AIEEE - COMMON PRACTICE TEST-5

Time: 3 hours **Maximum marks: 315**

MATHEMATICS

PART – I

1. The differential equation of all conics whose centre lie at the origin is of order :
(A) 2 (B) 3
(C) 4 (D) None of these

2. The differential equation representing the family of curves $y^2 = 2c\left(x + \sqrt{c}\right)$, where c is a positive parameter, is of :
(A) order = 1 (B) order =2
(C) order = 3 (D) degree = 4

3. The degree of differential equation $\left(\frac{dy}{dx}\right)^2 + 3\left(\frac{dy}{dx}\right)^3 = x^2 \log\left(\frac{x^2 y}{dx^2}\right)$ is
(A) 1 (B) 2
(C) 3 (D) none of these

4. If y_1 (x) and y_2(x) are two solutions of $\frac{dy}{dx} + f(x)\ y = r(x)$ then $y_1(x) + y_2(x)$ is solution of
(A) $\frac{dy}{dx} + f(x)y = 0$ (B) $\frac{dy}{dx} + 2f(x)y = r(x)$
(C) $\frac{dy}{dx} + f(x)y = 2r(x)$ (D) $\frac{dy}{dx} + 2f(x)y = 2r(x)$

5. The curve satisfying the equation $y_1 = \frac{y^2 - 2xy - x^2}{y^2 + 2xy - x^2}$ passing through (1, –1) is a :
(A) circle (B) straight line
(C) hyperbola (D) ellipse

6. The value of $\lim_{x\to\infty} y(x)$ obtained from the differential equation $\frac{dy}{dx} = y - y^2$, where y(0) = 2 is :
(A) zero (B) 1
(C) ∞ (D) none of these
As $x \to \infty$, y has no value.

7. If $x^2 + y^2 = 1$, then
(A) $yy'' - 2(y')^2 + 1 = 0$ (B) $yy'' + (y')^2 + 1 = 0$
(C) $x^2 + y^2 - 2y = 0$ (D) none of these

8. If $\frac{dy}{dx} = ky$, then y is (are) :
(A) ce^{-kx} (B) ce^{kx}
(C) $\frac{kxy^2}{z}$ (D) $e^{kx} + c$

9. The differential equation (x + y)dx + x dy = 0 is :
(A) homogeneous but not linear
(B) linear but not homogeneous
(C) both homogeneous and linear
(D) neither homogeneous nor linear

10. The solution of differential equation (cos x) cos y dx + sin x. sin y dy = 0 is :

(A) tan x = c (B) sec x – sec y = c
(C) sin x = c cos y (D) cos x = c sin y

11. The elimination of A and B from the equation $y^2 = Ax + B$ gives the differential equation of order :
(A) third (B) zero
(C) first (D) second

12. The solution of $\frac{dy}{dx} = 2^{y-x}$ is :
(A) $\frac{1}{2^x} - \frac{1}{2^y} = k$ (B) $\frac{1}{2^x} + \frac{1}{2^y} = k$
(C) $2^x + 2^y = k$ (D) $2^x - 2^y = k$

13. If xdy = y(dx + ydy), y(1) = 1 and y(x) > 0, then y (– 3) =
(A) 3 (B) 2
(C) 1 (D) 0

14. Integrating factor of differential equation $\cos x \frac{dy}{dx} + y \sin x = 1$ is :
(A) sin x (B) sec x
(C) tan x (D) cos x

15. Let f : R → R be a mapping defined by, $f(x) = x^3 + 5$, then $f^{-1}(x)$ is equal to
(A) $(5-x)^{1/3}$ (B) $(x+5)^{1/3}$
(C) 5 – x (D) $(x-5)^{1/3}$

16. Function f : R → R, $f(x) = x^2 + x$, is :
(A) one–one onto (B) one–one into
(C) many–one onto (D) many one into

17. The domain of the function $f(x) = \frac{1}{\sqrt{|x|-x}}$ is
(A) (0, ∞) (B) (– ∞ , 0)
(C) (– ∞, ∞) (D) none of these

18. The range of the function $f(x) = \tan\sqrt{\frac{\pi^2}{9} - x^2}$ is :
(A) $\left[0, \sqrt{3}\right]$ (B) $\left(0, \sqrt{3}\right)$
(C) $\left[0, \sqrt{3}\right)$ (D) $\left(0, \sqrt{3}\right]$

19. $\lim_{x\to 0} \frac{a^{\sin x} - 1}{b^{\sin x} - 1} =$
(A) $\frac{\log a}{\log b}$ (B) $\frac{\log b}{\log a}$
(C) $\frac{a}{b}$ (D) $\frac{b}{a}$

20. If $f(x) = \frac{1 - \sin x}{(\pi - 2x)^2}$, when $x \neq \frac{\pi}{2}$ and $f\left(\frac{\pi}{2}\right) = \lambda$, then f(x) will be a continuous function at $x = \frac{\pi}{2}$, when λ =
(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{1}{8}$ (D) none

21. The value of the derivative of $|x-1| + |x-3|$ at x = 2 is :
(A) – 2 (B) 0
(C) 2 (D) not defined

22. For the function $f(x) = e^x$, a = 0, b = 1, the value of c in mean value of theorem will be :
(A) log x (B) log (e – 1)
(C) 0 (D) 1

23. The tangent to the curve $y = e^{2x}$ at the point (0, 1) meets the x–axis at :

(A) $\frac{1}{2}$ (B) – 2

(C) $-\frac{1}{2}$ (D) 1

24. The smallest vale of $x^2 - 3x + 3$ in the interval $\left(-3, \frac{3}{2}\right)$ is

(A) $\frac{3}{4}$ (B) 5

(C) – 15 (D) – 20

25. The minimum value of the function $f(x) = 2|x-2|+5|x-3|, \forall x \in R$ is :

(A) 3 (B) 2

(C) 5 (D) 7

26. The value of $\int \frac{x^2 \tan^{-1}(x^3)}{1+x^6} dx$ will be

(A) $\frac{1}{6}\tan^{-1}(x^3)+C$ (B) $\frac{1}{6}\{\tan^{-1}(x^3)\}^2+C$

(C) $\frac{1}{6}(\tan^{-1}x^3)^3+C$ (D) $\frac{1}{3}(\tan^{-1}x^3)^4+C$

27. $\int \frac{dx}{\sqrt{2x-x^2}} =$

(A) $\cos^{-1}(x-1)+c$ (B) $\sin^{-1}(x-1)+c$

(C) $\cos^{-1}(1+x)+c$ (D) $\sin^{-1}(1-x)+c$

28. $\int \frac{xe^x}{(x+1)^2} dx =$

(A) $\frac{e^x}{1+x}+C$ (B) $\frac{xe^x}{(1+x)}+C$

(C) $\frac{e^x}{(1+x)^3}+C$ (D) $\frac{e^x}{(1+x)^2}+C$

29. If f(a – x) = f(x), then $\int_0^a x f(x)\, dx =$

(A) $\frac{a}{2}\int_0^a f(x)\, dx$ (B) $a\int_0^a f(x)\, dx$

(C) $\frac{a^2}{2}\int_0^a f(x)\, dx$ (D) none of these

30. $\int_{-1}^{1} |(1-x)| dx$ equals

(A) – 2 (B) 0

(C) 2 (D) 4

31. If $[x]$ denotes greatest integer ≤ x, then $\int_1^5 [|x-3|]\, dx =$

(A) 1 (B) 2

(C) 4 (D) 8

32. If $I_1 = \int_e^{e^2} \frac{dx}{\log x}$ and $I_2 = \int_1^2 \frac{e^x}{x} dx$, then

(A) $2I_1 = I_2$
(B) $I_1 = I_2$
(C) $I_1 = 2I_2$
(D) $I_1 + I_2 = 0$

33. $\lim_{n\to\infty}\left[\frac{n+1}{n^2+1^2}+\frac{n+2}{n^2+2^2}+\frac{n+3}{n^2+3^2}+\ldots+\frac{1}{n}\right]$ is equal to

(A) $\frac{\pi}{4}+\frac{1}{2}\log 2$
(B) $\frac{\pi}{4}-\frac{1}{2}\log 2$
(C) $-\left(\frac{\pi}{4}+\frac{1}{2}\log 2\right)$
(D) none of these

34. The area bounded by the parabola $y^2 = x$, the line $y = 4$ and y-axis is

(A) $\frac{16}{3}$
(B) $\frac{32}{3}$
(C) $\frac{64}{3}$
(D) $\frac{128}{3}$

35. The area of the curve $xy^2 = a^2 (a - x)$ bounded by y–axis is

(A) πa^2
(B) $2\pi a^2$
(C) $3\pi a^2$
(D) $4\pi a^2$

CHEMISTRY

PART – II

36. Volume V_1 ml of 0.1 M $K_2Cr_2O_7$ is needed for complete oxidation of 0.678 g N_2H_4 in acidic medium. The volume of 0.3 M $KMnO_4$ needed for same oxidation in acidic medium will be

(A) $\frac{2}{5}V_1$
(B) $\frac{5}{2}V_1$
(C) 113 V_1
(D) can't say

37. The molar ratio of Fe^{++} to Fe^{+++} in a mixture of $FeSO_4$ and $Fe_2(SO_4)_3$ having equal number of sulphate ion in both ferrous and ferric sulphate is

(A) 1 : 2
(B) 3 : 2
(C) 2 : 3
(D) can't be determined

38. How many ml of 0.3 M $K_2Cr_2O_7$ (acidic) is required for complete oxidation of 5 ml of 0.2 M SnC_2O_4 solution

(A) 3.33 ml
(B) 2.22 ml
(C) 1.1 ml
(D) 4.44 ml

39. The normality of 10 ml of a '20 V' H_2O_2 is

(A) 1.79
(B) 3.58
(C) 60.68
(D) 6.86

40. The maximum number of hydrogen bonds in which a water molecule can participate is:–

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

41. The IF_4^- ions observed to be square planar. What kind of hybrid orbital are used by I in IF_4^-?

(A) dsp^2
(B) sp^3
(C) sp^3d
(D) sp^3d^2.

42. The electronic configuration of an element 'X' is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. The formula of the most probable compound this element will form with calcium, Ca, is

(A) CaX
(B) Ca_2X_3
(C) Ca_3X_2
(D) CaX_2.

43. Which of the following statement is correct about O_2, O_2^+, O_2^- and O_2^{2-}

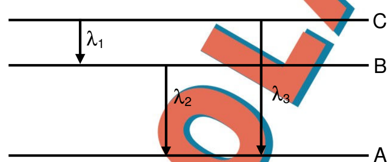
(A) Bond order of O_2 is greater than O_2^+ whereas less than O_2^-,.
(B) Bond order of O_2^{2-} is less than that of O_2^+ whereas greater than that of O_2.
(C) Bond order of O_2^+ is greater than that of O_2, O_2^- and O_2^{2-}.
(D) None of these

44. Evaluate the following ratios for the energy of the electron in a particular orbit :
[Kinetic : Potential] and [Total : Kinetic]
(A) [1 : – 2] and [– 1 : 1]
(B) [1 : 2] and [1 : 1]
(C) [1 : 1] and [1 : 1]
(D) [1 : 2] and [1 : 2]

45. If the I.E of He^+ is 54.4 eV then
(A) I.E of H is 13.6 eV and that of Li^{+2} 122.4 eV
(B) I.E. of H is 13.6 eV and that of Li^{+2} cannot be determined
(C) I.E. of H is 13.6 eV and that of Li^{+2} is 27.2 eV
(D) all of the above are wrong

46. What is the radius ratio for 2nd orbit of Li^{+2} ion and 3rd orbit of Be^{+3} ion?
(A) 3 : 1
(B) 16 : 27
(C) 4 : 9
(D) 3 : 4

47. Energy levels A, B, C of a certain atom corresponds to increasing values of energy, i.e., $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are the wavelength of radiations corresponding to the transitions C to B, B to A and C to A respectively, which of the following statement is correct :



(A) $\lambda_3 = \lambda_1 + \lambda_2$
(B) $\lambda_3 = \dfrac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$
(C) $\lambda_1 + \lambda_2 + \lambda_3 = 0$
(D) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

48. The molecular weight of a gas which diffuses through a porous plug of 1/6th of the speed of hydrogen under identical conditions is
(A) 27
(B) 72
(C) 36
(D) 48

49. The temperature to which a gas must be cooled before it can be liquefied by compression is called:
(A) Boyle temp.
(B) Critical temp.
(C) Liquefication temp.
(D) Inversion temp.

50. A certain gas diffuses from two different vessels A and B. The vessel A has circular orifice while vessel B has square orifice of length equal to radius of the orifice of vessel A. The ratio of the rates of diffusion of the gas from vessel A to vessel B, assuming same temperature and pressure is
(A) π
(B) $1/\pi$
(C) 1 : 1
(D) 2 : 1

51. The rate diffusion of SO_2, CO_2, PCl_3 and SO_3 are in the following order:
(A) $PCl_3 > SO_3 > SO_2 > CO_2$
(B) $SO_2 > SO_3 > PCl_3 > CO_2$
(C) $CO_2 > SO_2 > PCl_3 > SO_3$
(D) $CO_2 > SO_2 > SO_3 > PCl_3$

52. A catalyst lowers the energy of activation of the reaction by 25%. The temperature at which rate of uncatalysed reaction will be equal to that of the catalysed reaction at 27°C is:
(A) 127°C
(B) 300°C
(C) 37°C
(D) None of these

53. The decay constant of a radioactive element is $0.0693\ min^{-1}$. The time required to reduce the activity of the sample to 1/8th of its initial activity will be.
(A) 30 min
(B) 20 min
(C) 10 min
(D) None of these

54. If the time required for 90% completion of the reaction is 2 minutes, then the time after which the reaction is 99.9% completed is
(A) 4 minutes
(B) 6 minutes
(C) 8 minutes
(D) 10 minutes

55. If E_f and E_b are the activation energies of the forward and reverse reactions and the reaction is known to be exothermic then
(A) $E_f > E_b$
(B) $E_f < E_b$
(C) $E_f = E_b$
(D) $E_f \approx E_b$

56. Which one of the following reactions at equilibrium, with all reactants and products in the gaseous phase, would be uneffected by an increase in pressure.

(A) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (B) $2CO + O_2 \rightleftharpoons 2CO_2$

(C) $2H_2 + O_2 \rightleftharpoons 2H_2O$ (D) $N_2 + O_2 \rightleftharpoons 2NO$

57. For the reaction $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$, the value of K_C at 250°C is 26 mol^{-1}/litre. The value of K_p at this temperature will be

(A) 0.61 atm^{-1} (B) 0.57 atm^{-1}

(C) 0.85 atm^{-1} (D) 0.46 atm^{-1}

58. What would happen to a reversible reaction at equilibrium when temperature is raised, given that its ΔH is positive

(A) More of the products are formed (B) Less of the products are formed

(C) More of the reactants are formed (D) It remains in equilibrium

59. For the reaction, $2NO_2\,(g) \rightleftharpoons 2NO(g) + O_2\,(g)$, $K_C = 1.8 \times 10^{-6}$ at 185°C. At 185°C, the value of K_C for the reaction.

$NO(g) + \frac{1}{2}O_2\,(g) \rightleftharpoons NO_2\,(g)$ is

(A) 0.9×10^6 (B) 7.5×10^2

(C) 1.95×10^{-3} (D) 1.95×10^3

60. For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ in a vessel after the addition of equal number of mole of N_2 and H_2 equilibrium state is formed which of the following is correct?

(A) $[H_2] = [N_2]$ (B) $[H_2] < [N_2]$

(C) $[H_2] > [N_2]$ (D) $[H_2] > [NH_3]$

61. One mole of $N_2O_{4(g)}$ at 300K is kept in a closed container under one atm. It is heated to 600K when 20% by mass of $N_2O_{4(g)}$ decomposes to $NO_{2(g)}$. The resultant pressure is

(A) 1.2 atm (B) 2.4 atm

(C) 2.0 atm (D) 1.0 atm

62. 40% of a mixture of 0.2 mol of N_2 and 0.6 mol of H_2 react to give NH_3 according to the equation. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at constant temperature and pressure. Then the ratio of the final volume to the initial volume of gases are

(A) 4 : 5 (B) 5 : 4

(C) 7 : 10 (D) 8 : 5

63. For the reaction

$2NO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons N_2O_5(g)$ if the equilibrium constant is K_p, then the equilibrium constant for the reaction $2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$ would be

(A) K_p^2 (B) $2/K_p$

(C) $1/K_p^2$ (D) $1/\sqrt{K_p}$

64. Given the following reaction at equilibrium

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Some inert gas is added at constant volume. Predict which of the following facts will be affected?

(A) more of $NH_3(g)$ is produced

(B) less of $NH_3(g)$ is produced

(C) no affect on the degree of advancement of the reaction at equilibrium

(D) K_P of the reaction is increased

65. For the reaction $Cu(s) + 2Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$ the equilibrium constant, K_c is given by

(A) $\frac{[Cu^{2+}][Ag]^2}{[Cu][Ag^+]^2}$ (B) $\frac{[Cu][2Ag]}{[Cu^{2+}][2Ag^+]}$

(C) $\frac{[Cu^{2+}]}{[Ag^+]^2}$ (D) $\frac{[Ag^+]^2}{[Cu^{2+}]}$

66. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$. For this reaction initially the mole ratio was 1 : 3 of N_2 to H_2. At equilibrium 50% of each had reacted. If the equilibrium pressure was P, the partial pressure of NH_3 at equilibrium was

(A) P/3 (B) P/4

(C) P/6 (D) P/8

67. Two systems $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ and $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$ are simultaneously in equilibrium in a vessel at constant volume. If some CO is introduced into the vessel then at the new equilibrium the concentration of

(A) PCl_5 is greater
(B) PCl_3 remains unchanged
(C) PCl_5 is less
(D) Cl_2 is greater

68. At temperature, T, a compound $AB_{2(g)}$ dissociates according to the reaction $2AB_2 \rightleftharpoons 2AB_{(g)} + B_{2(g)}$ with a degree of dissociation x, which is small compared with unity. The expression of K_p in terms of x and the total pressure, P is

(A) $Px^3/2$
(B) $Px^2/3$
(C) $Px^3/3$
(D) $Px^2/2$

69. Concentration of reactants and products at equilibrium for
$A + 2B \rightleftharpoons C + D$ are,
[A] = 0.2, [B] = 0.1, [C] = 0.3, [D] = 0.5; the value of equilibrium constant is

(A) 75
(B) 150
(C) 2.5
(D) 750

70. The expression for K_p for $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ is

(A) $K_p = \dfrac{P_{CO_2}.P_{CaO}}{P_{CaO_3}}$
(B) $P_{CaO} \times P_{CO_2} = K_p$
(C) $K_p = P_{CO_2}$
(D) $K_p = \dfrac{P_{CaO}}{P_{CaCO_3}}$

PHYSICS

PART – III

71. If the relation between distance x and time t is denoted by $t = \alpha x^2 + \beta x$ where α and β are constant quantities, the deceleration of the particle is

(A) $2\alpha v^3$
(B) βv^3
(C) $2\alpha\beta v^3$
(D) $2\beta^2 v^3$

72. An aeroplane is flying at height 'h' with horizontal velocity u. The velocity of a dropped packet on reaching ground will be

(A) $\sqrt{u^2 + 2gh}$
(B) $\sqrt{2gh}$
(C) 2gh
(D) $\sqrt{u^2 - 2gh}$

73. The equation of a projectile is $y = \sqrt{3}x - \dfrac{gx^2}{2}$ the angle of projection is

(A) 30°
(B) 60°
(C) 45°
(D) None of these

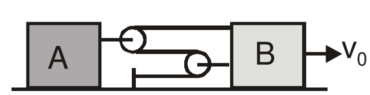
74. An isolated particle of mass m is moving in horizontal plane (x-y), along the x-axis , at a certain height above the ground. it suddenly explodes into two fragment of masses m/4 and 3m/4. An instant later, the smaller fragment is at y = +15cm. the larger fragment at this instant is at :

(a) y = –5 cm
(b) y = +20 cm
(c) y = +5 cm
(d) y = –20 cm

75. Two blocks of masses 10 kg and 4 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of 14 m/s to the heavier block in the direction of the lighter block. The velocity of the center of mass is :

(a) 30 m/s
(b) 20 m/s
(c) 10 m/s
(d) 5 m/s

76. Block B is moving towards right with constant velocity v_0. Velocity of block A with respect to block B is (Assume all pulleys and strings are ideal)



(A) $v_0/2$ left
(B) $v_0/2$ right
(C) $3/2v_0$ right
(D) $3/2v_0$ left

77. A long spring is stretched by 2 cm, its potential energy is U. If the spring is stretched by 10 cm, the potential energy stored in it will be -

(A) U/25 (B) U/5
(C) 5U (D) 25U

78. A body moves a distance of 10 m along a straight line under the action of force of 5N. If the work done is 25 joules, then the angle which the force makes with the direction of motion of the body is -

(A) 0º (B) 30º
(C) 60º (D) 0º

79. A body of mass m kg is lifted by a man to a height of one meter in 30 sec. Another man lifts the same mass to the same height in 60 sec. The work done by them are in the ratio -

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

80. A rod of mass M and length 2L is placed in a horizontal plane with one end hinged to a vertical axis. A horizontal force of $F = \frac{Mg}{2}$ is applied perpendicular to the rod at a distance $\frac{3L}{2}$ from the hinged end. The angular acceleration of the rod will be

(A) $\frac{4g}{5L}$ (B) $\frac{5g}{4L}$
(C) $\frac{9g}{16L}$ (D) $\frac{4g}{3L}$

81. A circular disc *X* of radius *R* is made from an iron plate of thickness *t*, and another plate *Y* of radius 4 *R* is made from an iron plate of thickness t/4. The ratio of moment of inertia I_Y / I_X is

(A) 32 (B) 16
(C) 1 (D) 64

82. A cord is wound round the circumference of wheel of radius r. The axis of the wheel is horizontal and moment of inertia about it is I. A weight mg is attached to the end of the cord and falls from rest. After falling through a distance h, the angular velocity of the wheel will be

(A) $\sqrt{\frac{2gh}{I + mr}}$ (B) $\left[\frac{2mgh}{I + mr^2}\right]^{1/2}$
(C) $\left[\frac{2mgh}{I + 2mr^2}\right]^{1/2}$ (D) $\sqrt{2gh}$

83. A body of mass m = 3.513 kg is moving along the x-axis with a speed of $5.00 ms^{-1}$. The magnitude of its momentum is recorded as

(A) $17.565 kg\, ms^{-1}$ (B) $17.56 kg\, ms^{-1}$
(C) $17.57 kg\, ms^{-1}$ (D) $17.6 kg\, ms^{-1}$

84. Consider a uniform square plate of side a and mass m. The moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

(A) $\frac{1}{12} ma^2$ (B) $\frac{7}{12} ma^2$
(C) $\frac{2}{3} ma^2$ (D) $\frac{5}{6} ma^2$

85. A block of mass 0.50 kg is moving with a speed of $2.00 ms^{-1}$ on a smooth surface. It strikes another mass of 1.00 kg and then they move together as a single body. The energy loss during the collision is

(A) 1.00 J (B) 0.67 J
(C) 0.34 J (D) 0.16 J

86. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth:

(A) The acceleration of S is always directed towards the centre of the earth.
(B) The angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant.
(C) The total mechanical energy of S varies periodically with time.
(D) The linear momentum of S remains constant in magnitude.

87. Two particles of mass m_1 and m_2 are initially at rest at infinite distance. Find their velocity of approach due to gravitational attraction, when their separation is d:

(A) $\sqrt{\frac{2G(m_1+m_2)}{d}}$ (B) $\sqrt{\frac{G(2m_1+m_2)}{3d}}$

(C) $\sqrt{\frac{3G(2m_1+m_2)}{d}}$ (D) $\sqrt{\frac{G(m_1+m_2)}{d}}$

88. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is $11 kms^{-1}$, the escape velocity from the surface of the planet would be

(A) $11 kms^{-1}$ (B) $110 kms^{-1}$

(C) $0.11 kms^{-1}$ (D) $1.1 kms^{-1}$

89. A small planet is revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force between the planet and the start were proportional to $R^{-5/2}$, then T would be proportional to

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

(C) $R^{7/2}$ (D) $R^{7/4}$

90. If the both the mass and the radius or earth decrease by 1%, the value of the acceleration due to gravity will

(A) decrease by 1% (B) increase by 1%

(C) increase by 2% (D) remain unchanged

91. The change in the value of g at a height h above the surface of the earth is the same as at a depth d below the surface of earth. When both d and h are much smaller than the radius of earth, then which of the following is correct?

(A) $d = 2h$ (B) $d = h$

(C) $d = \frac{h}{2}$ (D) $d = \frac{3h}{2}$

92. A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere.
(you may take $G = 6.67 \times 10^{-11}$ Nm^2/kg^2)

(A) 6.67×10^{-9} J (B) 6.67×10^{-10} J

(C) 13.34×10^{-10} J (D) 3.33×10^{-10} J

93. Average density of the earth

(A) is directly proportional to g (B) is inversely proportional to g

(C) does not depend on g (D) is a complex function of g

94. A rocket is launched vertically from the surface of the earth of radius R with an initial speed v. If atmospheric resistance is neglected, the maximum height attained by the rocket is given by

(A) $h = \frac{R}{\left(\frac{2gR}{v^2}-1\right)}$ (B) $h = \frac{R}{\left(\frac{2gR}{v^2}+1\right)}$

(C) $h = R\left(\frac{2gR}{v^2}-1\right)$ (D) $h = R\left(\frac{2gR}{v^2}+1\right)$

95. An extremely small and dense neutron star of mass M and radius R is rotating at an angular frequency ω. If an object is placed at its equator, it will remain stuck to it due to gravity if

(A) $M > \frac{R\omega}{G}$ (B) $M > \frac{R^2\omega^2}{G}$

(C) $M > \frac{R^3\omega^2}{G}$ (D) $M > \frac{R^2\omega^3}{G}$

96. If the distance between the earth and the sun were half its present value, the number of days in a year would have been

(A) 64.5 (B) 129

(C) 182.5 (D) 730

97. Two bodies of masses m_1 and m_2 are initially at rest at infinite distance apart. They are then allowed to move toward each other under mutual gravitational attraction. Their relative velocity of approach at a separation distance r between them is

(A) $\left[\dfrac{2G(m_1+m_2)}{r}\right]^{1/2}$ (B) $\left[\sqrt{\dfrac{2G}{r}}\dfrac{(m_1+m_2)}{2}\right]^{1/2}$

(C) $\left[\dfrac{r}{2G(m_1m_2)}\right]^{1/2}$ (D) $\left(\dfrac{2G}{r}m_1m_2\right)^{1/2}$

98. A satellite in force-free space sweeps stationary interplanetary dust at a rate $dM/dt = \alpha v$, where M is the mass and v is the velocity of the satellite and α is a constant. The acceleration of the satellite is

(A) $\dfrac{-2\alpha v}{M}$ (B) $\dfrac{-\alpha v^2}{M}$

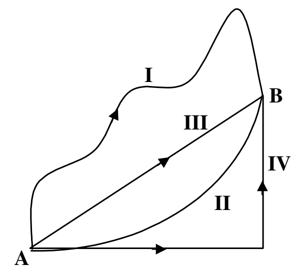
(C) $\dfrac{+\alpha v^2}{M}$ (D) $-\alpha v^2$

99. A person brings a mass of 1 kg from infinity to a point A. Initially, the mass was at rest but it moves at a speed of 3 m/s as it reaches A. The workdone by the person on the mass is –5.5 J. The gravitational potential at A is

(A) –1 J/kg (B) –4.5 J/kg
(C) –5.5 J/kg (D) –10 J/kg

100. In a gravitational force field a particle is taken from A to B along different paths as shown in the figure. Then

(A) work done along path I is more
(B) work done along path III is less
(C) work done along path IV is more
(D) work done along all paths is the same



101. The horizontal speed with which a satellite must be projected at 316 km above the surface of the earth so that it will have a circular orbit about the earth (R = 6400 km, g = 10 m/s^2) is

(A) 7500 m/s (B) 7800 m/s
(C) 8000 m/s (D) 3200 m/s

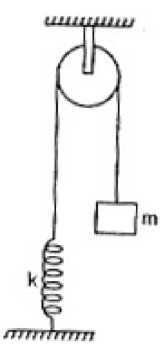
102. The angular momentum of the earth revolving round the sun is proportional to R^n where R is the distance between the earth and the sun. The value of n is

(A) 0.5 (B) 1.0
(C) 1.5 (D) 2.0

103. A planet has twice the density of earth but the acceleration due to gravity on its surface is exactly the same as on the surface of earth. Its radius in terms of earth R will be

(A) R/4 (B) R/2
(C) R/3 (D) R/8

104. Consider the situation shown in figure. Initially the spring is unstretched when the system is released from rest. Assuming no friction in the pulley, the maximum elongation of the spring is



(A) $\dfrac{mg}{k}$ (B) $\dfrac{2mg}{k}$

(C) $\dfrac{3mg}{k}$ (D) $\dfrac{4mg}{k}$

105. A mass 2 kg is tied to one end of a light rod of length l. What horizontal velocity should be imparted to the lower end so that it may just take up the horizontal position?

(A) $\sqrt{2gl}$ (B) $\sqrt{gl}$

(C) $\sqrt{\dfrac{12}{5}gl}$ (D) None of these