

**CORK INSTITUTE OF TECHNOLOGY**  
**INSTITIUID TEICNEOLAIOCHTA CHORCAI**

**Semester 1 Examinations 2009/10**

**School:** SCIENCE

**Programme Title:**

Bachelor of Science (Hons) – Analytical Chemistry with Quality Assurance, Year 1  
Bachelor of Science (Hons) – Herbal Science, Year 1  
Bachelor of Science (Hons) – Nutrition and Health Science, Year 1  
Bachelor of Science (Hons) – Pharmaceutical Biotechnology, Year 1  
Bachelor of Science – Applied Biosciences, Year 1  
Bachelor of Science – Analytical and Pharmaceutical Chemistry, Year 1  
Bachelor of Science – Applied Physics and Instrumentation, Year 1  
Higher Certificate in Science – Industrial Measurement and Control, Year 1

**Programme Code:** SCHQA\_8\_Y1  
SHERB\_8\_Y1  
SNHSC\_8\_Y1  
SPHBI\_8\_Y1  
SBIOS\_7\_Y1  
SCHEM\_7\_Y1  
SPHYS\_7\_Y1  
SIMCT\_6\_Y1

<b>Module Title:</b> INTRODUCTION TO PHYSICS C/A
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**Module Code:** PHYS6011

**External Examiner(s):** Dr V. Casey, Mr. J. McCombe

**Internal Examiner(s):** Ms C. Devaney  
Ms E. Norris  
Dr A. O'Connor  
Dr M. Woods

**Instructions:** Answer **any four** questions. All questions carry equal marks.

**Duration:** 2 Hours

**Sitting:** Autumn 2010

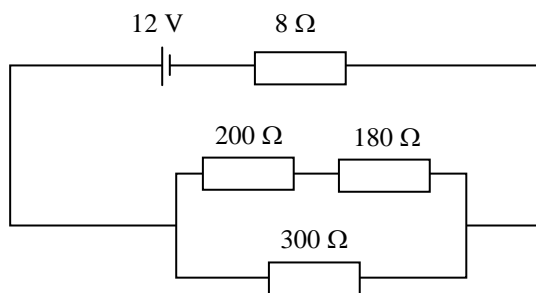
**Requirements for this examination:** Log tables.

1 **Answer ANY FIVE parts. Each part carries 5 marks.**

- (a) (i) Convert 0.45 mm to m and write your answer in scientific notation.  
(ii) State the SI unit for energy and the unit for power.
- (b) For a battery with an emf of 12 V and an internal resistance of  $5\ \Omega$ , calculate the maximum current it can deliver.
- (c) A water wave travels with a velocity of 0.64 m/s and the distance between two consecutive wave peaks is 2.5 m. Calculate (i) the frequency (ii) the period of the wave.
- (d) Sketch the Maxwell-Boltzmann distribution of molecular energies for two different temperatures, indicating which temperature is higher.
- (e) Outline how heat is transferred by convection.
- (f) Explain with the aid of a sketch why the apparent depth of a body when viewed under water is less than its real depth.
- (g) Illustrate what is meant by total internal reflection and give one application of it.

2 For the following circuit, calculate

- (i) the resistance of the parallel combination; [6 marks]
- (ii) the total current drawn from the battery; [4 marks]
- (iii) the voltage drop across the parallel combination; [4 marks]
- (iv) the current in each branch of the parallel combination; [6 marks]
- (v) the power dissipated in the  $200\ \Omega$  resistor. [5 marks]



- 3
- (a) Distinguish clearly between heat and temperature. What is the lowest possible temperature of a material on the *Kelvin* scale? [6 marks]
  - (b) What is meant by a thermometric property? Give an example of one commonly used in thermometry. [4 marks]
  - (c) Explain what is meant by a latent heat. A container holding 280 g of water at an initial temperature of  $35^{\circ}\text{C}$  is placed in a freezer. What power is needed to bring it to a final temperature of  $-18^{\circ}\text{C}$  in a time of 6 minutes? (The specific heat capacity of water is  $4186\ \text{J/kg}\cdot^{\circ}\text{C}$  and that of ice is  $2300\ \text{J/kg}\cdot^{\circ}\text{C}$ ; the latent heat of fusion of ice is  $330\ \text{kJ/kg}$ . The heat capacity of the container may be ignored.) [15 marks]

- 4 (a) An iron bar has a length of 1.5325 m at  $30^{\circ}\text{C}$ . What will be its length at  $-10^{\circ}\text{C}$ ? (The coefficient of linear expansion for iron is  $1.2 \times 10^{-5} \text{ }^{\circ}\text{C}^{-1}$ .) [5 marks]
- (b) State the factors which determine the rate of heat flow through a material. The windows in a room are 1.5 m high by 90 cm wide and have a thickness of 8 mm. If the inside temperature is  $22^{\circ}\text{C}$  and the external temperature is  $-2^{\circ}\text{C}$ , calculate (i) the rate of heat loss (or power loss)  $P$  through each window (ii) the total heat lost through a window in 15 minutes. (The thermal conductivity of glass is  $1.05 \text{ W/m}\cdot\text{K}$ .) [15 marks]
- (c) What is meant by a black-body? Give an example of a good approximation to a black-body. [5 marks]
- 5 (a) Sketch the formation of an image by a concave (diverging) lens for an object placed inside its focus. Indicate clearly whether the image is real or virtual and whether it is erect or inverted. [8 marks]
- Answer EITHER (b) or (c)**
- (b) A microscope comprises two convex (focusing) lenses with a separation of 10 cm. The objective has a focal length of 8 mm and the eyepiece has a focal length of 9 cm. An object is placed 12 mm in front of the objective. Sketch the formation of the final image and calculate the overall magnification. [17 marks]
- (c) Describe the operation of the human eye as an optical instrument in imaging an object. Explain how the eye focuses on near and distant objects and how this operation differs from the operation of a convex glass lens. [17 marks]
- 6 (a) (i) Define pressure and state its SI unit. [4 marks]
- (ii) Give a brief account of the measurement of blood pressure. [6 marks]
- (b) Water flows at a speed of 0.4 m/s through a garden hose that has a radius of 3 cm. The hose is horizontal.
- (i) Calculate the cross-sectional area of the hose.
- (ii) At what speed does the water flow through a nozzle at the end of the hose if the nozzle has a cross-sectional area of  $2.8 \times 10^{-5} \text{ m}^2$ ?
- (iii) Use Bernoulli's Principle to determine the pressure of the water entering the hose if the pressure at the nozzle is  $2 \times 10^5 \text{ Pa}$ . (The density of water is  $1000 \text{ kg/m}^3$ .) [15 marks]

**P.T.O.**

- 7 (a) An orchestra plays very softly at an average intensity of  $7.5 \times 10^{-6} \text{ W/m}^2$ . What is the intensity level in dB? (The threshold of human hearing is  $I_0 = 10^{-12} \text{ W/m}^2$ .) [8 marks]
- (b) A Doppler flowmeter is used to measure the speed of blood flow. Explain briefly how it works. [9 marks]
- (c) A bat moves with a speed of 3 m/s towards an insect sitting on a tree trunk. The bat emits a sound of frequency 35 kHz. Calculate the frequency heard by the insect. If the speed of the bat increases, will the frequency heard by the insect increase or decrease? (Take the speed of sound in air to be 343 m/s.) [8 marks]

### Useful information

*Stefan constant:*  $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$ ;

*Wien law constant*  $= 2.898 \times 10^{-3} \text{ m} \cdot \text{K}$ ;

*Absolute zero*  $= -273^\circ \text{C}$ .