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

B.Sc. (General) Degree
Third Year – Semester II Examination – Oct. / Nov. 2015

**PHY 3207 – ENERGY RESOURCES**

Answer **all FOUR** questions Time allowed: 2 Hours

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

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

1.

a. Discus the advantages of using alkaline metals in batteries as a reducer?
(25 marks)

b. Prove that the discharge current delivered by a battery is given by $I_d = \frac{E_\circ}{R_{app} + R_{ext}}$ where $E_\circ$ 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.
(25 marks)

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

d. The open circuit voltage of a battery is 12 V and a 10 Ω resistor is connected to it in parallel. Calculate the internal resistance of the battery if the discharge current is 1 A.
(15 marks)

e. Calculate the power delivered by the battery during discharge.
(15 marks)

2.

a. Write down the common conditions for formation of Fossil Fuels.
(20 marks)

b. Name commonly used coal mining methods.
(20 marks)

c. What is the principle behind the petroleum (Oil) refining?
(10 marks)

d. Describe the petroleum (Oil) refining process using relevant diagrams.
(50 marks)

3.

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 run on $H_2$ gas which operates at room temperature. The fuel cell produces an average electric power of 70 kW. The Gibbs free energy of the fuel cell reaction is 244.0 kJ $mol^{-1}$ at room temperature. If the efficiency of fuel cell is 60% calculate the amount of $H_2$ needed for a one hour trip.
(60 Marks)

4.

a. Describe the advantages of solar cells over other types of energy conversion devices.
(40 marks)

b. Figure 1 shows a current density versus voltage (cell potential) curve for a solar cell operates under 1000 W $m^{-2}$ 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.
(10 marks)

iv. The maximum power density of the cell.
(10 marks)

v. The fill factor of the cell.
(10 marks)

vi. The efficiency of the cell.
(10 marks)

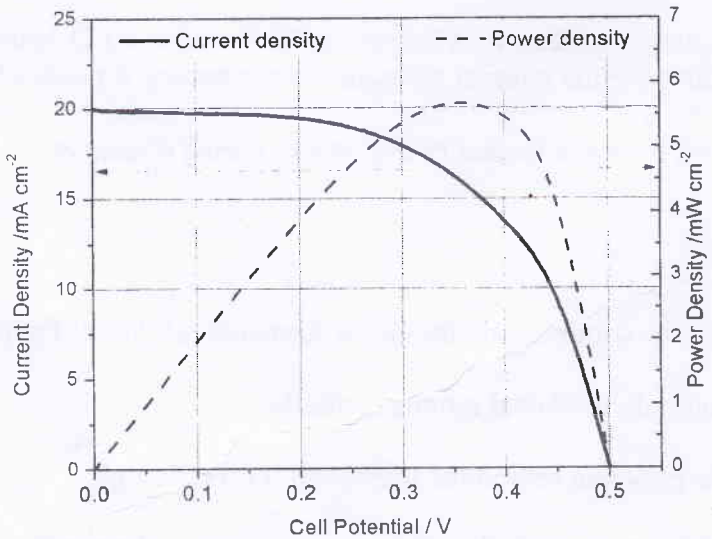


Figure 1