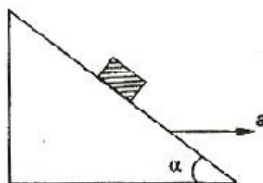


Physics

- A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flights in the two cases, then the product of the two times of flights is proportional to :
 (a) R^2 (b) $\frac{1}{R^2}$
 (c) $\frac{1}{R}$ (d) R
- An annular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, $\frac{F_1}{F_2}$ is :
 (a) $\frac{R_2}{R_1}$ (b) $\left(\frac{R_1}{R_2}\right)^2$
 (c) 1 (d) $\frac{R_1}{R_2}$
- A smooth block is released at rest on a 45° incline and then slides a distance d . The time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is :
 (a) $\mu_k = 1 - \frac{1}{n^2}$ (b) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$
 (c) $\mu_s = 1 - \frac{1}{n^2}$ (d) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$
- The upper half of an inclined plane with inclination ϕ is perfectly smooth, while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom, if the coefficient of friction for the lower half is given by :
 (a) $2 \sin \phi$ (b) $2 \cos \phi$
 (c) $2 \tan \phi$ (d) $\tan \phi$
- A bullet fired into a fixed target loses half of its velocity after penetrating 3cm. How much further it will penetrate before coming to rest, assuming that it faces constant resistance to motion ?
 (a) 3.0 cm (b) 2.0 cm
 (c) 1.5 cm (d) 1.0 cm
- Out of the following pairs, which one does not have identical dimensions ?
 (a) Angular momentum and Planck's constant
 (b) Impulse and momentum
 (c) Moment of inertia and moment of a force
 (d) Work and torque
- The relation between time t and distance x is $t = ax^2 + bx$, where a and b are constants. The acceleration is :
 (a) $-2abv^2$ (b) $2bv^3$
 (c) $-2av^3$ (d) $2av^2$
- A car, starting from rest, accelerates at the rate f through a distance S , then continues at constant speed for time t and then decelerates at the rate $f/2$ to come to rest. If the total distance travelled is $15S$, then :
 (a) $S = ft$ (b) $S = \frac{1}{6}ft^2$
 (c) $S = \frac{1}{2}ft^2$ (d) $S = \frac{1}{4}ft^2$
- A particle is moving eastwards with a velocity of 5 ms^{-1} . In 10 s the velocity changes to 5 ms^{-1} northwards. The average acceleration in this time is :
 (a) $\frac{1}{\sqrt{2}} \text{ ms}^{-2}$ towards north-east
 (b) $\frac{1}{2} \text{ ms}^{-2}$ towards north
 (c) zero
 (d) $\frac{1}{2} \text{ ms}^{-2}$ towards north-west
- A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2 . He reaches the ground with a speed of 3 m/s. At what height, did he bail out ?
 (a) 91 m (b) 182 m
 (c) 293 m (d) 111 m

11. A block is kept on a frictionless inclined surface with angle of inclination α . The incline is given an acceleration a to keep the block stationary. Then a is equal to :



- (a) $g/\tan \alpha$ (b) $g \operatorname{cosec} \alpha$
(c) g (d) $g \tan \alpha$
12. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100 m. It rolls down a smooth surface to the ground, then climbs up another hill of height 30 m and finally rolls down to a horizontal base at a height of 20 m above the ground. The velocity attained by the ball is :
- (a) 40 m/s (b) 20 m/s
(c) 10 m/s (d) $10\sqrt{30}$ m/s
13. A body A of mass M while falling vertically downwards under gravity breaks into two parts; a body B of mass $\frac{1}{3}M$ and, a body C of mass $\frac{2}{3}M$. The centre of mass of bodies B and C taken together shifts compared to that of body A towards :
- (a) depends on height of breaking
(b) does not shift
(c) body C
(d) body B
14. The moment of inertia of uniform semicircular disc of mass M and radius r about a line perpendicular to the plane of the disc through the centre is :
- (a) $\frac{1}{4}Mr^2$ (b) $\frac{2}{5}Mr^2$
(c) Mr^2 (d) $\frac{1}{2}Mr^2$
15. A particle of mass 0.3 kg is subjected to a force $F = -kx$ with $k = 15 \text{ N/m}$. What will be its initial acceleration, if it is released from a point 20 cm away from the origin ?
- (a) 3 m/s^2 (b) 15 m/s^2
(c) 5 m/s^2 (d) 10 m/s^2
16. The block of mass M moving on the frictionless horizontal surface collides with the spring of

spring constant k and compresses it by length L . The maximum momentum of the block after collision is :



- (a) $\sqrt{Mk} L$ (b) $\frac{kL^2}{2M}$
(c) zero (d) $\frac{ML^2}{k}$
17. A mass m moves with a velocity v and collides inelastically with another identical mass. After collision the 1st mass moves with velocity $\frac{v}{\sqrt{3}}$ in a direction perpendicular to the initial direction of motion. Find the speed of the second mass after collision :
- (a) v (b) $\sqrt{3} v$
(c) $\frac{2}{\sqrt{3}} v$ (d) $\frac{v}{\sqrt{3}}$
18. A 20 cm long capillary tube is dipped in water. The water rises upto 8 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be :
- (a) 8 cm (b) 10 cm
(c) 4 cm (d) 20 cm
19. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is :
- (a) $2S^2Y$ (b) $\frac{S^2}{2Y}$
(c) $\frac{2Y}{S^2}$ (d) $\frac{S}{2Y}$
20. Average density of the earth :
- (a) does not depend on g
(b) is a complex function of g
(c) is directly proportional to g
(d) is inversely proportional to g
21. A body of mass m is accelerated uniformly from rest to a speed v in a time T . The instantaneous power delivered to the body as a function of time, is given by :
- (a) $\frac{mv^2}{T^2} t$ (b) $\frac{mv^2}{T^2} t^2$
(c) $\frac{1}{2} \frac{mv^2}{T^2} t$ (d) $\frac{1}{2} \frac{mv^2}{T^2} t^2$

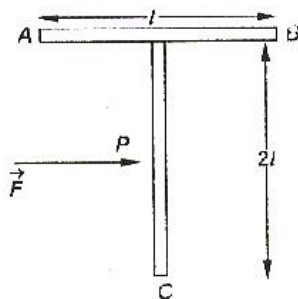
22. Consider a car moving on a straight road with a speed of 100 m/s. The distance at which car can be stopped, is : [$\mu_k = 0.5$]

(a) 800 m (b) 1000 m
(c) 100 m (d) 400 m

23. Which of the following is incorrect regarding the first law of thermodynamics ?

(a) It is not applicable to any cyclic process
(b) It is a restatement of the principle of conservation of energy
(c) It introduces the concept of the internal energy
(d) It introduces the concept of the entropy

24. A T shaped object with dimensions shown in the figure, is lying on a smooth floor. A force $\vec{F}$ is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect to C :



(a) $\frac{2}{3}l$ (b) $\frac{3}{2}l$
(c) $\frac{4}{3}l$ (d) l

25. 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 one of the following is correct ?

(a) $d = \frac{h}{2}$ (b) $d = \frac{3h}{2}$

(c) $d = 2h$ (d) $d = h$

26. 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 $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$)

(a) $13.34 \times 10^{-10} \text{ J}$ (b) $3.33 \times 10^{-10} \text{ J}$

(c) $6.67 \times 10^{-9} \text{ J}$ (d) $6.67 \times 10^{-10} \text{ J}$

27. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is :

(a) 1.59 (b) 1.62
(c) 1.4 (d) 1.54

28. The intensity of gamma radiation from a given source is I . On passing through 36 mm of lead, it is reduced to $I/8$. The thickness of lead, which will reduce the intensity to $I/2$ will be :

(a) 6 mm (b) 9 mm
(c) 18 mm (d) 12 mm

29. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm, is incident on it. The band gap in (eV) for the semiconductor is :

(a) 1.1 eV (b) 2.5 eV
(c) 0.5 eV (d) 0.7 eV

30. A Photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photocathode would :

(a) decrease by a factor of 4
(b) increase by a factor of 4
(c) decrease by a factor of 2
(d) increase by a factor of 2

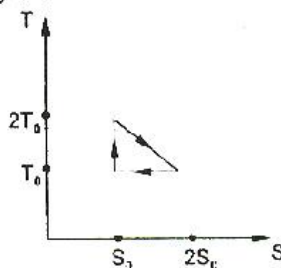
31. Starting with a sample of pure ^{66}Cu , 7/8 of it decays into Zn in 15 min. The corresponding half-life is :

(a) 10 min (b) 15 min
(c) 5 min (d) $7\frac{1}{2}$ min

32. If radius of the $^{27}_{13}\text{Al}$ nucleus is estimated to be 3.6 fermi, then the radius of $^{125}_{52}\text{Te}$ nucleus be nearly :

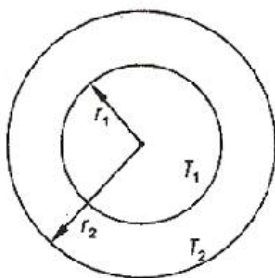
(a) 6 fermi (b) 8 fermi
(c) 4 fermi (d) 5 fermi

33. The temperature-entropy diagram of a reversible engine cycle is given in the figure. Its efficiency is :

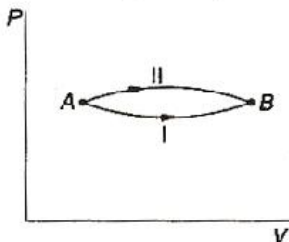


(a) 1/2 (b) 1/4
(c) 1/3 (d) 2/3

34. The figure shows a system of two concentric spheres of radii r_1 and r_2 and kept at temperatures T_1 and T_2 , respectively. The radial rate of flow of heat in a substance between the two concentric spheres, is proportional to :



- (a) $\frac{(r_2 - r_1)}{(r_1 r_2)}$ (b) $\ln \left(\frac{r_2}{r_1} \right)$
 (c) $\frac{r_1 r_2}{(r_2 - r_1)}$ (d) $(r_2 - r_1)$
35. A system goes from A to B via two processes I and II as shown in figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, then :



- (a) $\Delta U_1 = \Delta U_2$
 (b) relation between ΔU_1 and ΔU_2 cannot be determined
 (c) $\Delta U_2 > \Delta U_1$
 (d) $\Delta U_2 < \Delta U_1$
36. The function $\sin^2(\omega t)$ represents :
- (a) a periodic, but not simple harmonic, motion with a period $2\pi/\omega$
 (b) a periodic, but not simple harmonic, motion with a period π/ω
 (c) a simple harmonic motion with a period $2\pi/\omega$
 (d) a simple harmonic motion with a period π/ω
37. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is :
- (a) hyperbola (b) circle
 (c) straight line (d) parabola

38. Two simple harmonic motions are represented by the equations $y_1 = 0.1 \sin \left(100\pi t + \frac{\pi}{3} \right)$ and $y_2 = 0.1 \cos \pi t$. The phase difference of the velocity of particle 1, with respect to the velocity of particle 2 is :

- (a) $\frac{-\pi}{6}$ (b) $\frac{\pi}{3}$
 (c) $\frac{-\pi}{3}$ (d) $\frac{\pi}{6}$

39. A fish looking up through the water sees the outside world, contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and the fish is 12 cm below the water surface, the radius of this circle in cm is :

- (a) $36\sqrt{7}$ (b) $\frac{36}{\sqrt{7}}$
 (c) $36\sqrt{5}$ (d) $4\sqrt{5}$

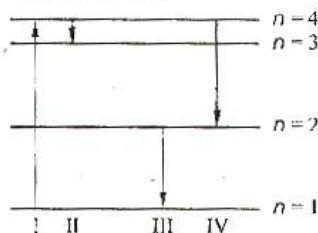
40. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye ? [Take wavelength of light = 500 nm]

- (a) 5 m (b) 1 m
 (c) 6 m (d) 3 m

41. A thin glass (refractive index 1.5) lens has optical power of -5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be :

- (a) 1 D (b) -1 D
 (c) 25 D (d) -25 D

42. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy ?



- (a) III (b) IV
 (c) I (d) II

43. If the kinetic energy of a free electron doubles, its de-Broglie wavelength changes by the factor :

- (a) $\frac{1}{2}$ (b) 2
 (c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

44. In a common base amplifier, the phase difference between the input signal voltage and output voltage is :

(a) $\frac{\pi}{4}$ (b) π
(c) zero (d) $\frac{\pi}{2}$

45. In a full wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be :

(a) 50 Hz (b) 25 Hz
(c) 100 Hz (d) 70.7 Hz

46. A nuclear transformation is denoted by $X(\pi, \alpha) \rightarrow {}^7_3\text{Li}$. Which of the following is the nucleus of element X ?

(a) ${}^{12}_5\text{C}$ (b) ${}^{10}_5\text{B}$
(c) ${}^9_5\text{B}$ (d) ${}^{11}_4\text{Be}$

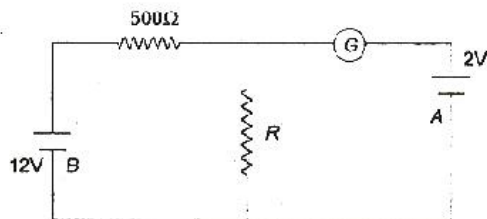
47. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milliamper and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 V, the resistance in Ohm's needed to be connected in series with the coil will be :

(a) 10^3 (b) 10^5
(c) 99995 (d) 9995

48. Two voltmeters, one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltmeters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are z_1 and z_2 respectively, the charge which flows through the silver voltmeter is :

(a) $\frac{q}{1 + \frac{z_1}{z_2}}$ (b) $\frac{q}{1 + \frac{z_2}{z_1}}$
(c) $q \frac{z_1}{z_2}$ (d) $q \frac{z_2}{z_1}$

49. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be :



(a) 200 Ω (b) 100 Ω
(c) 500 Ω (d) 1000 Ω

50. Two sources of equal emf are connected to an external resistance R . The internal resistances of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 , is zero, then :

(a) $R = \frac{R_2 \times (R_1 + R_2)}{(R_2 - R_1)}$

(b) $R = R_2 - R_1$

(c) $R = \frac{R_1 R_2}{(R_1 + R_2)}$

(d) $R = \frac{R_1 R_2}{(R_2 - R_1)}$

51. A fully charged capacitor has a capacitance C . It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity s and mass m . If the temperature of the block is raised by ΔT , the potential difference V across the capacitance is :

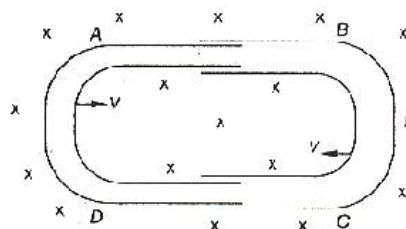
(a) $\sqrt{\frac{2mC\Delta T}{s}}$

(b) $\frac{mC\Delta T}{s}$

(c) $\frac{ms\Delta T}{C}$

(d) $\sqrt{\frac{2ms\Delta T}{C}}$

52. One conducting U -tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v , then the emf induced in the circuit in terms of B , l and v , where l is the width of each tube, will be :



(a) Blv (b) $-Blv$
(c) zero (d) $2Blv$

53. A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be :

(a) doubled (b) four times
(c) one-fourth (d) halved

54. Two thin, long, parallel wires, separated by a distance d carry a current of i A in the same direction. They will :

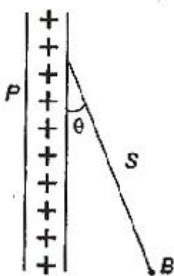
- (a) attract each other with a force of $\frac{\mu_0 i^2}{(2\pi d)}$
 (b) repel each other with a force of $\frac{\mu_0 i^2}{(2\pi d)}$
 (c) attract each other with a force of $\frac{\mu_0 i^2}{(2\pi d^2)}$
 (d) repel each other with a force of $\frac{\mu_0 i^2}{(2\pi d^2)}$

55. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is :

- (a) $\frac{1}{2} I_0$ (b) $\frac{1}{4} I_0$
 (c) zero (d) I_0

56. A charged ball B hangs from a silk thread S , which makes an angle θ with a large charged conducting sheet P , as shown in the figure. The surface charge density σ of the sheet is proportional to :

- (a) $\cos \theta$ (b) $\cot \theta$
 (c) $\sin \theta$ (d) $\tan \theta$



57. Two point charges $+8q$ and $-2q$ are located at $x=0$ and $x=L$ respectively. The location of a point on the x -axis at which the net electric field due to these two point charges is zero is :

- (a) $2L$ (b) $\frac{L}{4}$
 (c) $8L$ (d) $4L$

58. Two thin wire rings each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are $+q$ and $-q$. The potential difference between the centres of the two rings is :

- (a) $\frac{qR}{4\pi\epsilon_0 d^2}$
 (b) $\frac{q}{2\pi\epsilon_0} \left[\frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}} \right]$
 (c) zero
 (d) $\frac{q}{4\pi\epsilon_0} \left[\frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}} \right]$

59. A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C , then the resultant capacitance is :

- (a) $(n-1)C$ (b) $(n+1)C$
 (c) C (d) nC

60. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per second are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2 ?

- (a) 200 Hz (b) 202 Hz
 (c) 196 Hz (d) 204 Hz

61. If a simple harmonic motion is represented by $\frac{d^2x}{dt^2} + \alpha x = 0$, its time period is :

- (a) $\frac{2\pi}{\alpha}$ (b) $\frac{2\pi}{\sqrt{\alpha}}$
 (c) $2\pi\alpha$ (d) $2\pi\sqrt{\alpha}$

62. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillating bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would :

- (a) first increase and then decrease to the original value
 (b) first decrease and then increase to the original value
 (c) remain unchanged
 (d) increase towards a saturation value

63. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency ?

- (a) Zero (b) 0.5%
 (c) 5% (d) 20%

64. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled ?

- (a) $2I_0$ (b) $4I_0$
 (c) I_0 (d) $\frac{I_0}{2}$

65. Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3 A and 4 A are the currents flowing in each coil respectively. The magnetic induction in Wb/m^2 at the centre of the coils will be :

$$(\mu_0 = 4\pi \times 10^{-7} \text{ Wb/Am})$$

- (a) 12×10^{-5} (b) 10^{-5}
 (c) 5×10^{-5} (d) 7×10^{-5}

66. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in :
 (a) 0.05 s (b) 0.1 s
 (c) 0.15 s (d) 0.3 s
67. The self-inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of :
 (a) $4\mu\text{F}$ (b) $8\mu\text{F}$
 (c) $1\mu\text{F}$ (d) $2\mu\text{F}$
68. An energy source will supply a constant current into the load, if its internal resistance is :
 (a) equal to the resistance of the load
 (b) very large as compared to the load resistance
 (c) zero
 (d) non-zero but less than the resistance of the load
69. A circuit has a resistance of 12Ω and an impedance of 15Ω . The power factor of the circuit will be :
 (a) 0.8 (b) 0.4
 (c) 1.25 (d) 0.125
70. The phase difference between the alternating current and emf is $\pi/2$. Which of the following cannot be the constituent of the circuit ?
 (a) C alone (b) R, L
 (c) L, C (d) L alone
71. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity, then :
 (a) its velocity will decrease
 (b) its velocity will increase
 (c) it will turn towards right of direction of motion
 (d) it will turn towards left of direction of motion
72. A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B . The time taken by the particle to complete one revolution is :
 (a) $\frac{2\pi mq}{B}$ (b) $\frac{2\pi q^2 B}{m}$
 (c) $\frac{2\pi q B}{m}$ (d) $\frac{2\pi m}{qB}$
73. In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2Ω , the balancing length becomes 120 cm. The internal resistance of the cell is :
 (a) 1Ω (b) 0.5Ω
 (c) 4Ω (d) 2Ω
74. The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp, when not in use ?
 (a) 40Ω (b) 20Ω
 (c) 400Ω (d) 200Ω
75. A magnetic needle is kept in a non-uniform magnetic field. It experiences :
 (a) a torque but not a force
 (b) neither a force nor a torque
 (c) a force and a torque
 (d) a force but not a torque

Chemistry

76. The oxidation state of Cr in $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$ is :
 (a) 0 (b) +1
 (c) +2 (d) +3
77. Which one of the following types of drugs reduces fever ?
 (a) Tranquilliser (b) Antibiotic
 (c) Antipyretic (d) Analgesic
78. Which of the following oxides is amphoteric in character ?
 (a) SnO_2 (b) SiO_2
 (c) CO_2 (d) CaO
79. Which one of the following species is diamagnetic in nature ?
 (a) H_2 (b) H_2^+
 (c) H_2^- (d) He_2^+
80. If α is the degree of dissociation of Na_2SO_4 , the van't Hoff factor (i) used for calculating the molecular mass is :
 (a) $1 - 2\alpha$ (b) $1 + 2\alpha$
 (c) $1 - \alpha$ (d) $1 + \alpha$
81. Which of the following is a polyamide ?
 (a) Bakelite (b) Terylene
 (c) Nylon-66 (d) Teflon