



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

**B.Sc. (General) Degree in Applied Sciences**  
**Third Year – Semester I Examination – September / October 2019**

**PHY 3207 – ENERGY RESOURCES**

**Time: Two (02) hours**

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Answer all Questions.  
Use of a calculator is permitted.  
Symbols have their usual meanings.

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1. a) A country has to select suitable energy recourses to fulfil their energy needs. Write down two main advantages and two main disadvantages for each of the following energy resources.
  - i. Fossil fuel
  - ii. Solar cell
  - iii. Hydropower

**(06 marks)**
- b) Coal is the largest source of energy for the generation of electricity worldwide. Explain three main ranks of coal and its uses. 

**(06 marks)**
- c) Briefly explain three main types of modern surface mining methods. 

**(03 marks)**
- d) Discuss the conditions to form crude oil reservoirs and unconventional oil reservoirs. 

**(05 marks)**
2. a) Compare the primary batteries with the secondary batteries. 

**(05 marks)**
- b) Why do batteries go dead, but fuel cells do not? 

**(03 marks)**
- c) Characterize primary batteries according to their battery chemistry and write short notes on two of them. 

**(08 marks)**
- d) Lead - acid battery has two ends. One of them is metal and the other one is the corresponding metal oxide. Write down two reactions at the two ends. 

**(04 marks)**

3. a) Compare SOFC, PAFC, PEM, MCFC and AFC. Your comparison should include their operating temperature, efficiency, mobile ions and the applications. (05 marks)
- b) Compare photoelectric effect with photovoltaic effect. (02 marks)
- c) i. Majority of photovoltaic cells are silicon semiconductor junction devices. Write down the relationship between the variations of band gap with the temperature in semiconductor (02 marks)

ii. Hence determine the band gap in a silicon crystal at 40 °C.

For Silicon material,

$$E_g(0) = 1.16 \text{ eV}$$

$$a = 7 \times 10^{-4} \text{ eVK}^{-1}$$

$b = 1100 \text{ K}$ , where  $a$  and  $b$  are material constants in the relationship c) i. above. (03 marks)

- d) Calculate the shift in the Fermi-energy level in a silicon crystal doped with a group V impurity concentration of  $10^{15} \text{ cm}^{-3}$ .

Given: the effective density of states in the conduction band is  $2.82 \times 10^{19} \text{ cm}^{-3}$ ,

band gap is 1.1 eV,

room temperature is 27 °C,

Boltzmann's constant is  $1.38 \times 10^{-23} \text{ JK}^{-1}$  (08 marks)

4. a) Briefly discuss the different forms of hydropower currently in use. (05 marks)
- b) Discuss advantages and disadvantages of building up hydroelectric technology. (06 marks)
- c) In recent years, wind energy has become one of the most economical renewable energy technologies. Write down the factors which affect the power output of a wind turbine? (03 marks)
- d) Draw the power output curve versus wind speed of the turbine clearly showing the cut-in speed, rated speed and the cut-out speed. (06 marks)

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