



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

**B.Sc. (General) Degree Examination**  
**Third year - Semester I – February 2013**

**PHY 3207 – ENERGY RESOURCES**

**Answer four questions**

**TIME: 2 Hours**

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Universal gas constant (R) =  $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$   
Velocity of light in free space =  $3 \times 10^8 \text{ m s}^{-1}$

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

1. Discuss the major advantages and disadvantages of fossil fuels as a source of energy
  - a. What are the common conditions for formation of fossil fuels?
  - b. A car can travel 10 km from one liter of petrol (assume that petrol contains only octane). How many kilograms of carbon dioxide are put into the air when it travels 100 km? (The density of petrol is  $0.74 \text{ kg l}^{-1}$  and molar masses of carbon and hydrogen are  $12 \text{ g mol}^{-1}$  and  $1 \text{ g mol}^{-1}$  respectively)
  - c. What is the volume of emitted carbon dioxide amount at the standard pressure and temperature?
2.
  - a. Name commonly used coal mining methods.
  - b. Describe two mining method mentioned above.
  - c. Explain petroleum (Oil) refining process using relevant diagrams.

- 3.
- What are the 3 main components in a battery and describe their function briefly?
  - What are advantages of Li ion batteries?
  - 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 open circuit voltage,  $R_{app}$  is apparent internal resistant in the cell and  $R_{ext}$  is resistant of the external circuit.
  - Prove that the power delivered by a battery during discharge is given by  $P = \frac{E_o^2 R_{ext}}{(R_{app} + R_{ext})^2}$ .
4. What are the advantages of fuel cells over other types of energy conversion methods?
- A fuel cell car has a fuel cell which operates at 300 K and run on  $H_2$  gas. The fuel cell produces an average electric power of 50 kW. The Gibb's free energy for the fuel cell reaction is  $244.0 \text{ kJ mol}^{-1}$  at 300 K. Calculate the rate of hydrogen flow ( $\text{g s}^{-1}$ ) to the fuel cell, if the efficiency of the fuel cell is 60%.
  - Calculate the amount of  $H_2$  needed for a five hour trip.
5. i) a) What do you mean by nuclear fission and nuclear fusion?
- The nucleus  $C^{12}$  consists of 6 protons and 6 neutrons held in strong nuclear forces. The rest masses of  $C^{12}$ , proton and neutron are 12.000000 a. m. u. 1.007825 a. m. u. and 1.008665 a. m. u. respectively. What is the binding energy of  $C^{12}$  nucleus?
- ii) Write down a very brief essay on use of hydrogen fuel to fulfill future energy needs.

6. The following table shows the voltage and current density data for a solar cell under  $1000 \text{ W cm}^{-2}$  light irradiation.

i. Plot the voltage versus current density curve on the sheet provided.

Calculate,

- ii. the open circuit voltage of the cell.
- iii. the short circuit current density of the cell.
- iv. the maximum theoretical power density of the cell.
- v. the maximum power density of the cell.
- vi. the efficiency of the cell.

Table . Voltage and current density data

Voltage (mV)	500	450	400	350	300	250	200	150	100	50	0
$J(\text{mA/cm}^{-2})$	0	5	10	14	18	20	21	22	22.5	22.7	23

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