^3 + 3x^2 + 3x + 4$, then $x^3 f\left(\frac{1}{x}\right)$ is

(A) $f(-x)$ (B) $\frac{1}{f(x)}$ (C) $\left(f\left(\frac{1}{x}\right)\right)^2$ (D) $f(x)$

86. If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1,$ where $a > 0$ attains its maximum and minimum at *p* and *q* respectively such that $p^2 = q$, then *a* equals

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

87. The function $f(x) = \frac{\ln(\pi + x)}{\ln(e + x)}$ is

(A) Increasing on $[0, \infty)$ (B) Decreasing on $[0, \infty)$

(C) Decreasing on $\left[0, \frac{\pi}{e}\right)$ and increasing on $\left[\frac{\pi}{e}, \infty\right)$

(D) Increasing on $\left[0, \frac{\pi}{e}\right)$ and decreasing on $\left[\frac{\pi}{e}, \infty\right)$

88. The value of $\int_{-2}^{2}(ax^3 + bx + c)$ depends on

(A) The value of a (B) The value of b (C) The value of c (D) The values of a and b

89. Three letters are to be sent to different persons and addresses on the three envelopes are also written. Without looking at the addresses, the probability that the letters go into the right envelope is equal to

(A) $\frac{1}{27}$ (B) $\frac{1}{9}$ (C) $\frac{4}{27}$ (D) $\frac{1}{6}$

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90. Two dice are thrown. The probability that the sum of numbers appearing is more than 10, is(A) $\frac{1}{18}$ (B) $\frac{1}{12}$ (C) $\frac{1}{6}$ (D) None of these