



**RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES**

B.Sc. (General) Degree
Third Year – Semester II Examination – March / April 2014

PHY 3207 – ENERGY RESOURCES

Answer **FOUR** questions only

Time allowed: 2 Hours

$$\text{Universal gas constant (R)} = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$

The use of a non-programmable electronic calculator is permitted.

1.

- a. What do you mean by renewable and nonrenewable energy resources?
(20 marks)
- b. Discuss the advantages and disadvantages of renewable energy and nonrenewable energy resources.
(20 marks)
- c. Name two renewable energy and nonrenewable energy resources.
(10 marks)
- d. Assume petrol contains octane only and the density of petrol is 0.74 kg l^{-1} . The molar masses of carbon and hydrogen are 12 g mol^{-1} and 1 g mol^{-1} respectively. A car can run 12 km from a liter of petrol. How many kilograms of carbon dioxide are emitted when the car travels 100 km?
(30 marks)
- e. Discuss the advantages can be obtained by replacing this car by i) a hybrid car that runs 25 km per liter and ii) a fuel cell car.
(20 marks)

2.

a. What is the principle behind the petroleum (Oil) refining?

(10 marks)

b. Describe the petroleum (Oil) refining process using relevant diagrams.

(50 marks)

c. Name ten industries based on petroleum products.

(20 marks)

d. What do you mean by cracking and alkylation?

(20 marks)

3.

a. What are the advantages of Li ion batteries compared to other type of batteries?

(30 marks)

b. Prove that the discharge current delivered by a battery is given by $I_d = \frac{E_o}{R_{app} + R_{ext}}$ where E_o is the open circuit voltage, R_{app} is the apparent internal resistance in the cell and R_{ext} is the resistance of the external circuit.

(30 marks)

c. Prove that the power delivered by a battery during discharge is given by $P = \frac{E_o^2 R_{ext}}{(R_{app} + R_{ext})^2}$.

(20 marks)

d. The open circuit voltage and short circuit current of a battery are 1.5 V and 1 A respectively. Calculate the discharge current and power delivered by the battery when it discharged through a 10 Ω resistor.

(20 marks)

4.

a. What are the advantages of fuel cells over other types of energy conversion devices?

(20 marks)

b. Name the five types of Fuel cells.

(20 marks)

c. A fuel cell car has a fuel cell which operates at 25 °C and run on H₂ gas. The fuel cell produces an average electric power of 100 kW. The Gibbs free energy for the fuel cell reaction is 244.0 kJ mol⁻¹ at 25 °C. If the efficiency of the fuel cell is 70% calculate the amount of H₂ needed for a one hour trip.

(60 arks)

5.

Figure 1 shows a current density versus voltage (cell potential) curve for a solar cell under 1000 W cm⁻² light irradiation. The maximum power point is marked on the graph. Calculate following parameters of this solar cell.

i. The open circuit voltage of the cell.

(10 marks)

ii. The short circuit current density of the cell.

(10 marks)

iii. The maximum theoretical power density of the cell.

(20 marks)

iv. The maximum power density of the cell.

(20 marks)

v. The fill factor of the cell.

(20 marks)

vi. The efficiency of the cell.

(20 marks)

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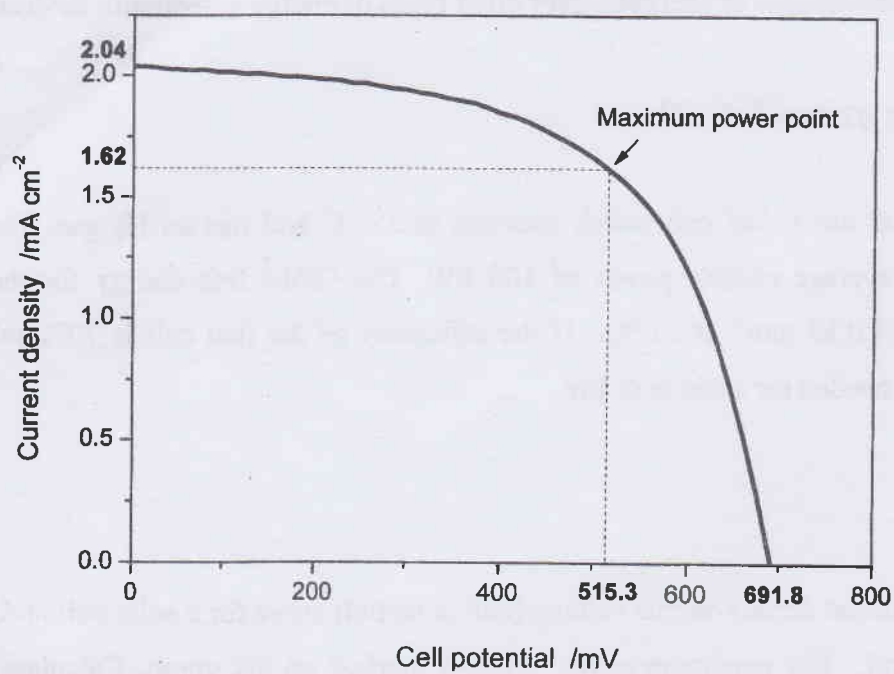


Figure 1