Mock Test - 2

Time : 3 hrs **M.M : 70**

General Instructions

- There are 37 questions in all. All questions are compulsory.
- This question paper has four sections: Section A, Section B, Section C, and Section D.
- Section A contain twenty questions of 1 mark each, Section B contain seven questions of 2 marks each, Section C contains seven questions of 3 marks each and Section D contains three questions of 5 marks each.
- There is no overall choice. However, an internal choice has been provided in two questions of one mark, two questions of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- You may use the following values of physical constants wherever necessary.
  $C = 3 \times 10^8$m/s, $h = 6.63 \times 10^{-34}$ J-s, $e = 1.6 \times 10^{-19}$C, $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}, $\varepsilon_0 = 8.854 \times 10^{-12}$C^{2}N^{-1}m^{-2}, $1/4\pi\varepsilon_0 = 9 \times 10^9$ N-m^{2}C^{-2}, $m_e = 9.1 \times 10^{-31}$ kg, mass of neutron $= 1.675 \times 10^{-27}$kg, mass of proton $= 1.673 \times 10^{-27}$ kg, Avogadro's number $= 6.023 \times 10^{23}$ per gram mole, Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}.

SECTION A (Objective Questions, 1M)

Directions (Q. Nos. 1-10)

Select the most appropriate option from those given below each question.

1. If an electron is revolving in its Bohr orbit having Bohr radius of $0.523\overset{o}{A}$, then the radius of third orbit is
(a) 4234 nm (b) $4496\overset{o}{A}$ (c) $4.761\overset{o}{A}$ (d) 5125 nm

2. Definite value of energy possessed by quantum of radiation is called
(a) proton (b) photon (c) deuteron (d) lapton

3. A parallel plate capacitor is charged to 100×10^{-6} C. Due to radiations falling from a radiating source, the plate looses charge at the rate of 2×10^{-7} Cs^{-1}. The magnitude of displacement current is
(a) 10^{-6} (b) 10^{-4} (c) 2×10^{-7} (d) 2×10^{-7} mCs^{-1}

4. The amount of charge Q passing in time t through a cross-section of a wire is $Q = 5t^2 + 3t + 1$. The value of current at time t = 5 s is
(a) 9 A (b) 49 A (c) 53 A (d) None of these

5. A ray passing through or directed towards centre of curvature of a spherical mirror is reflected such that it traces back its own path, because
(a) It does not follow law of reflection
(b) Angle of incidence is 0^0
(c) Centre of curvature is midway between object and pole
(d) Distance of centre of curvature from focus is equal to its distance from pole

6. Surface area of a nucleus (assuming it to be a perfect sphere), is (where, A = mass number and $r_0 = 1.2 \times 10^{-15}$m)
(a) $(1.8 \times 10^{-29})A^{1/3}$ (b) $(1.8 \times 10^{-29})A^2$ (c) $(1.8 \times 10^{-29})A^{2/3}$ (d) $(1.8 \times 10^{-29})A^3$

7. Yellow light is used in a single-slit diffraction experiment with slit width of 0.6 mm. If yellow light is replaced by X-rays, then the observed pattern will reveal
(a) that the central maximum is narrower (b) more number of fringes
(c) less number of fringes (d) no diffraction pattern

8. 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

9. The dominant mechanisms for motion of charge carriers in forward and reverse biased silicon p-n junctions are
(a) drift in forward bias, diffusion in reverse bias
(b) diffusion in forward bias, drift in reverse bias
(c) diffusion in both forward and reverse bias
(d) drift in both forward and reverse bias

10. If the de-Broglie wavelengths for a proton and for α-particle are equal, then the ratio of their velocities will be in the ratio
(a) 4 : 1 (b) 2 : 1 (c) 1 : 2 (d) 1 : 4

Directions (Q. Nos. 11-15)

Give reason

11. A charged particle projected in a region of perpendicular magnetic field moves with a constant speed.

12. The magnetic field produced by a current carrying solenoid is independent of its length and cross-section area.

13. If an electron and a proton enter a magnetic field with equal velocities, the force experienced by both will be same.

14. The true geographic north direction cannot be found by using a compass needle.

15. We can never isolate the North or South pole of a magnet.

Directions (Q. Nos. 16-20)

Answer the following

16. Assume that each atom of copper contributes one free electron. What is the average drift velocity of conduction electrons in a copper wire of cross-sectional area 10^{-7} m^2 having number of free electrons in a per unit volume equal to 8.53×10^{28} and carrying a current of 1.5 A?

OR

The storage battery of a car has an emf of 12V. If the internal resistance of the battery is 0.2Ω, then what is the maximum current that can be drawn from the battery?

17. What is an LED? How is it biased and why?

18. What is displacement current? Write its mathematical expression.

19. Why is a choke coil preferred to resistance in AC circuits?

OR

How can we improve the quality factor of a tuning circuit?

20. How much mass has to converted into energy to produce electric power of 200 MW for one hour?

SECTION B

(Short Answer Type Questions , 2 M)

21. Show that the total induced charge simply depends upon the change of flux and is independent of the time rate of change of flux.

22. What are holes? Give their important characteristics.

23. In Bohr's atomic model, an electron is revolving in n = 3 level. Calculate the speed and timer period of revolution of electron.

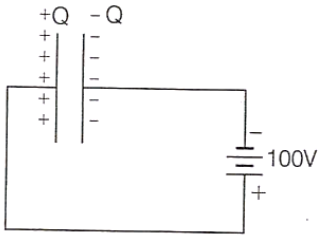
OR

24. Derive an expression for angle of dip, if B_H and B_v are horizontal and vertical component of resultant earth's magnetic field. Also, support your answer with figure depicting three magnetic elements of earth.

25. If a charged spherical conductor of radius 10 cm has potential V at a point distant 5 cm from its centre, then find the potential at a point distant 15 cm from the centre.

OR

A 900pF capacitor is charged by 100 V battery in the given figure. How much electrostatic energy and charge are stored by the capacitor?



26. A long train is moving with uniform speed from North to South.

(i) Will any induced emf appear across the ends of its axle?

(ii) Will the answer be affected if the train moves from East to West?

27. Give the limitations of Bohr's theory of hydrogen atom.

SECTION C

(Long Answer Type Questions , 3 M)

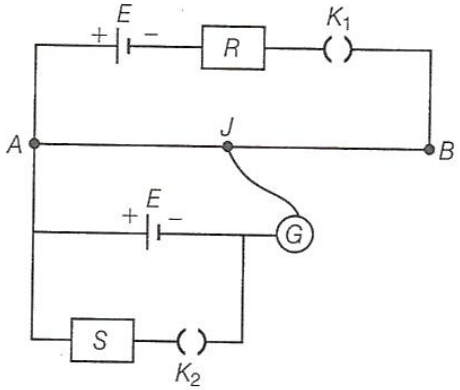
28. Write the characteristic properties of photons.

29. Use the mirror equation to show that

(i) A convex mirror always produces a virtual image independent of the location of the object.

(ii) An object placed between the pole and focus of a concave mirror produces a virtual and enlarged image.

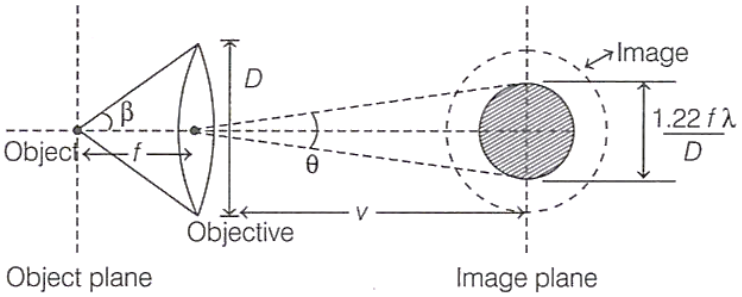
30. Two students X and Y perform an experiment or potentiometer as shown in the circuit diagram, keeping other thins unchanged, (i) X increases the value of R (ii) Y decreases the value of resistance S in the set up.



How would these changes effect the position of null point in each case and why?

31. The minimum distance between two objects, which can just be seen as separate by the optical instrument.

Also, the resolving power of any optical instrument is defined as the reciprocal of its limit of resolution. So, for a microscope, when the object is placed slightly beyond f, a real image is formed at distance v as shown below.



Here, limit of resolution of microscope d = $\frac{1.22f\lambda}{D}$

On the basis of above passage,

(i) Is it possible to specify limit of resolution in terms of β?

(ii) Also, write the factors on which its resolution power depends.

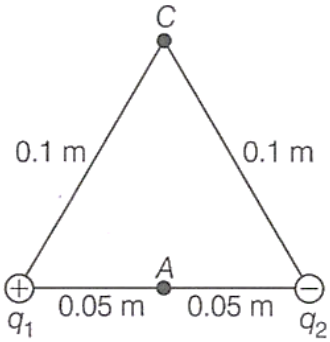
32. An air capacitor has a capacitance of 2 μF, which becomes 12μF when a dielectric medium is filled in the space between the plates. Find

(i) dielectric constant of that material.

(ii) induced charge on the dielectric due to given to the positive plate of the capacitor.

OR

Two point charges q_1 and q_2 of $+10^{-8}$ C and -10^{-8}C, respectively are placed 0.1 m apart.



Then, find the magnitudes of electric fields at A and C.

33. Give the V-I characteristics of the following

(i) p-n junction diode

(ii) Zener diode

(iii) solar cell

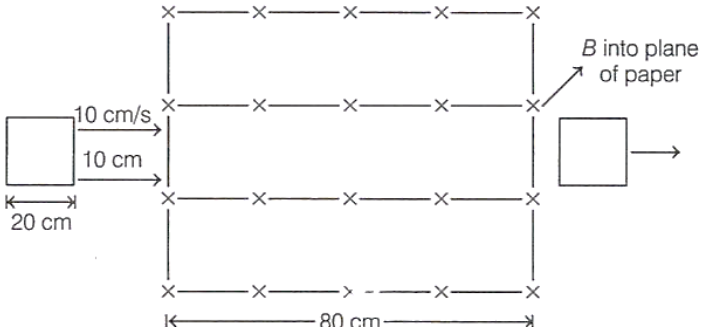
34. (i) Ram and Shyam went to a hill station in their summer vacation. During the outgoing, Shyam was shivering with cold. Ram put a blanket on him and ignited fire near by Shyam. After sometime, Shyam became normal. What type of helped Shyam to become normal?

(ii) What type of electromagnetic waves are explosive material?

(iii) Write the name of wave, which is used in RO purifier to kill bacteria in water.

SECTION:D (Long Answer Type Question, 5 M)

35. Define mutual inductance of a pair of coils and write on which factors does it depend. A square loop of 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in figure.



It is then moved towards the right with a velocity of 10 cm^{-1} till it goes out of the field. Plot a graph showing the variation of

(i) magnetic flux(ϕ) through the loop with time (t)

(ii) induced emf (e) in the loop with time (t)

(iii) induced current in the loop if it has resistance of 0.1Ω

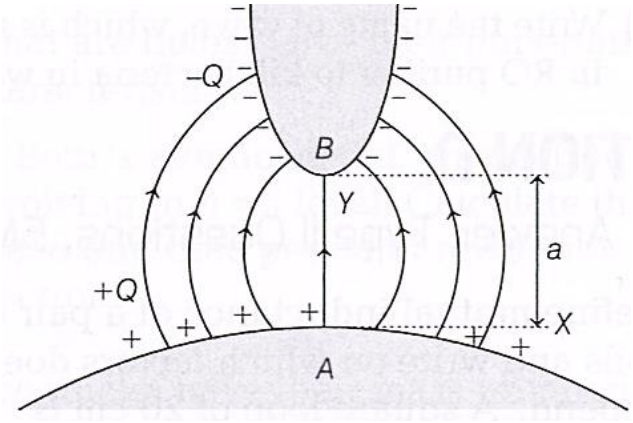
OR

(i) A 10V, 650Hz, source is connected to a series combination of R = 100Ω, C = 10μ F and L = 0.15H.

Find out the time in which the resistance will get heated by 10^0C, if the thermal capacity of the resistance will get heated by 10^0C, if the thermal capacity of the resistance = 20J/^{0}C.

(ii) Obtain the resonant frequency and quality factor of a series L-C-R circuit with L = 4 H, C = 64μF and R = 20Ω.

36. (i) Two conductors carrying equal and opposite charges create a non-uniform field as shown in the figure given below. What will be the capacity of this capacitor if the field along Y-axis varies as E = $\frac{Q}{\varepsilon_0 A}$[1 + BY^2], where B is a constant?



(ii) (a) An electrostatic field line is a continuous curve, i.e. it cannot have sudden breaks. Why is it so?

(b) Explain, why two field lines never cross one another.

OR

A non-conducting disc of radius r and uniform positive surface charge density σ is placed on the ground with its axis along Z-axis. A particle of mass m and positive charge q is dropped along the axis of the disc, from a height H with zero initial velocity. The particle has $q/m = 4\varepsilon_0 g/\sigma$.
(i) Find the value of H if the particle just reaches the disc.
(ii) Draw the graph of its potential energy as a function of its height and find its equilibrium position from the centre of the disc.

37. (i) In a Young's double slit experiment, the two slits are kept 2 mm apart and the screen in positioned 140 cm away from the plane of the slits. The slits are illuminated with light of wavelength 600 nm. Find the distance of the third bright fringe, from the central maximum, in the interference pattern obtained on the screen.
(ii) If the wavelength of the incident light were changed to 480 nm, then find out the shift in the position of third bright fringe from the central maximum.
(iii) In a single-slit diffraction pattern observed on a screen placed at D metre distance from the slit of width d metre find the ratio of the width of the central maximum to the width of other secondary maximum.

OR

(i) A beam of light converges to a point P. Now, a lens is placed on the path of the convergent beam 12 cm apart from P. At what point does the beam converge, if the lens is
(ii) Find the position of the image formed by the lens combination given in the following figure.