SHARJAH INDIAN SCHOOL

MODEL EXAMINATION – JANUARY 2012

Class : XII (Boys Wing) **Time Allotted: 3hrs.**
Subject: PHYSICS **Max. Marks : 70**
Day & Date: Monday, 09/01/2012

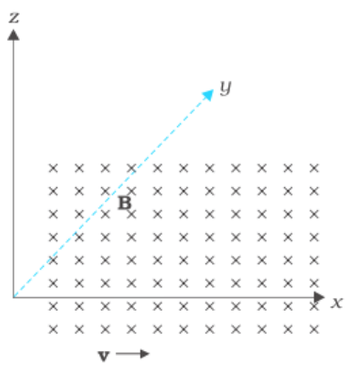
General Instructions:

1. ***All questions are compulsory.***
2. ***There are 30 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 18 carry two marks each, questions 19 to 27 carry three marks each and questions 28 to 30 carry five marks each.***
3. ***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 each. You have to attempt only one of the given choices in such questions.***
4. ***Use of calculators is not permitted.***
5. ***You may use the following physical constants wherever necessary :***
   $c = 3 \times 10^8 ms^{-1}$ $h = 6.6 \times 10^{-34} Js$ $e = 1.6 \times 10^{-19} C$ $\mu_o = 4\pi \times 10^{-7} A^{-1} m T$
   Boltzmann constant $k = 1.38 \times 10^{23} JK^{-1}$ Avogadro's number $N_A = 6.023 \times 10^{23}$/mole
   Mass of neutron $m_n = 1.6 \times 10^{-27}$ kg

Name of student:…… Exam. No:…….

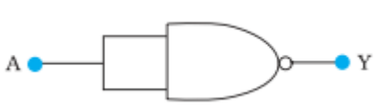
1. Two identical spheres having charges +Q and –Q are separated by a given distance so that a force F exists between them. What will be the force when they are kept in contact and then separated by the same distance again? 1

2. An electron is moving along X axis in a uniform magnetic field shown in the figure. Give the direction of Lorentz force. 1



3. Rainbow is never observed in the moon. Why? 1

4. Write the value of output Y for inputs A = B = 0, when given to the following logic gate: 1



5. Is the ratio of frequency ultraviolet rays to infrared rays in glass less than, equal to or greater than one? 1

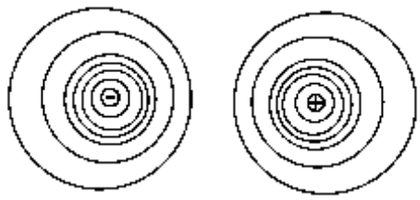
6. Plot two graphs showing the variation of photoelectric current with applied voltage for the same intensity, but of different frequencies of incident radiations when falling on a given photosensitive metal, 1

7. How will (i) the trans-conductance and (ii) the current amplification factor of a transistor change on increasing the doping level of the base region? 1

8. Why is a.c more dangerous than d.c for the same voltage? 1

9. A message signal of frequency 10 kHz and peak voltage of 10 volts is used to modulate a carrier of frequency 1 MHz and peak voltage of 20 volts. Determine:
(a) modulation index, (b) the side bands produced. 2

10. (a) Can two equipotential surfaces intersect each other? Give reason.
(b) Identify the charge distribution corresponding to the following pattern of equi-potential surfaces.



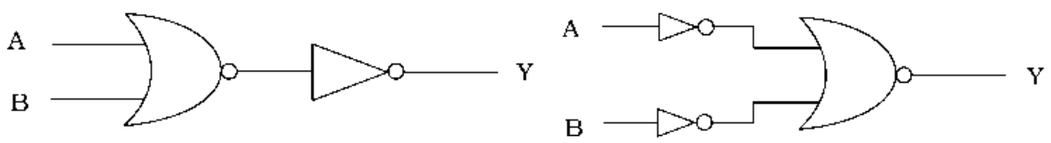
2

11. Two metallic wires of the same material have the same length but cross-sectional area is the ratio 1:2. They are connected (i) in series and (ii) in parallel. Compare the drift velocities of electrons in the two wires in both the cases (i) and (ii). 2

12. Obtain an expression for the resistivity of the material of a wire in terms of the free electron density (n) and relaxation time (τ). 2

13. In a compass, the magnetic needle has magnetic moment 6.7 x 10^{-2} Am^2 and moment of inertia I = 7.5 10^{-6} kg $m^{2.}$ It performs 10 complete oscillations in 6.7 s. What is the magnitude of the magnetic field? 2

14. You are given the two circuits as shown in Fig. 14.44. Show that circuit (a) acts as OR gate while the circuit (b) acts as AND gate. 2



(a) (b)

15. A convex lens made of crown glass has radii of curvature 5 cm and 10 cm respectively. Find the longitudinal chromatic aberration of the lens if μ_v = 1.523 and μ_r = 1.515. 2

(OR)

Show that a convex lens produces'N' times magnified image when the object distances, from the lens, have magnitudes (f ± f/N). Here f is the magnitude of focal length of the lens. 2

16. A rectangular coil of N turns and area A is rotated in a uniform magnetic field of intensity B with an angular velocity ω. Obtain an expression for the maximum induced emf in the coil. What would be flux linked with the coil at the instant when the induced emf is maximum? 2

17. Electromagnetic waves with wave length
(i) λ_1 are used to in LASIK eye surgery.
(ii) λ_2 are produced using Magnetron valves.
(iii) λ_3 have magnitudes in the range 1nm to 10^{-3} nm.
Identify the waves and arrange them in ascending order of their magnitudes. 2

18. State Lenz's law in electromagnetic induction. Justify the relevance of the law of conservation of energy with Lenz's law 2

19. (a) Why we do not encounter diffraction effects of light in everyday observations?
(b) In the observed diffraction pattern due to a single slit, how will the width of central maximum be affected if
(i) the width of the slit is doubled.
(ii) the wavelength of the light used is increased?
Justify your answer in each case. 3

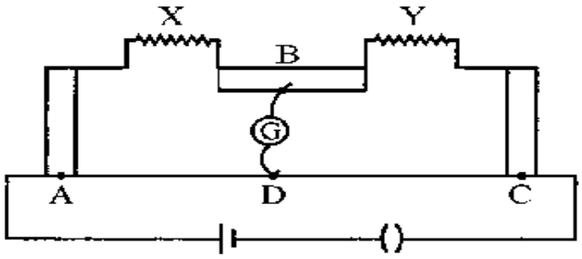
20. What is meant by 'modulation'? Why is it needed? Draw a block diagram of a simple modulator for obtaining an AM signal. 3

21. Draw the ray diagram showing the formation of image by a convex mirror. Hence obtain the relation between focal length, object distance and the image distance. 3

22. A 60 V, 10W lamp is to run on 110 V, 60 Hz a.c. mains. Calculate the inductance of the choke coil required. How much pure resistance would be necessary in the circuit to achieve the same result? Which of the two is preferred? 3

23. What are 'matter waves'? Obtain an expression for the wavelength associated with an electron, accelerated under a given potential difference. Draw the wave packet description of an electron. 3

24. The figure below shows the experimental set up of a meter bridge. When the two unknown resistances X and Y are inserted, null point D is obtained 40cm from the end A. When a resistance of 10 Ω is connected in series with X, the null point shifts by 10 cm. Find the position of the null point when the 10 Ω resistance is instead connected in series with 'Y'. Also determine the values of X and Y.



3

25. Using the postulates of Bohr Atom model, obtain an expression for the energy possessed by an electron revolving around the nucleus of Hydrogen atom. 3

26. The half life of $_{92}U^{238}$ against α-decay is 4.5 x 10^{9} years. What is the activity of 1g sample of $_{92}U^{238}$? 3

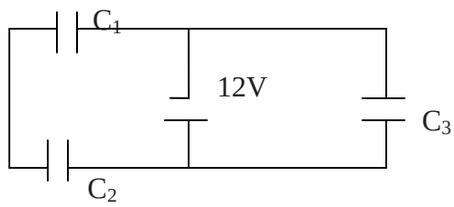
(OR)

Calculate the binding energy per nucleon of $_{20}Ca^{40}$ nucleus. Given: m ($_{20}Ca^{40}$) = 39.962589u Mass of a neutron = 1.008665u and mass of a proton = 1.007825u. 1u = 931MeV 3

27. With the help of a neat circuit diagram, explain the working of a transistor as an oscillator. What are the Burkhausen criteria associated with an oscillator? 3

28. (i) State Gauss' theorem. On the basis of this, prove that, for a point outside a charged spherical shell, it behaves as a point charge.

(ii) Three identical capacitors C_1, C_2 and C_3 of capacitance 6μF each are connected to a 12 V battery as shown.



Find

(i) Charge on each capacitor

(ii) Equivalent capacitance of the network

(OR)

(i) Explain the principle on which Van de Graff generator operates. Draw a labeled schematic sketch and write briefly its working.

(ii) A Van de Graff generator is capable of building up a potential difference of 15×10^6 V. The dielectric strength of the gas surrounding the electrode is 5×10^7 V/m. What is the minimum radius of the shell spherical shell required? 5

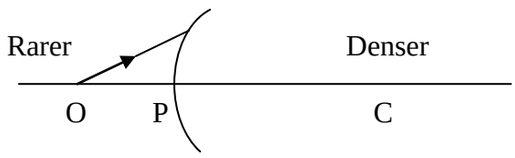
29. A straight thick long wire of uniform cross section of radius 'a' is carrying a steady current I. Use Ampere's circuital law to obtain a relation showing the variation of the magnetic field inside and outside the wire with distance r, ($r \leq a$) and ($r > a$) of the field point from the centre of its cross section. Plot the graph showing the nature of this variation.
Calculate the ratio of magnetic field at a point a/3 above the surface of the wire to that at a point a/3 below its surface. What is the maximum value of the field of this wire?

(OR)

(i) Draw the labeled diagram of a moving coil galvanometer. Prove that in a radial magnetic field, the deflection of the coil is directly proportional to the current flowing in the coil.

(ii) Which one of the two – an ammeter or a milli-ammeter, has greater resistance, when made from identical galvanometers? Explain. 5

30. (a) A spherical surface of radius of curvature R separates a rarer medium and a denser medium as shown in the figure.



Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance 'u', image distance 'v', radius of curvature R and the refractive indices n_1 and n_2 of the two media.

(b) Obtain the relation between the focal length and radius of curvature of an equi-convex lens made of a material of refractive index 1.5.

(OR)

(a) Draw a labeled diagram of an astronomical telescope used in the normal adjustment position. Write the expression for its magnifying power and length.

(b) Two astronomical telescopes T_1 and T_2 have the same magnifying power. If the ratio of apertures of their objectives is 3:2, find

(i) the ratio of their resolving powers and

(ii) the ratio of the intensities of the image formed by them. 5