Total No. of Questions : 12]   [Total No. of Printed Pages : 4

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F. E. Examination - 2009

APPLIED SCIENCE - II

(2003 Course)

Time : 3 Hours]   [Max. Marks : 100

Instructions :

(1) Answer 3 questions for section I and 3 questions from section II.

*(2) Answer to the **two sections** should be written in **separate answer-books**.*

(3) Black figures to the right indicate full marks.

(4) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

(5) Neat diagrams must be drawn wherever necessary.

(6) Assume suitable data, if necessary.

Constants :

Planaks' Constant $h = 6.63 \times 10^{-34}$ J-S.

Charge on Electron $e = 1.6 \times 10^{-19}$ C

Mass of Electron $m_e = 9.1 \times 10^{-31}$ kg.

Speed of Light $c = 3 \times 10^8$ m/s.

SECTION - I

Q.1) (A) Obtain an expression for the energy levels of a particle enclosed in a rigid box. Draw energy level diagram for different values of quantum numbers.   [07]

(B) State Heisenbergs uncertainly principle. Illustrate it with an experiment based on electron diffraction by a single slit.   [06]

(C) What potential difference must be applied to an electron microscope to produce electron of wavelength 0.4A° ?   [04]

OR

Q.2) (A) State De Broglie's Hypothesis of Matter Waves. Describe Davision and Germer's Experiment as an evidence for it. [07]

(B) Derive Schrodinger's Time-independent Wave Equation. [06]

(C) An electron has a speed of 600 m/s with an accuracy of 0.005%. Calculate the uncertainty with which we can locate the position of electron. [04]

Q.3) (A) With the help of a neat labelled diagram explain the construction and working of Ruby Laser. [07]

(B) State and explain :
   (1) Meissner Effect
   (2) Critical Field [06]

(C) What are the advantages of Optical Fibre Communication ? [04]

OR

Q.4) (A) What are Ferrites ? Write four important properties and any four uses of Ferrites. [07]

(B) What is Holography ? Explain the recording and reconstruction of a Hologram. [06]

(C) Explain Type-I and Type-II Superconductors. [04]

Q.5) (A) What is Hall Effect ? Obtain an expression for Hall Voltage (V_H). [06]

(B) Explain principle, construction and working of Bainbridge Mass Spectrograph. [06]

(C) The resistivity of an N-type Semiconductors is $10^{-6} \Omega$m. Calculate the number of donor atoms which must be added to obtain the same resistivity. (Given : $\mu_e = 1000$ cm^2/V$_{sec}$) [04]

OR

Q.6) **(A)** Explain the motion of an electron in Perpendicular Electric Field. **[06]**

(B) On the basis of band theory of solids classify the solids into conductors, semi-conductors and insulators. **[06]**

(C) An electron of 50 eV enters in a Perpendicular Magnetic Field of 0.04 wb/m². Find the radius of path of an electron in the field. **[04]**

SECTION - II

Q.7) **(A)** Explain how the Calorific Value of coal can be determined by using Bomb Calorimeter. **[07]**

(B) Describe the process of distillation of Crude Petroleum with diagram. Give composition, boiling range and uses of any three fractions obtained. **[06]**

(C) 2.5 gms of air-dried coal sample was taken in a silica crucible, after heating it in an electric oven at 105-110°C for 1 hour, the residue was weighed 2.410g. The residue was then ignited at 700-750°C to a constant weight of 0.246 g.

In an another experiment, 1 gm of the same sample was heated in a silica crucible covered with vented lid at a temperature 950 ± 20°C for exactly 7 minutes. After cooling the weight of residue was found to be 0.611 gms.

Calculate % of Fixed Carbon and Calorific Value of coal using Goutel's Formula. Value of 'a' being given as 129. **[04]**

OR

Q.8) **(A)** What a Ultimate Analysis ? How the percentages of C, H and N are determined from the given sample of coal. **[07]**

(B) (1) Give the preparation and advantages of 'Biodiesel'. **[03]**

(2) Following observations were noted in the Boy's Gas Calorimeter Experiment. Find G.C.V. and N.C.V. of the Gaseous Fuel.

(a) Volume of gaseous fuel burnt (NTP volume) = 0.1m³

(b) Weight of water circulated for cooling = 27.5 kg.

(c) Weight of steam condensed = 0.025 kg.

        (d)   Temperature of Inlet Water   = 25.5°C

        (e)   Temperature of Outlet Water   = 31.4°C

        (Latent heat of H_2O = 587 Kcal/kg)   **[03]**

  (C) A producer gas used as a fuel has following volumetric composition :

      H_2 = 28%, CO =12%, CH_4 = 2%, CO_2 = 16%, N_2 = 42%

      Find the volume of air required for complete combustion of 1 m^3 of the gas. Air contains 21% by volume of oxygen. **[04]**

Q.9) (A) Write short note on Fuel Cell.   **[07]**

     (B) Explain Reversible, Irreversible and Concentration Cell. **[06]**

     (C) Distinguish between Galvanising and Tinning. **[04]**

OR

Q.10) (A) Describe different factors affecting rate of Corrosion. **[07]**

     (B) Write short notes on :

        (1) Modifying the Environment

        (2) Application of Inhibitors   **[06]**

     (C) What is meant by Batteries ? What are the types of Batteries ? Give two examples of each.   **[04]**

Q.11) (A) Explain in detail the Setup for Thin Layer Chromatography. **[06]**

     (B) State and derive Beer's and Lamberts Law. **[06]**

     (C) Explain transitions involved in UV - Spectroscopy. **[04]**

OR

Q.12) (A) Write the principle, instrumentation and working of IR Spectroscopy with diagram. **[06]**

     (B) Describe the principles of gas chromatography with the help of a diagram for gas chromatograph. **[06]**

     (C) What is a Spectrophotometer ? What are its major components ? Explain in brief. **[04]**