Mock Test 2016-17

Physics(042)

Time allowed: 3 hours *Maximum Marks: 70*

General Instruction:

1. *All questions are compulsory*
2. *There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks. You have to attempt only one of the choices in such questions.*
3. *Question numbers 1 to 5 are very short answer questions, carrying 1 mark each.*
4. *Question numbers 6 to 10 are short answer questions, carrying 2 marks each.*
5. *Question numbers 11 to 22 are short answer questions, carrying 3 marks each.*
6. *Question number 23 is value added question of 4 marks.*
7. *Question numbers 24 to 26 are long answer questions, carrying 5 marks each.*
8. *Use of calculators is not permitted. However, you may use log table if necessary.*
9. *You may use the following values of physical constants wherever necessary.*

   $c=3\times10^{8}ms^{-1}$; $h=6.6\times10^{-34}$-Js; $e=1.6\times10^{-19}C$; $\mu_0 = 4\pi\times10^{-7}TmA^{-1}$

   Mass of neutron $m_n \cong 1.6\times10^{-27}$ *kg*

   Boltzmann's constant $K = 1.38\times10^{-23}$ JK^{-1}

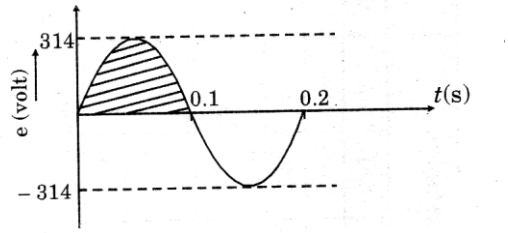
   Avogadro's number $N_A = 6.023\times10^{23}$/*mole*

Special Instructions:

1. *First fifteen minutes will be only to read the paper. Please start attempting the paper at 10:45 a.m.*
2. *Attempt in any manner but please write the correct question number.*
3. *Manage your time accordingly and try to attempt all the questions.*
4. *Please write whatever is required in the answer sheet.*
5. *Please checks that this question paper contains 26 questions*
6. *First fill the OMR Sheet, then attempt the questions.*

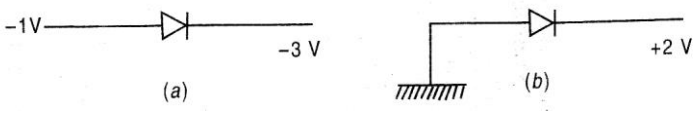
1) A compass needles, pivoted about the horizontal axis and free to move in the magnetic meridian, is observed to point along the
   a. Vertical direction at a plane A.
   b. Horizontal direction at a plane B.

   Give the value of the angle of dip at these two places.
2) Give the value of the threshold voltage for a (i) silicon diode (ii) germanium diode.
3) An electron is moving with velocity *v* along the axis of a long straight solenoid carrying current I. What will be the force acting on the electron due to the magnetic field of the solenoid?
4) The figure given below shows the variation of an alternating emf with time. What is the average value of the emf for the shaded part of the graph?

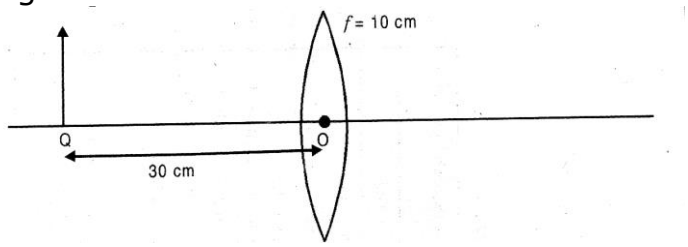


5) Name the phenomenon associated with the production of back emf in a coil due to change of electric current through the coil itself.

   Name and define the SI unit used for measuring this characteristic of the coil.
6) Name the device that converts changes in intensity of illumination into changes in electric current. Give three applications of this device.
7) A given p-n junction is biased in two different ways as shown in the figure. Identify the type of biasing used in each case. What is the effect of these biasings on the barrier potential across the given p-n junction?



8) Find the position of the image formed by the lens shown in the figure.



Another lens is placed in contact with this lens to shift the image further away from the lens. What is the nature of the second lens?

9) A nucleus of mass M initially at rest splits into two fragments of masses $\frac{M'}{3} and \frac{2M'}{3}$ (M>M′). Find the ratio of de-Broglie wavelengths of the two fragements.

Or

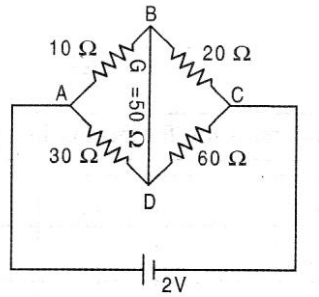
Calculate the ratio of de-Broglie wavelength associated with a deutron moving with velocity 2v and an alpha particle moving with velocity v.

10) The output of an unregulated dc power supply needs to be regulated. Name the device that can be used for this purpose and draw the relevant circuit diagram.also draw its characteristic curve

11) A resistance of R ohm draws current from a potentiometer as shown in the figure. The potentiometer has a total resistance of R_0 ohm. A voltage V is applied to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer.

OR

The given figure shows a network of resistance. Name the circuit so formed.



What is the current flowing in the arm BD of the circuit? Also find net resistance of the circuit then State the two laws used to find the current in different branches of this circuit.

12) Write the relation between angle of incidence (i) the angle of emergence (e), the angle of prism (A) and the angle of deviation (δ) for rays undergoing refraction through a prism. What is the relation between $\angle$i and $\angle$e for rays undergoing minimum deviation? Using this relation obtain an expression for the refractive index (μ) of the material of the prism in terms of $\angle$A and angle of minimum deviation.

13) (a)Define the terms (i) disintegration constant and (ii) half life of radioactive nucleus. Obtains the relation between the two.

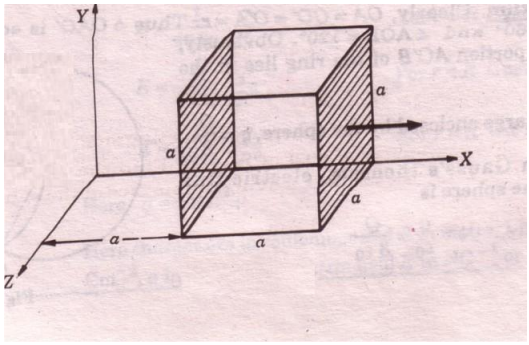
(b) A radio active nucleus has a decay constant =0.3465 per day. How long would it take the nucleus to decay to 75% of its initial amount ?(Log_{10} 3= 0.4771)

14) A Galvanometer to be converted to voltmeter to measure up to

(a) V volt by connecting R_1 resistance in series

(b) V/2 volt by connecting R_2 resistance in series. Find Resistance R in terms of R_1 and R_2 required to convert it to voltmeter which can read 2V

15) The electric field components in Fig. are $E_x = -\alpha x^{1/2}, E_z = 0$, in which given by $\alpha = 800 \text{N/Cm}^2$. Calculate (i) the flux φ_E through the cube and (ii) the charge within the cube. Assume that *a* = 0.1 m



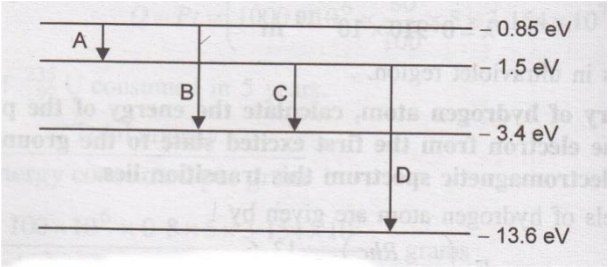
16) Explain how oscillation takes place in LC circuit.A radio can tune over the frequency range of a portion of medium wave(MW) broadcast band(800kHz to 1200kHz). If its LC circuit has an effective inductance of 200 micro Henry, What must be the range of variable capacitor ?

17) Electromagnetic waves with wavelength

a. λ_1 are used to treat muscular strain.
b. λ_2 are used by a FM radio station for broadcasting.
c. λ_3 are used to detect fracture in bones.
d. λ_4 are absorbed by the ozone layer of the atmosphere.

Identify and name the part of electromagnetic spectrum to which these radiations belong. Arrange these wavelengths in decreasing order of magnitude.

18) The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm.



19) Write three factors which justify the need of modulating a message signal. Show diagrammatically how an amplitude modulated wave is obtained when a modulating signal is superimposed on a carrier wave.

20) Draw the circuit diagram to study the characteristics of NPN transistor in common emitter mode. Sketch typical input, output characteristics . With help of characteristics explain how the current gain and input resistance can be calculated.

21) How does an unpolarised light can be polarized? Two polaroids A and B are kept in crossed position. How should a third Polaroid C be placed between them so that the intensity of transmitted light by Polaroid B reduces to $1/8^{th}$ of the intensity of incident light at A

22) State Ampere's circuital law. Use this law to obtain an expression for the magnetic field due to a toroidal solenoid of radius r and number of turns N.

Or

Obtain an expression for the frequency of revolution of a charged particle and maximum Kinetic energy of it, moving in a uniform transverse magnetic field. How does the time period of the circulating ions in a cyclotron depend on (i) the speed (ii) the radius of the path of ions.

23) Rohan was watching his favourite TV programme along with his family at night. Suddenly the light went off causing darkness all over. Rohan's mother asked him to bring candle along with matchstick from the kitchen.Rohan at once picked the mobile phone and pressed the button lighting up the surrounding. His mother was surprised and asked where the light was coming from. Rohan proudly showed her the mobile.

(i) How is the light produced in a mobile phone

(ii) Name the device used for this purpose and write its principle

(iii) Which values are displayed by Rohan?

24) (a) What do you mean by electric dipole ?Obtain an expression for the electric field due to electric dipole on axial line of electric dipole

(b) An electric dipole of length 2 cm is placed with its axis making an angle of 60° to a uniform electric field of 10^5 NC^{-1} If it experiences a torque $8\sqrt{3}$ Nm, calculate the

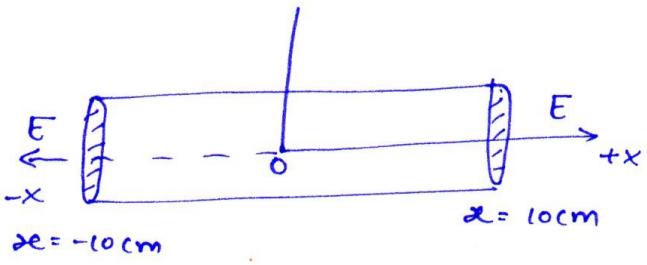
(i) magnitude of the charge on the dipole, and

(ii) potential energy of the dipole

Or

(a)State the theorem which relates the enclosed charge, inside a closed surface, with the electric flux through it. Use this theorem to obtain the electric field due to a uniformly charged thin spherical shell at an (i) outside point (ii) inside point.

(b) Given E = 200 $\hat{i}$ for x => 0 and E = – 200$\hat{i}$ for x = < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the axis.

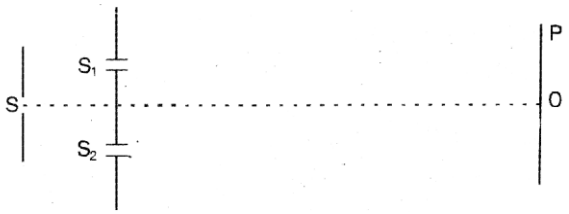


(a) What is flux through each face?

(b) What is flux through the side of the cylinder?.

(c) What is net charge inside the cylinder?

24. (a)Following figure shows an experimental set up similar to young's double slit experiment to observe interference of light.



Here $SS_2 - SS_1 = \frac{\lambda}{4}$

Write the condition of (i) constructive (ii) destructive interference at any point P in term of path difference $\Delta S_2P - S_1P$.

Does the central fringe observed in the above set up lie above or below O? Give reason in support of your answer.

(b)Yellow light of wavelength 6000 $\overset{o}{A}$ produces fringes of width 0.8 mm in Young's double slit experiment. What will be the fringe width if the light source is replaced by another monochromatic source of wavelength 7500 $\overset{o}{A}$ and separation between the slits is doubled?

Or

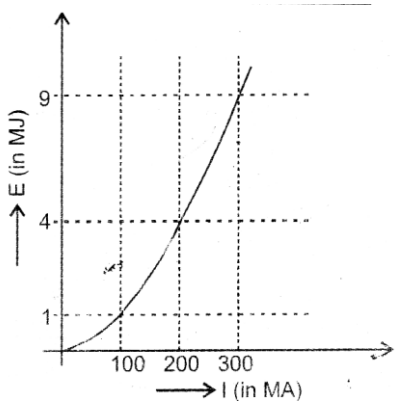
(a)Draw a graph showing the variation of intensity with angle in a single slit diffraction pattern. Explain why the intensity of the first secondary maximum is much less than that of the first secondary maximum is much less than that of the central maximum.

(b)Light of wavelength 6000 $\overset{o}{A}$, is used to illuminate a slit of width 0.1 mm. Obtain the angular position of the first minimum in the resulting diffraction pattern. What will happen to the intensity of the central maximum if the width of the slit were to be reduced to 0.05 mm?

25)(a)Using phosor diagram of a series LCR circuit connected to an AC source $E=E_0Sinwt$. Derive the relation between current and EMF and then find average power in this circuit

(b)A circuit is set up by connecting L=100 mH, C=5 μF and R $=100\Omega$ in series. An alternating emf of $(150\sqrt{2}volt, \left(\frac{500}{\pi}\right)$ Hz is applied across this series combination. Calculated the impedence of the circuit.

OR



(a)State Lenz's Law. The energy E, required to build up a steady current I, in a given coil, varies with I in the manner shown. Calculate the self inductance of the coil.

(b) A circular coil of radius r, is placed co-axially with another circular coil of radius R (R>>r) with the centres of the two coils coinciding with each other. Obtain an expression for the mutual inductance of this pair of coils.