

Cork Institute of Technology  
Bachelor of Science (Honours) in Herbal Science – Stage 1  
(NFQ Level 8)  
Autumn 2007  
**Physics**  
(Time: 3 Hours)

Instructions  
Answer **FIVE** questions.  
 $g = 9.8 \text{ ms}^{-2}$

Examiners: Ms. C. Devaney  
Dr. D. Corrigan  
Mr. E. Walsh

- Q1. (a) (i) Define coefficient of friction. (2 marks)  
(ii) Write a brief note on friction at the hip joint. (4 marks)
- (b) A skater of mass 65 kg with an initial speed of  $7.6 \text{ ms}^{-1}$  is gliding across ice.  
The coefficient of friction between the skate blades and the ice is 0.1.
- (i) Calculate the deceleration (uniform) caused by the frictional force. (5 marks)  
(ii) How far will the skater travel before coming to rest? (5 marks)  
(iii) Calculate the work done in bringing the skater to rest. (4 marks)
- Q2. (a) Explain;
- (i) Torque (2 marks)  
(ii) Centripetal force (2 marks)  
(iii) Give a brief account of a fixed angle rotor centrifuge. (4 marks)
- (b) The angular speed of the rotor in a centrifuge increases from 4010 revs per min to 13,560 revs per min in a time of 5s.
- (i) Express the above angular speeds in SI units ( $\text{rads}^{-1}$ ) (4 marks)  
(ii) What is the angular acceleration of the rotor? (4 marks)  
(iii) Calculate the angle through which the rotor turns in the 5s time interval. (4 marks)

- Q3 (a) Define:
- (i) Specific heat capacity
  - (ii) Latent heat of vapourisation (4 marks)
- (b) List two requirements necessary in the design of a thermometer. (4 marks)
- (c) Calculate the amount of heat energy required per hour to raise the temperature of inspired air from  $-40^{\circ}\text{C}$  to the body temperature of  $+37^{\circ}\text{C}$ .  
Assume that the breathing rate is 0.77 kg of air per hour.  
Specific heat capacity of air,  $c = 1050 \text{ J kg}^{-1} \text{ K}^{-1}$  (6 marks)
- (d) To cool the body of a 75 kg jogger by  $1.5^{\circ}\text{C}$ , how many kilograms of water in the form of perspiration have to be evaporated?  
Specific heat capacity of jogger =  $3500 \text{ J kg}^{-1} \text{ K}^{-1}$   
Latent heat of vapourisation of water =  $2.42 \times 10^6 \text{ J kg}^{-1}$  (6 marks)
- Q4. (a) (i) Define pressure and state the SI unit in which it is measured. (3 marks)
- (ii) State the equation for pressure at a point below a liquid column of height  $h$ . (3 marks)
- (b) (i) State the Equation of Continuity. (4 marks)
- (ii) The blood speed in a normal segment of a horizontal artery is  $0.11 \text{ ms}^{-1}$ .  
An abnormal segment of the artery is narrowed down by arterioscleritic plaque to one fourth the normal cross-sectional area.  
Calculate the difference in pressure between the normal and constricted segments of the artery.  
Note: Bernoulli's Equation:  $P_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2$   
Density of blood,  $\rho = 1060 \text{ kg m}^{-3}$  (10 marks)

- Q5. (a) (i) What are ultrasonic waves? (2 marks)
- (ii) Write a brief note on the clinical uses of ultrasonics. (5 marks)
- (iii) Define intensity of a sound wave and state the SI unit. (3 marks)
- (b) Deep ultrasonic heating is used to promote healing of torn tendons. The sound generator used in the above procedure is circular with a radius of 1.8 cm and it produces a sound intensity of  $5.9 \times 10^3 \text{ Wm}^{-2}$ . How much time is required for the sound generator to emit 4800J of sound energy? (10 marks)
- Q6. (a) (i) Draw a ray diagram illustrating how a compound microscope forms an image of an object. (6 marks)
- (ii) With reference to the human eye, what is meant by accommodation? How is it achieved? (4 marks)
- (b) A convex lens having a 60 cm focal length, is placed 100 cm from a frog. Where will the image of the frog be located? Calculate the magnification. (10 marks)
- Q7. (a) (i) List in order of increasing frequency, four regions of the electromagnetic spectrum of radiation. (4 marks)
- (ii) Use sketches to distinguish between constructive and destructive interference of waves. (4 marks)
- (b) A  $14\Omega$  coffee maker and a  $16\Omega$  frying pan are connected across a 120V source of voltage. A  $23\Omega$  bread maker is connected in parallel with the above series arrangement.
- (i) Draw the circuit diagram
- (ii) Calculate the total resistance of the circuit.
- (iii) Calculate the current drawn from the voltage supply (12 marks)
- Q8. (a) By referring to the periodic table of elements write the decay equations for the following:
- (i) the alpha decay of neptunium-237 (Np)
- (ii) the beta decay of phosphorus-32 (P)
- (iii) the gamma decay of potassium-42 (K) (8 marks)
- (b) Write brief notes on:
- (i) alpha radiation (6 marks)

(ii) the uses of radioisotopes

(6 marks)