KINETICS

KINETICS का साथ है तो सफ़लता का विश्वास है।

IIT JEE

PST- 09 SET-A

KINETICS
We Nurture The Future
IIT-JEE | Medical | Foundations

Batch: AARAMBH
Date: 21/10/2024
Marks: 300
TOPIC:
PHYSICS: CIRCULAR MOTION, COM, FRICTION
CHEMISTRY: P-BLOCK, REDOX REACTION, EQUILIBRIUM, MOLE CONCEPT
MATHEMATICS: POINT & STRAIGHT LINE, CIRCLE, TRIGO-2, BIONOMIAL

PHYSICS

1. A small object of uniform density rolls up a curved surface with an initial velocity 'v'. It reaches upto a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position. The object is

(a) hollow sphere (b) disc
(c) ring (d) solid sphere

2. A body of mass 100 g is sliding from an inclined plane of inclination 30°. What is the frictional force experienced if $\mu = 1.7$

(a) $1.7 \times \sqrt{2} \times \frac{1}{\sqrt{3}} N$ (b) $1.7 \times \sqrt{3} \times \frac{1}{2} N$
(c) $1.7 \times \sqrt{3}\ N$ (d) $1.7 \times \sqrt{2} \times \frac{1}{3} N$

3. The upper half of an inclined plane of inclination θ is perfectly smooth while the lower half is rough. A body starting from the rest at top comes back to rest at the bottom if the coefficient of friction for the lower half is given by

(a) $\mu = \sin\theta$ (b) $\mu = \cot\theta$
(c) $\mu = 2\cos\theta$ (d) $\mu = 2\tan\theta$

4. Two particles of masses 1 kg and 3 kg move towards each other under their mutual force of attraction. No other force acts on them. When the relative velocity of approach of the two particles is 2m/s, their centre of mass has a velocity of 0.5 m/s. When the relative velocity of approach becomes 3 m/s, the velocity of the centre of mass is

(a) 0.5 m/s (b) 0.75 m/s
(c) 1.25 m/s (d) Zero

5. Two point masses m and M are separated by a distance L. The distance of the centre of mass of the system from m is

(a) $L(m/M)$ (b) $L(M/m)$
(c) $L\left(\frac{M}{m+M}\right)$ (d) $L\left(\frac{m}{m+M}\right)$

6. A body of mass 5kg rests on a rough horizontal surface of coefficient of friction 0.2. The body is pulled through a distance of 10m by a horizontal force of 25 N. The kinetic energy acquired by it is (g = 10 ms^2)

(a) 330 J (b) 150 J
(c) 100 J (d) 50 J

7. A block is kept on an inclined plane of inclination θ of length l. The velocity of particle at the bottom of inclined is (the coefficient of friction is μ)

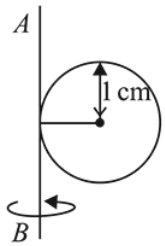
(a) $\sqrt{2gl(\mu\cos\theta - \sin\theta)}$ (b) $\sqrt{2gl(\sin\theta - \mu\cos\theta)}$
(c) $\sqrt{2gl(\sin\theta + \mu\cos\theta)}$ (d) $\sqrt{2gl(\cos\theta + \mu\sin\theta)}$

8. If μ_s, μ_k and μ_r are coefficients of static friction, sliding friction and rolling friction, then

(a) $\mu_s < \mu_k < \mu_r$ (b) $\mu_k < \mu_r < \mu_s$
(c) $\mu_r < \mu_k < \mu_s$ (d) $\mu_r = \mu_k = \mu_s$

9. A metal coin of mass 5 g and radius 1 cm is fixed to a thin stick AB of negligible mass as shown in the

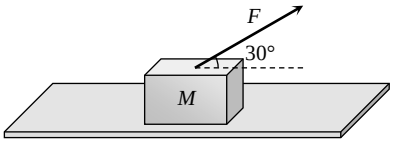
figure The system is initially at rest. The constant torque, that will make the system rotate about AB at 25 rotations per second in 5s, is close to:



(a) 4.0×10^{-6}Nm
(b) 1.6×10^{-5}Nm
(c) 7.9×10^{-6} Nm
(d) 2.0×10^{-5}Nm

10. A block of mass $M = 5\,kg$ is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force $F = 40\ N$ is applied, the acceleration of the block will be $(g = 10\ m/s^2)$

(a) $5.73\ m/\sec^2$
(b) $8.0\ m/\sec^2$
(c) $3.17\ m/\sec^2$
(d) $10.0\ m/\sec^2$



11. A body of 5 *kg* weight kept on a rough inclined plane of angle 30° starts sliding with a constant velocity. Then the coefficient of friction is (assume g = 10 m/s^2)

(a) $1/\sqrt{3}$ (b) $2/\sqrt{3}$
(c) $\sqrt{3}$ (d) $2\sqrt{3}$

12. Three masses are placed on the x-axis: 300 g at origin, 500 $g at x = 40$ cm and 400 g at $x =$ 70 cm. The distance of the centre of mass from the origin is

(a) 40 cm (b) 45 cm
(c) 50 cm (d) 30 cm

13. Four particle of masses *m*, 2*m*, 3*m* and 4*m* are arranged at the corners of a parallelogram with each side equal to *a* and one of the angle between two adjacent sides is 60°. The parallelogram lies in the *x*-*y* plane with mass *m* at the origin and 4*m* on the *x*-axis. The centre of mass of the arrangement will be located at

(a) $\left(\frac{\sqrt{3}}{2}a,\ 0.95a\right)$ (b) $\left(0.95a,\ \frac{\sqrt{3}}{4}a\right)$

(c) $\left(\frac{3a}{4},\ \frac{a}{2}\right)$ (d) $\left(\frac{a}{2},\ \frac{3a}{4}\right)$

14. Two persons of masses 55 kg and 65 kg respectively, are at the opposite ends of a boat. The length of the boat is 3.0 m and weighs 100 kg. The 55 kg man walks up to the 65 kg man and sits with him. If the boat is in still water the center of mass of the system shifts by

(a) 3.0 m (b) 2.3 m
(c) zero (d) 0.75 m

15. A brick of mass 2 *kg* begins to slide down on a plane inclined at an angle of 45° with the horizontal. The force of friction will be

(a) 19.6 *sin* 45° (b) 19.6 cos 45°
(c) 9.8 *sin* 45° (d) 9.8 cos 45°

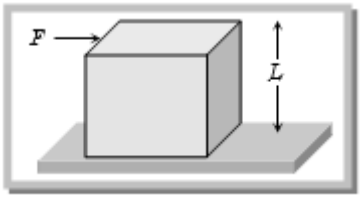
16. If the rotational kinetic energy of a body is increased by 300% then the percentage increase in its angular momentum will be

(a) 600% (b) 150%
(c) 100% (d) 1500%

17. The time dependence of the position of a particle of mass $m = 2$ is given by $\vec{r}(t) = 2t\hat{i} - 3t^2\hat{j}$. Its angular momentum, with respect to the origin, at time $t = 2$ is :

(a) $48(\hat{i} + \hat{j})$ (b) $36\hat{k}$
(c) $-34(\hat{k} - \hat{i})$ (d) $-48\hat{k}$

18. A cubical block of side *L* rests on a rough horizontal surface with coefficient of friction μ. A horizontal force *F* is applied on the block as shown. If the coefficient of friction is sufficiently high so that the block does not slide before toppling, the minimum force required to topple the block is



(a) Infinitesimal

(b) $mg/4$

(c) $mg/2$

(d) $mg(1-\mu)$

19. A force of 750 *N* is applied to a block of mass 102 *kg* to prevent it from sliding on a plane with an inclination angle 30° with the horizontal. If the coefficients of static friction and kinetic friction between the block and the plane are 0.4 and 0.3 respectively, then the frictional force acting on the block is

(a) 750 *N* (b) 500 *N*

(c) 345 *N* (d) 250 *N*

20. What is the torque of the force $\vec{F} = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}N$ acting at the point $\vec{r} = 3\hat{\imath} + 2\hat{\jmath} + 3\hat{k}m$ about origin?

(a)$-6\hat{\imath} + 6\hat{\jmath} - 12\hat{k}$

(b)$-17\hat{\imath} + 6\hat{\jmath} + 13\hat{k}$

(c)$6\hat{\imath} - 6\hat{\jmath} + 12\hat{k}$

(d)$17\hat{\imath} - 6\hat{\jmath} - 13\hat{k}$.

21. A given object takes *n* times as much time to slide down a 45° rough incline as it takes to slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is given by

(a) $\left(1-\frac{1}{n^2}\right)$ (b) $\frac{1}{1-n^2}$

(c) $\sqrt{\left(1-\frac{1}{n^2}\right)}$ (d) $\sqrt{\frac{1}{1-n^2}}$

22. Three identical spheres, each of mass 1 *kg* are placed touching each other with their centres on a straight line. Their centres are marked *K*, *L* and *M* respectively. The distance of centre of mass of the system from *K* is

(a) $\frac{KL+KM+LM}{3}$ (b) $\frac{KL+KM}{3}$

(c) $\frac{KL+LM}{3}$ (d) $\frac{KM+LM}{3}$

23. Rotational kinetic energy of a given body about an axis is proportional to

(a) Time period (b) $(\text{Time period})^2$

(c) $(\text{Time period})^{-1}$ (d) $(\text{time period})^{-2}$

24. The speed of a homogenous solid sphere after rolling down an inclined plane of vertical height h form rest without sliding is

(a)$\sqrt{\frac{10}{7}gh}$ (b)$\sqrt{gh}$

(c)$\sqrt{\frac{6}{5}gh}$ (d)$\sqrt{\frac{4}{3}gh}$

25. Starting from rest, a body slides down a 45° inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is

(a) 0.33 (b) 0.25

(c) 0.75 (d) 0.80

CHEMISTRY

26. Number ofmoles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be

(a) 7.5 moles (b) 0.2 moles

(c) 0.6 moles (d) 0.4 moles.

27. If equilibrium constant for reaction $2AB \rightleftharpoons A_2 + B_2$, is 49, then the equilibrium constant for reaction

$AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$, will be

(a) 7 (b) 20

(c) 49

(d) 21

28. Which of the following have same number of significant figures?

(A) 0.00253

(B) 1.0003

(C) 15.0

(D)163

Choose the correct answer from the options given below

(a) A, B and C only

(b) C and D only

(c) B and C only

(d) A, C and D only

29. For the redox reaction,

$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$ The correct coefficients of the reactants for the balanced equation are

MnO_4^-	$C_2O_4^{2-}$	H^+
(a) 16	5	2
(b) 2	5	16
(c) 2	16	5
(d) 5	16	2 (*NEET2018*)

30. How many atoms in total are present in 1 kg of sugar?

(a) 7.92×10^{25} atoms (b) 6×10^{23} atoms

(c) 6.022×10^{25} atoms (d) 1000 atoms

31. What would be the pH of an ammonia solution if that of an acetic acid solution of equal strength is 3.2? Assume dissociation constant for NH3& acetic acid are equal.

(a) 3.2 (b) 6.4

(c) 9.6

(d) 10.8

32. What is the mass of carbon dioxide which contains the same number of molecules as are contained in 40 g of oxygen?

(a) 40 g (b) 55 g

(c) 32 g (d) 44 g

33. What is the mass ratio of ethylene glycol ($C_2H_6O_2$, molar mass = 62 g/mol) required for making 500 g of 0.25 molal aqueous solution and 250 mL of 0.25 molar aqueous solution ?

(a)1 : 1 (b)3: 1

(c) 2 : 1 (d) 1 : 2

34. In an equilibrium reaction for which $\Delta G^0 = 0$ the equilibrium constant K_p should be

(a) 0

(b) 1

(c) 2

(d) 10

35. The element that does NOT show catenation is:

(a) Ge (b) Si

(c) Sn (d) Pb

36. pH of Ba(OH)2 solution is 12. Its solubility product is

(a) $10^{-6}\,M^3$

(b) $4 \times 10^{-6}\,M^3$

(c) $0.5 \times 10^{-7}\,M^3$

(d) $5 \times 10^{-7}\,M^3$

37. An example of a disproportionate reaction is:

(a) $2MNO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

(b) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

(c) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_4 + O_2$

(d) $2CuBr \rightarrow CuBr_2 + Cu$

38. The numerical value of the equilibrium constant or any chemical change is affected by changing the

(a) Concentration of product

(b) Catalyst

(c)Concentration of reacting substance

(d) Temperature

39. The compound that cannot act both as oxidising and reducing agent is:

(a) H_2SO_3 (b) HNO_2 (c) H_3PO_4 (d) H_2O_2

40. It is found that the equilibrium constant increases by a factor of four when the temperature is increased from 25^oC to 40^oC. The value of ΔH^o is

(a) $25.46\ kJ\ mol^{-1}$

(b) $171.67\ kJ\ mol^{-1}$

(c) $89.43\ kJ\ mol^{-1}$

(d) $71.67\ kJ\ mol^{-1}$

41. The number of moles of methane required to produce $11 g CO_2(g)$ after complete combustion is : (Given molar mass of methane in $gmol^{-1}$: 16)

(a) 0.35 (b) 0.5

(c) 0.75 (d) 0.25

42. The number of $2-$centre$-2-$electron and $3-$centre$-2-$electron bonds in B_2H_6 respectively, are:

(a) 2 and 1 (b) 4 and 2

(c) 2 and 2 (d) 2 and 4

43. An organic compound has 42.1% carbon, 6.4% hydrogen and remainder is oxygen. If its molecular weight is 342, then its molecular formula is :

(a) $C_{11}H_{18}O_{12}$ (b) $C_{12}H_{20}O_{12}$

(c) $C_{12}H_{22}O_{11}$ (d) $C_{14}H_{20}O_{10}$

44. The chloride that CAN NOT get hydrolysed is:

(a)$PbCl_4$ (b)CCl_4

(c)$SnCl_4$ (d)$SiCl_4$

45. 4 ml of HCl solution of pH = 2 is mixed with 6 ml of NaOH solution of pH = 12. what would be the final pH of solution ? log 2 = 0.3

(a)10.3 (b)11.3

(c)11

(d)4.3

46. C_{60}, an allotrope of carbon cantains:
(a) 12 hexagons and 20 pentagons.
(b) 18 hexagons and 14 pentagons.
(c) 16 hexagons and 16 pentagons.
(d) 20 hexagons and 12 pentagons.

47. The amorphous form of silica is:
(a) Tridymite(b) Kieselguhr
(c) Cristobalite (d) Quartz

48. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to
(a) I_2 & IO_3^- (b) IO_3^- & I_2
(c) IO_3^- & IO_3^- (d) I_2 & I_2

49. The element that shows greater ability to form $p\pi - p\pi$ multiple bonds, is :
(a)Sn (b) C
(c) Ge (d) Si

50. The oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
(a) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(b) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$
(c) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(d) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

MATHEMATICS

51. The sum of all rational terms in the expansion of $\left(2^{\frac{1}{5}} + 5^{\frac{1}{3}}\right)^{15}$ is equal to :
(a) 3133 (b) 931
(c) 6131 (d) 633

52. If the constant term in the expansion of $\left(\frac{\sqrt[5]{3}}{x} + \frac{2x}{\sqrt[3]{5}}\right)^{12}$, $x \neq 0$, is $\alpha \times 2^8 \times \sqrt[5]{3}$, then 25α is equal to :
(a) 724 (b) 742
(c) 639 (d) 693

53. The figure formed by the pairs of lines $6x^2 + 13xy + 6y^2 = 0$ and $6x^2 + 13xy + 6y^2 + 10x + 10y + 4 = 0$, is a
(a) Square (b) Parallelogram
(c) Rhombus (d) Rectangle

54. The lines $ax^2 + 2hxy + by^2 = 0$ are at right angles if
(a) $a + b = 0$ (b) $a + b = 1$
(c) $h^2 - ab = 0$ (d) $a = b$

55. If the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ touches x-axis, then
(a) $g = f$ (b) $g^2 = c$
(c) $f^2 = c$ (d) $g^2 + f^2 = c$

56. If $P(6, 1)$ be the orthocentre of the triangle whose vertices are $A(5, -2)$, $B(8, 3)$ and $C(h, k)$, then the point C lies on the circle:
(a) $x^2 + y^2 - 61 = 0$
(b) $x^2 + y^2 - 52 = 0$
(c) $x^2 + y^2 - 65 = 0$
(d) $x^2 + y^2 - 74 = 0$

57. For $a \neq b \neq c$, if the lines $x + 2ay + a = 0$ $x + 3by + b = 0$ and $x + 4cy + c = 0$ are concurrent, then a, b, c are in
(a) Arithmetic progression
(b) Geometric progression
(c) Harmonic progression
(d) Arithmetico geometric progression

58. If the term independent of x in the expansion of $\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ is 405 , then $k =$
(a) ± 1 (b) 0
(c) ± 3 (d) ± 5

59. If a circle whose centre is (1, -3) touches the line $3x - 4y - 5 = 0$, then the radius of the circle is
(a) 2 (b) 4
(c) $\frac{5}{2}$ (d) $\frac{7}{2}$

60. If the circles $(x + 1)^2 + (y + 2)^2 = r^2$ and $x^2 + y^2 - 4x - 4y + 4 = 0$ intersect at exactly two distinct points, then
(a) $5 < r < 9$ (b) $0 < r < 7$
(c) $3 < r < 7$ (d) $\frac{1}{2} < r < 7$

61. Let the locus of the mid points of the chords of circle $x^2 + (y - 1)^2 = 1$ drawn from the origin intersect the line $x + y = 1$ at P and Q. Then, the length of PQ is :
(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$
(c) $\frac{1}{2}$ (d) 1

62. If $\tan 2\theta \tan \theta = 1$, then the general value of θ is
(a) $\left(n + \frac{1}{2}\right)\frac{\pi}{3}$ (b) $\left(n + \frac{1}{2}\right)\pi$
(c) $\left(2n \pm \frac{1}{2}\right)\frac{\pi}{3}$ (d) None of these

63. If $\sqrt{3}\cos\theta + \sin\theta = \sqrt{2}$, then the most general value of θ is
(a) $n\pi + (-1)^n \frac{\pi}{4}$ (b) $(-1)^n \frac{\pi}{4} - \frac{\pi}{3}$

(c) $n\pi+\frac{\pi}{4}-\frac{\pi}{3}$ (d) $n\pi+(-1)^n\frac{\pi}{4}-\frac{\pi}{3}$

64. The number of integral terms in the expansion of $(\sqrt{3}+\sqrt[8]{5})^{256}$ is

(a) 32 (b) 33

(c) 34 (d) 35

65. The equation of tangents to the circle $x^2+y^2=4$ which are parallel to $x+2y+3=0$ are

(a) $x-2y=\pm 2\sqrt{5}$

(b) $x-2y=\pm 2$

(c) $x+2y=\pm 2\sqrt{3}$

(d) $x+2y=\pm 2\sqrt{5}$

66. The coefficient of x^4 in the expansion of $(1-x-x^2+x^3)^6$ is

(a) 120 (b) 15

(c) -75 (d) -60

67. Find the equation of a circle of radius 5 units whose centre lies on x-axis and passes through the point $(2,4)$.

(a) $x^2+y^2-12x-11=0$

(b) $x^2+y^2-4x-21=0$

(c) $x^2+y^2+2x-24=0$

(d) $x^2+y^2+12x-11=0$

68. The middle term in the expansion of $\left(4x^3-\frac{15}{4x}\right)^8$ is

(a) $70(15x)^4$ (b) $1820x^8$

(c) $70(15x^2)^4$ (d) $2560x^4$

69. If $\sec^2\theta=\frac{4}{3}$, then the general value of θ is

(a) $2n\pi\pm\frac{\pi}{6}$ (b) $n\pi\pm\frac{\pi}{6}$

(c) $2n\pi\pm\frac{\pi}{3}$ (d) $n\pi\pm\frac{\pi}{3}$

70. The centre of the circle whose radius is 3 units and touching internally the circle $x^2+y^2-4x-6y-12=0$ at the point $(-1,-1)$ is

(a) $\left(\frac{4}{5},\frac{7}{5}\right)$ (b) $\left(\frac{4}{5},\frac{-7}{5}\right)$

(c) $\left(\frac{-4}{5},\frac{-7}{5}\right)$ (d) $\left(\frac{-4}{5},\frac{7}{5}\right)$

71. Let the circle $C_1: x^2+y^2-2(x+y)+1=0$ and C_2 be a circle having centre at $(-1,0)$ and radius 2 . If the line of the common chord of C_1 and C_2 intersects the y-axis at the point P , then the square of the distance of P from the centre of C_1 is :

(a) 2 (b) 1

(c) 4 (d) 6

72. If $2x^2-10xy+2\lambda y^2+5x-16y-3=0$ represents a pair of straight lines, then point of intersection of those lines is

(a) $(2,-3)$ (b) $(5,-16)$

(c) $\left(-10,\frac{-7}{2}\right)$ (d) $\left(-10,\frac{-3}{2}\right)$

73. If the image of the point $(-4,5)$ in the line $x+2y=2$ lies on the circle $(x+4)^2+(y-3)^2=r^2$, then r is equal to:

(a) 2 (b) 3

(c) 1 (d) 4

74. If $2\sin\theta+\tan\theta=0$, then the general values of θ are

(a) $2n\pi\pm\frac{\pi}{3}$ (b) $n\pi,2n\pi\pm\frac{2\pi}{3}$

(c) $n\pi,2n\pi\pm\frac{\pi}{3}$ (d) $n\pi,\ n\pi+\frac{2\pi}{3}$

75. The parametric equation of the circle $x^2+y^2-6x-2y+9=0$ are

(a) $x=3+\cos\theta, y=1+\sin\theta$

(b) $x=1+\cos\theta, y=3+\sin\theta$

(c) $x=\cos\theta, y=\sin\theta$

(d) $x=3+\sin\theta, y=1+\cos\theta$