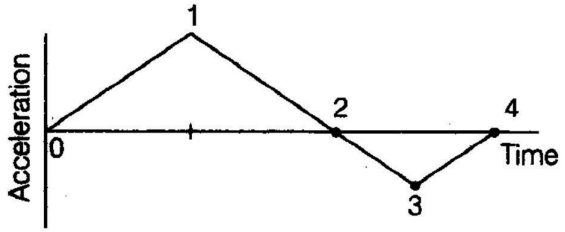
1. The nearest star to our solar system is 4.3 light years away. The distance of this star in Parsec is (Mean distance between the earth and the sun = $1.5 \times 10^{11}\text{m}$ and one light year = $9.46 \times 10^{15}\text{m}$)
(a) 1.3
(b) 8.0
(c) 13.0
(d) 33×10^4

Correct: a

2. A particle has initial velocity $(2\hat{i} + 3\hat{j})$ and acceleration $(0.3\hat{i} + 0.2\hat{j})$. The magnitude of velocity after 10 seconds will be
(a) $5\sqrt{2}$ units
(b) $7\sqrt{2}$ units
(c) $9\sqrt{2}$ units
(d) 9 units

Correct: a

3. Acceleration-time graph of a body moving in a straight line is as shown in figure. The body started its motion from rest.



At what point is the body moving with the largest speed?
(a) 1

(b) 2
(c) 3
(d) 4

Correct: b

4. A balloon has a mass of 10 gram in air. The air escapes from the balloon at a uniform rate with a velocity of 5 cm/s and the balloon shrinks completely in 2.5 s. The average force acting on the balloon will be
(a) 200 dyne
(b) 20 dyne
(c) 20 Newton
(d) 2000 dyne

Correct: b

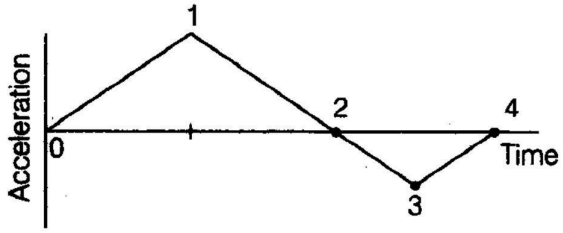
5. The relation between time t and distance x for a moving particle is $t = ax^2 + \beta x$, where α and β are constants. If v is the velocity at distance X, then the retardation of the particle is
(a) $20v^3$
(b) $2\beta v^3$
(0) $2\alpha\beta v^3$
(d) $2\beta^2 v^2$

Correct: a

6. If a particle of mass m is moving in a horizontal circle of radius r with a centripetal force $\left(-\frac{K}{r^2}\right)$ total energy is
(a) $-\frac{K}{2r}$
(b) $-\frac{K}{t}$
(c) $-\frac{2K}{t}$
(d) $-\frac{4K}{t}$

Correct: a

7. Figure represents the position-time graph of a body of mass 4 kg. Impulse $\left(kgms^{-1}\right)$ imparted to the body at t = 0 is



(a) 6
(b) 4
(c) 3

(d) 0

Correct: a

8. A body of mass m accelerates uniformly from rest to v_1 in the time t_1. The instantaneous power delivered to the body as a function of time

(a) $\frac{mv_1^2t}{t_1}$

(b) $\frac{mv_1t}{t_1}$

(c) $\frac{mv_1t^2}{t_1}$

(d) $\frac{mv_1^2t}{t_1^2}$

Correct: d

9. A man throws a ball of mass 3.0 kg with a speed of 5.0 m/s. His hand is in contact with the ball for 0.2 s. If he throws 4 balls in 2 seconds, the average force exerted by him in 1 second is:

(a) 15 N

(b) 30 N

(c) 150 N

(d) 75 N

Correct: b

10. Two bodies of masses m and 4m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is in

(a) $-\frac{4Gm}{r}$

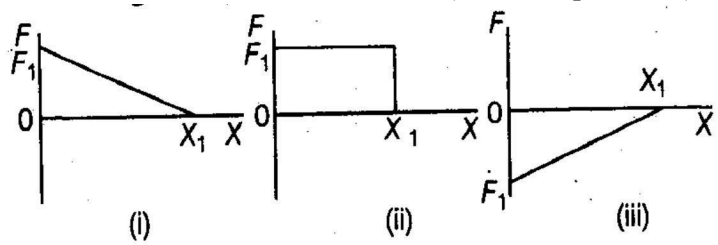
(b) $-\frac{6Gm}{r}$

(c) $-\frac{9Gm}{r}$

(d) zero

Correct: c

11. The graphs below show the magnitude of the force on a particle as it moves along the positive X-axis from the origin to X = X₁. The force is parallel to the X-axis and conservative. The maximum magnitude F₁ has the same
value for all graphs. Rank the situations according to the change in the potential energy associated with the force, least (or most positive) to greatest (or most positive)



(a) (i), (ii), (iii)

(b) (i), (iii), (ii)

(c) (iii), (ii),(i)
(d) (ii), (i), (iii)

Correct: d

12. The freezer in a refrigerator is located at the top section so that
(a) the entire chamber of the refrigerator is cooled quickly due to convection
(b) the motor is not heated
(c) the heat gained from the environment is high
(d) the heat gained from the environment is low

Correct: a

13. The time period of a physical pendulum is $2\pi\sqrt{I/mgd}$, where I is the moment of inertia of the pendulum about the axis of rotation .
and d is perpendicular distance between the axis of rotation and the centre of mass of the pendulum. A circular ring hängs from a nail on a wall.
The mass of the ring is 3 kg and its radius is 20 cm. If the ring is slightly displaced, the time of resulting oscillations will be
(a) 1.0 s
(b) 1.3 s
(c) 1.8 s
(d) 2.1 s

Correct: b

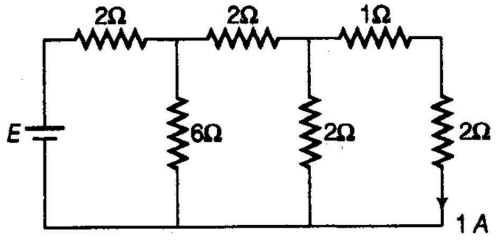
14. Two non-reactive monatomic ideal gases have their atomic masses in the ratio 2:3. The ratio of their partial pressures, when enclosed in a vessel kept at a constant temperature is 4:3. The ratio of their densities is
(a) 1:4
(b) 1:2
(c) 6:9
(d) 8:9

Correct: d

15. A block is released from rest on a 45° smooth incline and slide a distance d. The time taken to slide the same distance is n times as much to slide on a 45° rough incline than on the smooth incline. The coefficients of friction for the rough incline is
(a) $\sqrt{1-\frac{1}{n^2}}$
(b) $1-\frac{1}{n^2}$
(c) $\sqrt{1-\frac{1}{2n^2}}$
(d) $1-\frac{1}{2n^2}$

Correct: b

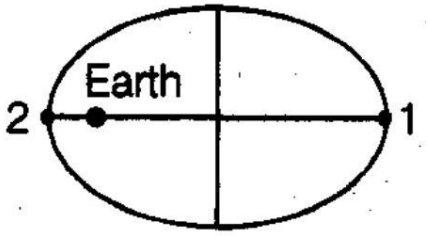
16. A circuit is shown in the figure. The e.m.f. of the battery is a



(a) 4 V
(b) 6 V
(c) 12 V
(d) 8 V

Correct: c

17. A small satellite is in elliptical orbit around the earth as shown in figure, L denotes the magnitude of its angular momentum and K denotes its kinetic energy. If 1 and 2 denote two positions of the satellite, then



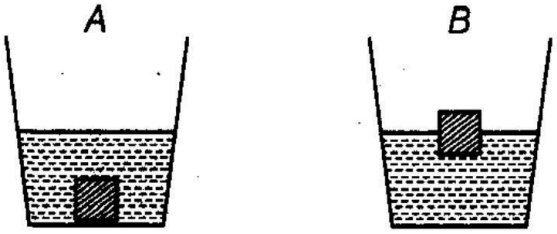
(a) $L_2 = L_1, K_2 = K_1$
(b) $L_2 = L_1, K_2 > K_1$
(c) $L_2 > L. K_2 < K_1$
(d) $L_2 = L_1, K_2 < K_1$

Correct: b

18. Substances, when placed in a magnetic field acquire feeble magnetisation in the direction opposite to that of the applied field are called
(a) diamagnetic substances
(b) ferromagnetic substances
(c) paramagnetic substances
(d) ferro magnetisation

Correct: a

19. A piece of ice is tied using a string to the bottom of bucket A. The bucket is filled with water with ice completely submerged in it.' Another bucket B is filled with water and a piece of ice is released in water. If floats on the surface of water (see Fig.). What would be the impact on the level of water in the two buckets, when ice pieces melt away completely?



(a) Level of water remain unchanged in both the buckets.
(b) Level of water will go down in bucket A, but will remain unchanged in bucket B.
(c) Level of water will go down in bucket, A but will go up in bucket B.
(d) Level of water will remain unchanged in bucket A, but will go up in bucket B.

Correct: b

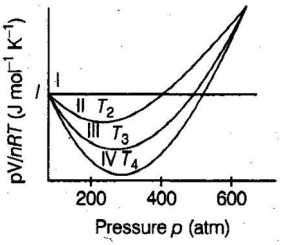
20. Consider the following thermodynamical variables
(i) Pressure
(ii) Internal Energy
(ii) Volume
(iv) Temperature
Out of these, the intensive variable(s) is (are)
(a) (i) only
(b) (i), (iv)
(c) (i), (ii)
(d) (i), (ii), (iv)

Correct: b

21. On stretching a wire its length is increased by 0.2%, its resistance will
(a) increase by 0.1%
(b) decrease by a 1%
(c) increase by 0.2%
(d) increase by 0.4%

Correct: d

22. Different curves in the figures show the behaviour of gases



(i) Curve I represent ideal gas behaviour
(ii) Curves II, III and IV also represents ideal gas behaviour at different temperatures T_2, T_3 and T_4
(iii) Curves II, III and IV represents behaviour of a real gas at different temperatures T_2, T_3 and T_4
(iv) $T_2 > T_3 > T_4$

(v) $T_2 < T_3 < T_4$
The correct statements are
(a) (i), (ii),(iv)
(b) (i). (iii), (iv)
(c) (i) (iii), (v)
(d) (i), (ii), (v)

Correct: b

23. Sound waves from a loudspeaker reach a point P via two paths which differ in length by 1.8 m. When the frequency of sound is gradually increased, the resultant intensity at P is found to be maximum the frequency is 1000 Hz. At what next higher frequency will a maximum be detected?
(velocity of sound= 360 m/s)
(a) 1200 Hz
(b) 1400 Hz
(c) 1600 Hz
(d) 1800 Hz

Correct: a

24. In a series LCR circuit with an alternating voltage source of frequency f, the current leads the voltage by 45°. The value of C is
(a) $\frac{1}{\pi f(2\pi fL-R)}$
(b) $\frac{1}{2\pi f(2\pi fL-R)}$
(c) $\frac{1}{\pi f(2\pi fL+R)}$
(d) $\frac{1}{2\pi f(2\pi fL-R)}$

Correct: d

25. The air pressure at sea level is 101325 Pa. At the centre of a rarefaction of a sound wave in air, the pressure is 91000 Pa. Which is the most likely pressure at the centres of a compression of the same wave?
(a) 91000 Pa
(b) 101000 Pa
(c) 111650 Pa
(d) 121000 Pa

Correct: c

26. Four charges each equal to (-Q) are placed at the four corners of a square and a charge q is placed at its centre. If the system of charges is in equilibrium, the value of q is
(a) $\frac{Q}{4}(2\sqrt{2}-1)$
(b) $\frac{Q}{4}(2\sqrt{2}+1)$

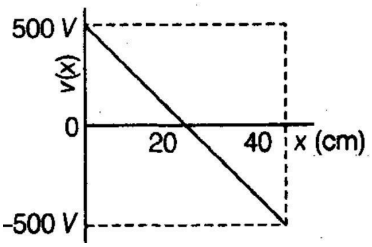
(c) $\frac{Q}{2}Q\sqrt{2}-1)$
(d) $\frac{Q}{2}R\sqrt{2}+1$

Correct: b

27. The electric field associated with an electromagnetic wave in vacuum is given by $\mathbf{E}=\hat{i}40\cos\left(kz-6\times10^{8}t\right)$ where E, z and t are Volt/m, metre and second respectively. The value of wave vector k is
(a) $2m^{-1}$
(b) $0.5\mathrm{m}^{-1}$
(c) $6\mathrm{m}^{-1}$
(d) $3\mathrm{m}^{-1}$

Correct: a

28. An electron is placed on X-axis where the electric potential depends on x as shown in figures (the potential does not depend on y and z). What is the electric force on the electron ?



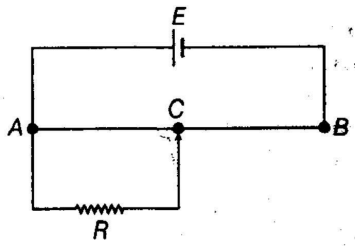
(a) $40\times10^{-18}\mathrm{N}$
(b) $80\times10^{-16}\mathrm{N}$
(c) $3.2\times10^{-56}\mathrm{N}$
(d) $40\times10^{-16}\mathrm{N}$

Correct: d

29. The charging current for a capacitor at any instant is 0.78 A. The displacement current across the capacitor plates at that instant is
(a) $\frac{0.78}{\epsilon_0}A$
(b) $0.78\mu_0 A$
(c) $\frac{0.78}{2}A$
(d) 0.78 A

Correct: d

30. Figure shows a potentiometer. Length of the potentiometer wire AB is 100 cm and its resistance is 100Ω. EMF of the battery E is 2V. A resistance R of 50Ω draws current from the potentiometer. What is the voltage across R when the sliding contact C is at the mid-point of AB?



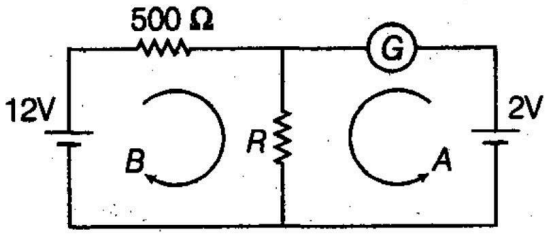
(a) $2/3$v
(b) 1 V
(c) $4/3$V
(d) $3/2$V

Correct: a

31. Which of the following colour suffers maximum deviation in a prism?
(a) blue
(b) yellow
(c) green
(d) orange

Correct: a

32. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, then the value of R is



(a) 100Ω
(b) 200Ω
(c) 500Ω
(d) 1000Ω

Correct: a

33. A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons?
(mass of the proton = 167 x 10-27 kg)
(a) 0.33 T
(b) 0.66 T
(c) 1.5 T
(d) 3.0 T

Correct: b

34. The human eye has a lens which has a
(a) soft portion at its centre
(b) hard surface
(c) varying refractive index
(d) constant refractive index

Correct: c

35. In a certain mass spectrometer, an ion beam passes through a velocity filter consisting of mutually perpendicular fields E and B. The beam then enters a region of another magnetic field B', perpendicular to the beam. The radius of curvature of the resulting ion beam is proportional to
(a) EB'/B
(b) EB/B'
(c) BB'/E
(d) E/BB'

Correct: d

36. The wavelength of 1 keV photon is $1.24 \times 10^{-9}\mathrm{m}$. What is the frequency of 1 MeV photon?
(a) $1.24 \times 10^{15}\mathrm{Hz}$
(b) $2.4 \times 10^{20}\mathrm{Hz}$
(c) $1.24 \times 10^{18}\mathrm{Hz}$
(d) $2.4 \times 10^{23}\mathrm{Hz}$

Correct: b

37. Two different coils have self-inductance $L_1 = 9\mathrm{mH}$ and $L_2 = 3\mathrm{mH}$. At a certain instant, the current in the two coils is increasing at the same rate and the power supplied to the coils is also the same. The ratio of the energy stored in the two coils (U_1/U_2)at that instant is
(a) ⅓
(b) 1
(c) 3
(d) 27

Correct: a

38. Density of nuclear matter is nearly
(a) $10^{26}\mathrm{kg/m^3}$
(b) $10^{24}\mathrm{kg/m^3}$
(c) $10^{17}\mathrm{kg/m^3}$
(d) $10^{3}\mathrm{kg/m^3}$

Correct: c

39. In electromagnetic waves travelling in vacuum
(i) The electric field E is always perpendicular to the magnetic field B.
(ii) The cross product Ex B always gives the direction in which the waves travel.
(iii) The field E and B vary sinusoidally.
(iv) There is a phase difference of $\frac{\pi}{2}$ between E and B.
The correct statement(s) (are)
(a) (i), (iii)
(b) (i), (iii), (iv)
(c) (i), (ii), (iii), (iv)
(d) (i), (ii), (iii)

Correct: a

40. Which of the series of hydrogen atom spectrum lies in the visible region of electromagnetic spectrum?
(a) Lyman series
(b) Balmer series
(c) Pfund series
(d) Brackett series

Correct: b

41. The angle of prism and refractive index of the material of the prism are A and $\cot \frac{A}{2}$, respectively. The angle of minimum deviation of the prism is
(a) $\frac{\pi}{2} - A$
(b) $\pi - A$
(c) $\pi - \frac{A}{2}$
(d) $\pi - 2A$

Correct: d

42. Assume that the light of wavelength is 6000 Å coming from a star. What is the time resolution of a telescope whose objective has a diameter of 100 inch?
(a) $3.66 \times 10^{-7}\text{rad}$
(b) $1.44 \times 10^{-7}\text{rad}$
(c) $2.9 \times 10^{-7}\text{rad}$
(d) $5.8 \times 10^{-7}\text{rad}$

Correct: c

43. The relation between force acting on the electron and principle quantum number in hydrogen atom is
(a) $F \propto n^4$
(b) $F \propto n^2$

(c) $F_{+}\frac{1}{n^2}$
(d) $F \propto \frac{1}{n^4}$

Correct: d

44. When a beam of 10.6 eV photons of intensity $2.0\mathrm{W/m^2}$ falls on a metallic surface of area $1 \times 10^{-4}\mathrm{m}^2, 0.53\%$ of the incident photons eject photoelectrons. What is the number of photoelectrons emitted per second?
(a) 1.18×10^{16}
(b) 6.25×10^{11}
(c) 6.25×10^{13}
(d) 6.25×10^{15}

Correct: b

45. The band gap in Ge and Si in eV respectively is
(a) 0.7, 1.1
(b) 1.1, 0.7
(c) 1.1, 0
(d) 0, 1.1

Correct: a

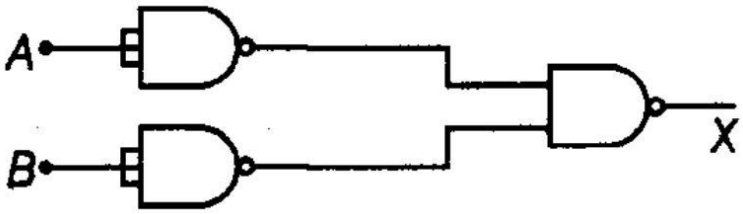
46. Identify the correct statement(s) from among the following
(i) The constancy of the binding energy per nucleon in the range 30 < A < 170 is a consequence of the fact that the nuclear force is short ranged.
(ii) The nuclear force does not depend on the charge of nucleons.
(iii) The nuclear force is repulsive when distance between two nucleons is less than 0.8 fm.
(a) (i) only
(b) (i), (iii)
(c) (i), (ii)
(d) (i), (i), (ii)

Correct: d

47. A 100 m long antenna is mounted on a 500 m tall building. The complex can become a transmission tower for waves with λ
(a) $= 400\mathrm{m}$
(b) $= 25\mathrm{m}$
(c) $= 150\mathrm{m}$
(d) $= 2400\mathrm{m}$

Correct: a

48. The combination of gates shown in figure yields



(a) NAND gate
(b) OR gate
(c) NOT gate
(d) XOR gate

Correct: b

49. For an amplitude modulated wave, the maximum amplitude is found to be 12 V while the minimum amplitude is found to be 4 V. The modulation index μ will be
(a) 0.25
(b) 0.50
(c) 0.75
(d) 1.00

Correct: b

50. An alpha particle accelerated through V volts is fired towards a nucleus. It distance of closest approach is r. If a proton accelerated through the same potential is fired towards the same nucleus, its distance of closest approach will be
(a) r
(b) 2r
(c) r/2
(d) r/4

Correct: a