CBSE Sample Paper 3

General Instruction:

1. Answer all questions
2. Internal choices are provided for some questions
3. Question numbers 1 to 8 are very short answer questions and carry 1 mark each.
4. Question numbers 8 to 18 are short answer questions and carry 2 marks each.
5. Question numbers 19 to 27 are also short answer questions and carry 3 marks each.
6. Question numbers 28 to 30 are long answer questions and carry 5 marks each.
7. Use log tables if necessary.

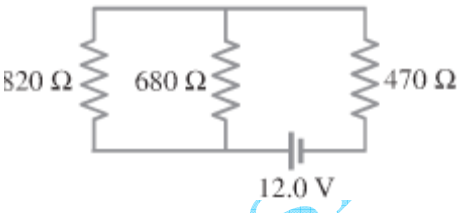
Very Short Answer type questions

Question 1
What are the Energy losses in Transformer

Question 2
Which has a greater resistance for same voltage 220 V

a) 1 KW electric Heater
b) 100W filament bulb

Question 3
Find the equivalent resistance in the circuit



Question 4
Find the voltage across 470ohm resistor in previous question

Question 5
What is the average value of AC during a half cycle and full cycle?

Question 6
The maximum KE of the electrons emitted in a photocell is 10eV. What is the stopping potential?

Question 7
What do you understand by the transformation ratio of the transformer?

Question 8
If M is the mass of the nucleus and A its atomic mass, the what is the packing fraction

Short Answer type questions

Question 9
An electron of charge e moves in a circular orbit of radius R around the nucleus. The magnetic field due to the orbital motion of the electron at the site of the nucleus is B_0. Find out the angular velocity of the electron in terms of B_0 ,e and R

Question 10
The half life of radioactive sample is 30 sec.
Find out following
a)The decay constant
b) time taken for the sample to decay to ¾ of its initial value

Question 11
A cylindrical wire is stretched to increase its length by 10%. Calculate the % increase in the resistance of this wire

Question 12
State Faraday's law of electromagnetic induction. Express it mathematically.

Question 13
The binding energies of the nuclei A^n and B^{2n} are respectively X and Y joules per nucleon, if 2X -Y < 0 ,then find the energy released in the nuclear reaction

$$A^n + A^n -> B^{2n}$$

Question 14
The output voltage of an ideal transformer connected to 240 ac mains is 24 V. When the transformer is used to light a bulb with rating 40V, 40W, calculate
a) the current in the bulb
b) Current in the primary coil of the circuit.

Question 15
What is Lorentz Force? If the charged particles moves parallel to magnetic field,what will be the force on it?

Question 16
Two straight and parallel wire X and Y are present. .The current in X is I_0
a)when the wire Y is brought close to wire X,what will be the direction of the induced current in Y
b) when the wire Y is being taken away from X,what will be the direction of induced current in Y

Question 17
What is photoelectric cell's? Explain the working of Photovoltaic cell

Question 18
In a common –emitter amplifier the load resistance of the output circuit is 1000 times the load resistance of the input circuit . If α =.98 ,the calculate the voltage gain

Question 19
Heavy water is a suitable moderator in Nuclear reactor why?

Question 20
What is a antenna and how it works? Name the types of antenna

Question 21
A circular coil of N turns and radius R_0 is kept normal to a magnetic field given by

$$B = B_0 \cos \omega t$$

Deduce the expression for the EMF induced in this coil.State the rule which help us determine the direction of induced current

Question 22
Explain the meaning of photo electric work function by giving necessary equation?

Question 23
Write down the properties of Magnetic lines of forces ? What is the unit of Magnetic Field

Question 24
Two concentric coplanar circular loops made of wire with resistance per unit length 10^{-4} Ω/m have diameters .2 m and 2 m respectively.

A time varying potential difference V=(4+2.5 t) V is applied to larger loop.
Find the induced current in the small loop

Question 25
An alternating voltage given by
$V(t) = 10\sqrt{2}\sin(2500t + 45^0)$
It is applied across a series combination of Resistance R=3K ohm and Capacitor of capacitance C=.1μF
Find out following things from the above given values
i)The peak value and rms value of the current in the circuit
ii)The phase difference between current and voltage
iii)The power factor of the circuit

Question 26
There are three charges on a straight line
One Positive Charge q
Two Negative Charge -Q
Find the value of q/Q so that the entire system is in equilibrium?
Will this equilibrium be stable

Question 27
What are coherent sources ? How does the width of interference fringes in Young's double slit experiment change when
a)The distance between the slits and screen is increased
b)Frequency of the source is decreased

Question 28
Device the formula for the electric field due to a circular loop of positive charge ie, charged ring at an axial point

Question 29
What is a transistor ? Explain the construction and working of p-n-p transistor with the help of neat diagram?

Question 30
i)States Bohr's postulates for hydrogen atom. Explain the origin of Balmer series of spectral lines
ii) The first line of Balmer series of a hydrogen like atom has a wavelength of 1640 Å. Find the ionization energy of the atom
Given
$h=6.6X10^{-34}$ Js
$c=3.0X10^{8}$ m/s

Solutions

Solution 1

1) copper losses
2) Eddy current losses
3) Hysteresis losses
4) Flux losses

Solution 2

Resistance of Heater

$$R_1 = \frac{V^2}{P} = \frac{220X220}{1000} = 48.4ohm$$

Resistance of Bulb

$$R_2 = \frac{V^2}{P} = \frac{220X220}{100} = 484ohm$$

So it is clear bulb has higher resistance

Solution 3

The equivalent resistance is found by combining the 820 and 680 resistors in parallel, and then adding the 470 resistor in series with that parallel combination.

$$R_{eq} = \left(\frac{1}{820} + \frac{1}{680}\right)^{-1} + 470 = 842ohm$$

Solution 4

The current delivered by the battery will be given by

$$I = \frac{V}{R_{eq}} = \frac{12}{842} = 1.425X10^{-2}\,A$$

The voltage across the 470 ohm resistor can be found using ohm's law

V_{470}=IR=6.7 V

Solution 5

Half cycle = $\frac{2i_0}{\pi}$

Full cycle =zero

Solution 6

$$\frac{1}{2}mv^2 = eV_0$$

So V_0=10 V

Solution 9

An electron moving in a circular orbit is equivalent to a current carrying loop.Therefore current in that loop will be given by

I=e/T

Where T is the time period of the motion of electron around the nucleus

Now

$$T = \frac{2\pi r}{v}$$

Therefore current would be

$$I = \frac{ev}{2\pi r} = \frac{e\omega}{2\pi}$$

Now we know that Magnetic field at the center of a current carrying loop is given by

$$B_0 = \frac{\mu_0 I}{2R_0} = \frac{\mu_0 e\omega}{4\pi R_0}$$

Or

$$\omega = \frac{4\pi R_0 B_0}{\mu_0 e}$$

Solution 8

In n-type of semi-conductor, the conduction is due to electrons while p-type conductor has holes for conduction. The mobility of electron are higher for electrons then holes so that whys n-type are more conductive then p –type semiconductor

Solution 10

a) Disintegration constant

$$\lambda = \frac{.693}{T_{1/2}}$$

Or

λ=.0231 s^{-1}

b) By definition of half life

½ of the initial mass remains un disintegrated in 30 sec

¼ of the initial mass remains un disintegrated in next 30 sec

Therefore 3/4th of the initial mass disintegrate in 60sec

Solution 11

Let us assume L , A and R be the initial length , cross-sectional area and resistance

And Let L_1 ,A_1 and R_1 be the final length , cross-sectional area and resistance

Now since length is increased by 10%

$$L_1 = L + LX\frac{10}{100} = 1.1L$$

Since Volume remains same

$$AL = A_1 L_1$$

$$A_1 = \frac{A}{1.1}$$

Let a be the specific resistance of the material of the wire, then resistance of the wire before and after will be given by

$$R = a\frac{L}{A}$$

$$R_1 = a\frac{L_1}{A_1} = 1.21a\frac{L}{A}$$

So percentage increase in resistance is

$$\frac{R_1 - R}{R} X100 = \left(\frac{R_1}{R} - 1\right) X100 = 21\%$$

Solution 13

Energy released =2nY-nX-nX=2n(Y-X)

Solution 14

The Current in the bulb or secondary is

$$i_s = \frac{P_s}{V_S} = \frac{40}{40} = 1A$$

Now for the transformer ,we know that

$$V_s I_s = V_P I_P$$

Or I_p=.1 A

Solution 16

a)The induced current will be opposite to current in X

b) the Induced current will be in same direction as X

Solution 18

$$\beta = \frac{\alpha}{1-\alpha} = \frac{.98}{1-.98} = 49$$

Therefore Voltage gain is given by

$$V_{gain} = \beta\frac{R_2}{R_1} = 49X1000 = 49X10^3$$

Solution 20

Suppose the initial quantity of radium is N_0 .Then the quantity left after n half lives will be

$$N = N_0\left(\frac{1}{2}\right)^n$$

Now here N=25% of N_0=N_0/4

So

$$\frac{N_0}{4} = N_0\left(\frac{1}{2}\right)^n$$

Or n=2

Therefore time of disintegration =half-life X number of half lives
=1600X2=3200 years

Solution 24

The resistance of the Larger loop

$$= 2\pi R * 10^{-4} = 2\pi * 1 * 10^{-4} = 2\pi 10^{-4}$$

Current in the larger loop will be

$$I = \frac{V}{R} = \frac{(4 + 2.5t)}{2\pi 10^{-4}}$$

The magnetic Field due to this current in the larger loop at the common center will be

$$B = \frac{\mu_0 I}{2R} = \frac{\mu_0 (4 + 2.5t)}{2 * 1 * 2\pi 10^{-4}} = \frac{\mu_0 (4 + 2.5t)}{4\pi 10^{-4}}$$

Since the smaller loop is very small compared to bigger loop,the magnetic field at the center can be assumed to be the magnetic field in the smaller loop

So flux through smaller loop

$$\phi = BA = \frac{\mu_0 (4 + 2.5t)}{4\pi 10^{-4}} (\pi 10^{-2)} = \frac{\mu_0 (4 + 2.5t)}{4} 10^2$$

Induced EMF in the smaller loop

$$E = \frac{d\phi}{dt} = 62.5\mu_0$$

Now resistance of the smaller loop

$$= 2\pi R * 10^{-4} = 2\pi * .1 * 10^{-4} = 2\pi 10^{-5}$$

So induced current

$$I = \frac{E}{R} = \frac{62.5\mu_0}{2\pi 10^{-5}} = 1.25A$$

Solution 25

The voltage is given by

$$V(t) = 10\sqrt{2}\sin(2500t + 45^0)$$

Comparing it with the standard equation

$$V = V_0 \sin(\omega t + \phi)$$

We get

$V_0 = 10\sqrt{2} Volt$

$\omega = 2500 rad / se$

Now the impedance of the circuit is given by

$$Z = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}$$

Substituting the above values

Z=5000Ω

The rms Value of the current in the circuit is given by

$$i_{rms} = \frac{V_{rms}}{Z} = \frac{V_0}{Z\sqrt{2}} = 2X10^{-3} A$$

$$i_0 = i_{rms}\sqrt{2} = 2\sqrt{2}X10^{-3} A$$

The phase difference between the current and voltage is

$$\phi = \tan^{-1}\left(\frac{1/\omega C}{R}\right) = \tan^{-1}(4/3)$$

The power factor of the circuit is

$$\cos\phi = \frac{R}{Z} = .6$$

Solution 26

For the charge q to be in equilibrium, the charges –Q should be at equal distance from it in opposite direction. For equilibrium of Charge Q, the sum of forces acting on it should also be zero. Let assume r be the distance between the charges

So

$$\frac{Q^2}{4r^2} - \frac{Qq}{r^2} = 0$$

Hence q=Q/4

It does not depend on the distance r.

The equilibrium position is not stable. Since when charge –Q is shifted along left by a distance x,The force of attraction from positive charge

$$F_1 = \frac{Q^2}{4(a+x)^2}$$

The force of repulsion from negative charge

$$F_2 = \frac{Q^2}{(2a+x)^2}$$

It is clear that $F_2 > F_1$

So the charge Q will move still farther from the position of equilibrium

Similarly if the charge –Q is move toward right.The force of attraction will be more then Force of repulsion and it will move toward the center.
Now if the charge q is moved right or left ,the force of attraction on one side will more than the force of attraction of other side,so it will return to equilibrium position.

Solution 30
For balmer series of a hydrogen-like atom ,we have

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right), n = 3,4,5.....$$

For first line,n=3

$$\frac{1}{\lambda} = r\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5R}{36}$$

$$R = \frac{36}{5\lambda}$$

Ionization energy is given by
=Rhc
Substituting the values ,we get
E=54.4eV