

**CORK INSTITUTE OF TECHNOLOGY  
INSTITIUID TEICNEOLAIOCHTA CHORCAI**

**Autumn Examinations 2007/08**

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

**School:** SCIENCE

**Programme Title:**

Bachelor of Science – Applied Physics and Instrumentation, Year 1

Higher Certificate in Science – Industrial Measurement and Control, Year 1

Bachelor of Science – Applied Biosciences, Year 1

Bachelor of Science – Biomedical Science, Year 1

**Programme Code:** SPHYS\_7\_Y1  
SIMCT\_6\_Y1  
SBIOS\_7\_Y1  
SBMSC\_7\_Y1

**External Examiner(s):** Dr N. McMillan

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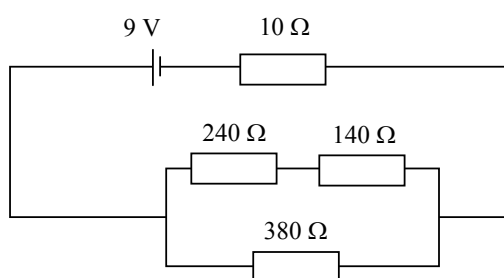
**Instructions:** Answer any **four** questions. All questions carry equal marks.

**Duration:** 2 Hours

**Sitting:** Autumn 2008

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

- 1 (a) An object is placed 9 cm in front of a convex lens of focal length 14 cm. Sketch the formation of the image. Is it real or virtual? Calculate the position and magnification of the image. [13 marks]
- (b) State Snell's law of refraction. A light ray in glass (refractive index 1.52) strikes the surface at an angle of  $28^\circ$ . At what angle does it emerge into the air? What is meant by the critical angle? Calculate it for glass of this refractive index. State one application of total internal reflection (TIR). [12 marks]
- 2 For the following circuit, calculate the resistance of the parallel combination and hence the total current drawn from the battery. How is electrical power defined? What power is dissipated in the  $380\ \Omega$  resistor? [25 marks]



- 3 (a) Explain what is meant by a latent heat. A block of ice of mass 80 g is taken out of a freezer at an initial temperature of  $-18^\circ\text{C}$ . What heat energy is required to heat the ice and melt it at  $0^\circ\text{C}$ ? (The specific heat capacity of ice is  $2300\text{ J/kg}^\circ\text{C}$  and the latent heat of fusion of ice is  $330\text{ kJ/kg}$ .) [12 marks]
- (b) A wall of a house is 8.0 m long by 9.0 m high. It is constructed with concrete blocks of thickness 120 mm. The temperature inside the house is  $18^\circ\text{C}$  and the external temperature is  $10^\circ\text{C}$ . Calculate (i) the rate of heat loss (or power loss)  $P$  through the wall (ii) the total heat loss ( $Q$ ) through the wall in 30 minutes. (The thermal conductivity of concrete is  $1.3\text{ Wm}^{-1}\text{K}^{-1}$ .) [13 marks]
- 4 (a) A car is travelling at  $25\text{ ms}^{-1}$  when the driver sees a pedestrian about to cross the road. He sounds the horn with a frequency of 600 Hz as he passes the pedestrian. The speed of sound is  $330\text{ ms}^{-1}$ . What is the *frequency* of the sound heard by the pedestrian (i) as the car approaches (ii) as the car recedes after passing the pedestrian? What is the name of this physical effect? [13 marks]
- (b) RTE 2FM broadcasts at a frequency of 92.2 MHz. The velocity of the radio waves is  $3 \times 10^8\text{ ms}^{-1}$ . (i) Radio waves are *transverse waves*. What does this mean? (ii) State the *wave equation*. Hence determine the wavelength of the radio waves. (iii) Explain what is meant by the *frequency* and *wavelength* of a wave. [12 marks]

- 5 (a) What does the colour of an object tell you about its absorption properties? Hence explain what is meant by a black-body. A rectangular block of sides 60 cm, 40 cm and 1.2 m, with an emissivity of 0.75, is at a temperature of  $180^{\circ}\text{C}$  in an environment at  $-10^{\circ}\text{C}$ . What power must be supplied to maintain it at this temperature? What is the peak wavelength of the radiation that it emits? [13 marks]
- (b) Briefly explain the terms (i) saturation vapour pressure (ii) relative humidity. What effect does the relative humidity have on sweating? [6 marks]
- (c) Sketch the Maxwell-Boltzmann distribution for two temperatures, clearly labelling the axes and indicating which temperature is higher. [6 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*  $= -273^{\circ}\text{C}$ .