01 An alternating potential $V = V_0 \sin \omega t$ is applied across a circuit. As a result the current $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ flows in it. The power consumed in the circuit per cycle is

(a) zero (b) $0.5\, V_0 I_0$

(c) $0.707\, V_0 I_0$ (d) $1.414\, V_0 I_0$

02 A direct current of 2 A and an alternating current having a maximum value of 2A flow through two identical resistances. The ratio of heat produced in the two resistances will be

(a) 1 : 1 (b) 1 : 2

(c) 2 : 1 (d) 4 : 1

03 A 10 Ω resistance, 5 mH coil and 10 μF capacitor are joined in series. When a suitable frequency alternating current source is joined to this combination, the circuit resonates. If the resistance is halved, the resonance frequency

(a) is halved (b) is doubled

(c) remains unchanged (d) in quadrupled

04 A complex current wave is given by $i = (5 + 5 \sin 100\, \pi t)$ A. Its average value over one time period is given as

(a) 10 A (b) 5 A

(c) $\sqrt{50}$ A (d) 0

05 In a transformer, the coefficient of mutual inductance between the primary and the secondary coil is 0.2 H. When the current changes by 5 A/s in the primary, the induced emf in the secondary will be

(a) 5 V (b) 1 V

(c) 25 V (d) 10 V

06 The second line in Paschen series is obtained when the electron makes transition from

(a) fourth orbit to third orbit

(b) seventh orbit to third orbit

(c) sixth orbit to third orbit

(d) fifth orbit to third orbit

07 Which of the following parameters are the same for all hydrogen like atoms and ions in their ground states?

(a) Radius of the orbit

(b) Speed of the electrons

(c) Energy of the atom

(d) Orbital angular momentum of the electron

08 An electron moves in a circular orbit at a distance from a proton with kinetic energy E. To escape to infinity, the minimum energy which must be supplied to the electron is

(a) E (b) $2E$ (c) $0.5E$ (d) $E\sqrt{2}$

09 The velocity of an electron in the first orbit of H-atom is v. The velocity of an electron in the 2nd orbit of He^+ is

(a) $2\, v$ (b) v

(c) $v/2$ (d) $v/4$

10 An electron makes a transition from orbit $n = 4$ to the orbit $n = 2$ of a hydrogen atom. The wave number of the emitted radiations (R = Rydberg's constant) will be

(a) $\frac{16}{3R}$ (b) $\frac{2R}{16}$ (c) $\frac{3R}{16}$ (d) $\frac{4R}{16}$

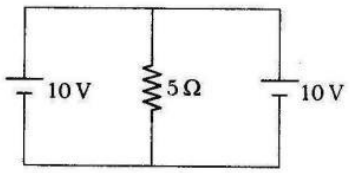
11 A wire has resistance 12 Ω. It is bent in the form of a circle. The effective resistance between the two points on any diameter is equal to

(a) 12 Ω (b) 6 Ω (c) 3 Ω (d) 24 Ω

12 The maximum power dissipated in an external resistance R, when connected to a cell of emf E and internal resistance r, will be

(a) $\frac{E^2}{r}$ (b) $\frac{E^2}{2r}$ (c) $\frac{E^2}{3r}$ (d) $\frac{E^2}{4r}$

13 Current through the 5 Ω resistor is



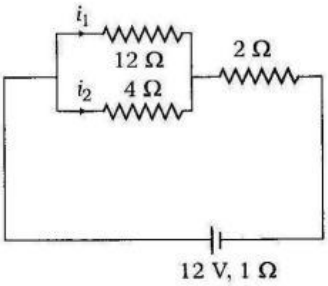
(a) 2A (b) 4A

(c) zero (d) 1A

14 The resistance of a wire is 10 Ω. 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

15 In the circuit shown, the currents i_1 and i_2 are



(a) $i_1 = 1.5$ A, $i_2 = 0.5$ A (b) $i_1 = 0.5$ A, $i_2 = 1.5$ A
(c) $i_1 = 1$ A, $i_2 = 3$ A (d) $i_1 = 3$ A, $i_2 = 1$ A

16 If the energy of the photon is increased by a factor of 4, then its momentum

(a) does not change
(b) decreases by a factor of 4
(c) increases by a factor of 4
(d) increases by a factor of 2

17 The number of photons of wavelength 540 nm emitted per second by an electric bulb of power 100 W is approximately (taking $h = 6 \times 10^{-34}$ Js)

(a) 4×10^{16} (b) 4×10^{10}
(c) 3×10^{20} (d) 3×10^{18}

18 Photon and electron are given energy (10^{-2} J). Wavelengths associated with photon and electron are λ_{ph} and λ_{el}, then correct statement will be

(a) $\lambda_{ph} > \lambda_{el}$ (b) $\lambda_{ph} < \lambda_{el}$
(c) $\lambda_{ph} = \lambda_{el}$ (d) $\frac{\lambda_{el}}{\lambda_{ph}} = c$

19 The retarding potential necessary to stop the emission of photoelectron, when a target material of work function 1.24 eV is irradiated with light of wavelength 4.36×10^{-7} m is

(a) 0.36 V (b) 1.60 V (c) 2.84 V (d) 4.08 V

20 The surface of some material is radiated, by waves of $\lambda_1 = 3.5 \times 10^{-7}$ m and $\lambda_2 = 5.4 \times 10^{-7}$ m, respectively. The ratio of the stopping potential in two cases is 2 : 1. The work function of the material is

(a) 0.86 eV (b) 1.345 eV
(c) 1.05 eV (d) 2.20 eV

21 A small sphere is charged to a potential of 50 V and a big hollow sphere is charged to a potential of 100 V. Electricity will flow from the smaller sphere to the bigger one when

(a) the smaller one is placed inside the bigger one and connected by a wire
(b) bigger one placed by the side of the smaller one and connected by a wire
(c) Both are correct
(d) Both are wrong

22 Two identical charges are placed at the two corners of an equilateral triangle. The potential energy of the system is U. The work done in bringing an identical charge from infinity to the third vertex is

(a) U (b) $2U$ (c) $3U$ (d) $4U$

23 A parallel plate capacitor has a uniform electric field E (V/m) in the space between the plates. If the distance between the plates is d(m) and area of each plate is $A(m^2)$, then the energy (joule) stored in the capacitor is

(a) $\frac{1}{2}\varepsilon_0 E^2$ (b) $\varepsilon_0 EAd$

(c) $\frac{1}{2}\varepsilon_0 E^2 Ad$ (d) $E^2 Ad/\varepsilon_0$

24 0.2 F capacitor is charge to 600 V by a battery, on removing the battery, it is connected with another parallel plate condenser of 1F . The potential decreases to

(a) 100 V (b) 120 V (c) 300 V (d) 600 V

25 In a magnetic field of 0.05 T, area of a coil changes from 101 cm^2 to 100 cm^2 without changing the resistance which is 2 Ω. The amount of charge that flows during this period is

(a) 2.5×10^{-6} C

(b) 2×10^{-6} C

(c) 10^{-6} C

(d) 8×10^{-6} C

26 The resistance and inductance of series circuit are 5Ω and 20 H, respectively. At the instant of closing the switch, the current is increasing at the rate 4 As^{-1}. The supply voltage is

(a) 20 V (b) 80 V

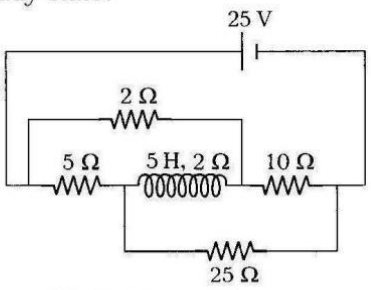
(c) 120 V (d) 100 V

27 The number of turns in the coil of an AC generator is 5000 and the area of the coil is 0.25 m^2. The coil is rotated at the rate of 100 cycles/s in a magnetic field of 0.2 Wm^{-2}. The peak value of the emf generated is nearly

(a) 786 kV (b) 440 kV

(c) 220 kV (d) 157 kV

28 In the circuit shown, what is the energy stored in the coil at steady state?



(a) 21.3 J (b) 42.6 J (c) Zero (d) 213 J

29 The structure of solids is investigated by using

(a) cosmic rays (b) X-rays

(c) γ-rays (d) infrared radiations

30 Radio waves diffract around building although light waves do not. The reason is that radio waves

(a) travel with speed larger than c

(b) have longer wavelength than light

(c) carry news

(d) are not electromagnetic waves

31 If ε_0 and μ_0 are respectively, the electric permittivity and the magnetic permeability of free space, ε and μ the corresponding quantities in a medium, the refractive index of the medium is

(a) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$ (b) $\frac{\mu\varepsilon}{\mu_0\varepsilon_0}$

(c) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ (d) $\sqrt{\frac{\mu\mu_0}{\varepsilon\varepsilon_0}}$

32 A particle of charge q and velocity v passes undeflected through a space with non-zero electric field E and magnetic field B. The undeflecting conditions will hold, if

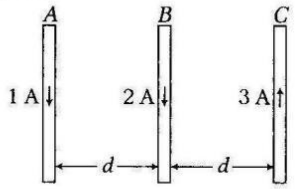
(a) signs of both q and E are reversed

(b) signs of both q and B are reversed

(c) Both B and E are changed in magnitude but keeping the product of B and E fixed

(d) Both B and E are doubled in magnitude

33 Three long straight wires A, B and C are carrying current as shown in figure. Then, the resultant force on B is directed



(a) towards A
(b) towards C
(c) perpendicular to the plane of paper and outward
(d) perpendicular to the plane of paper and inward

34 A wire of length 2 m carrying a current of 1 A is bend to form a circle. The magnetic moment of the coil is (in A-m^2)

(a) 2π (b) $\pi/2$ (c) $\pi/4$ (d) $1/\pi$

35 The angle between the earth's magnetic and the earth's geographic axis is

(a) zero (b) 11.5°
(c) 23° (d) None of these

36 A vibration magnetometer is placed at the south pole, then the time period will be

(a) zero
(b) infinity
(c) same as at magnetic equator
(d) same as at any other place on earth

37 A bar magnet of magnetic moment 3 A-m^2 is placed in a uniform magnetic induction field of 2×10^{-5} T. If each pole of the magnet experiences a force of 6×10^{-4} N, the length of the magnet is

(a) 0.5 m (b) 0.3 m
(c) 0.2 m (d) 0.1 m

38 90% of a radioactive sample is left undecayed after time t has elapsed. What percentage of the initial sample will decay in a total time $2t$?

(a) 20% (b) 19%
(c) 40% (d) 38%

39 In the reaction ${}_1^2\text{H} + {}_1^3\text{H} \rightarrow {}_2^4\text{He} + {}^1n_0$, if the binding energies of ${}_1^2\text{H}, {}_1^3\text{H}$ and ${}_2^4\text{He}$ are respectively, a, b and c (in MeV), then the energy (in MeV) released in this reaction is

(a) $c + a - b$ (b) $c - a - b$
(c) $a + b + c$ (d) $a + b - c$

40 A double convex lens made of glass (refractive index n =1.5) has both radii of curvature of magnitude 20 cm. Incident light rays parallel to the axis of the lens will converge at a distance L such that

(a) $L = 20$ cm (b) $L = 10$ cm
(c) $L = 40$ cm (d) $L = \frac{20}{3}$ cm

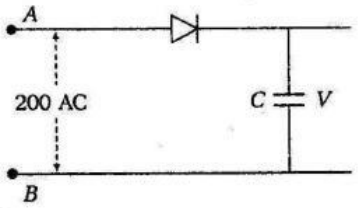
41 A ray of light strikes a horizontal plane mirror at an angle of 45°. A second plane mirror is attached at an angle θ with it. If ray after reflection from second mirror runs parallel to the first mirror, then θ is

(a) 45° (b) 60° (c) 67.5° (d) 135°

42 The focal length of the objective of a terrestrial telescope is 80 cm and it is adjusted for parallel rays, and its magnifying power is 20. If the focal length of erecting lens is 20 cm, then full length of telescope will be

(a) 84 cm (b) 100 cm
(c) 124 cm (d) 164 cm

43 A 220 V AC supply is connected between points A and B (figure). What will be the potential difference V across the capacitor?



(a) 220V (b) 110 V (c) 0 V (d) $220\sqrt{2}$V

44 The transfer ratio β of a transistor is 50. The input resistance of the transistor when used in the common emitter configuration is 1 kΩ. The peak value of the collector AC current for a peak value of AC input voltage of 0.01 V is

(a) 100 μA (b) 0.01 μA
(c) 0.25 μA (d) 500 μA

45 In the standard Young's double slit experiment, the intensity on the screen at a point distant 1.25 fringe widths from the central maximum is (assuming slits to be identical)

(a) $\frac{1}{2} I_{max}$ (b) $\frac{1}{4} I_{max}$
(c) $\frac{1}{3} I_{max}$ (d) I_{max}