

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Examinations 2010/11

Module Title: Physics (ACCS)

Module Code: PHYS 6012

School: Science

Programme Title:

Higher Certificate in Industrial Measurement and Control – Year 1

Bachelor of Science in Analytical and Pharmaceutical Chemistry – Year 1

Bachelor of Science (Honours) in Analytical Chemistry with Quality Assurance – Year 1

**Programme Code: SIMCT_6_Y1
 SCHEM_7_Y1
 SCHQA_8_Y1
 EOMNI_8_Y1**

External Examiner(s): Dr.V. Casey, Dr. Siobhan Daly, Mr. Eamonn Burke

Internal Examiner(s): Ms. C. Devaney

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

Duration: 2 Hours

Sitting: Summer 2011

Requirements for this examination: Log Tables.

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

- Q1. (a) Calculate the stopping distance for a car travelling at a speed of 95 km/h if the car decelerates at -8 ms^{-2} . The reaction time of the driver is 1 s.
How long (including the driver's reaction time) will it take for the car to come to rest?
(9 Marks)
- (b) State the *Law of Conservation of Momentum*
A 1600 kg empty trolley travelling at a speed of 2.5 ms^{-1} rolls under a loading bin.
A 3000 kg load is deposited in the trolley. What is the speed of the trolley immediately after being loaded?
(6 Marks)
- (c) Water flows over a dam at the rate of 6500 kg per minute and falls vertically 81 m before striking the turbine blades.
- (i) Calculate the speed of the water just before striking the turbine blades.
(ii) Calculate the power generated if 58% efficiency is assumed.
(10 Marks)
- Q2. (a) Outline the conditions necessary to observe interference for light. Show that for Young's slits of separation d , the condition for constructive interference is
$$m \lambda = d \sin \theta$$

(9 Marks)
- (b) In a double slit experiment a screen is placed 1.25 m from the slits. The third order bright fringe is located at 6.6 cm from the central bright fringe. The slit separation is 0.024 mm. Calculate the wavelength of the light.
(7 Marks)
- (c) Explain what is meant by the resolution of an optical instrument.
What factors determine the resolution?
A telescope with a lens of diameter 30 cm is used to view a binary star system (two stars close together).
- (i) What is the minimum angular separation for them to be resolved?
(ii) If the binary system is at a distance of 6×10^{20} km from earth, what is the distance between the two stars?
Assume light of wavelength $\lambda = 550 \text{ nm}$.
(9 Marks)

- Q3. (a) Describe the operation of a *Geiger Counter*. (10 Marks)
- (b) Explain the terms
- (i) *Atomic Number*
 - (ii) *Isotope*.

A drug prepared for a patient is tagged with Technetium (${}^{99}_{43}\text{Tc}$) which has a half-life of 6.06 hours. What is the decay constant of this isotope?

What mass of ${}^{99}_{43}\text{Tc}$ is required to give an activity of 5.6×10^4 Bq?

Calculate the activity after 4 hours. (Avogadro's number is $N_A = 6 \times 10^{23} \text{ mol}^{-1}$)

(15 Marks)

- Q4. (a) State *Faraday's Law* of induction. Explain how a transformer works, referring to this law in your answer. (9 Marks)
- (b) The primary windings of a transformer are connected to a 110 V AC supply. The secondary windings are connected across a 2.4Ω , 75 W bulb.
- Calculate
- (i) the current through the primary windings of the transformer,
 - (ii) the turns ratio.

Mention any assumption you have made.

(8 Marks)

- (c) A 30 cm long solenoid is to produce a magnetic field of 38 mT at its centre. Calculate the current needed in the solenoid if it has 975 turns

(Take $\mu = 4\pi \times 10^{-7} \text{ Hm}^{-1}$) Sketch the magnetic field surrounding the solenoid. (8 Marks)

- Q5. (a) A laser which produces monochromatic light of wavelength $\lambda = 633 \text{ nm}$, is used to calibrate a diffraction grating. The first order diffraction line is found at an angle of 21.5° . How many lines per millimetre are there on the grating? (7 Marks)
- (b) If the coefficient of friction between a 40 kg crate and the floor is 0.650 what force is needed to move the crate? How much work is done in moving the crate a distance of 5m? (6 Marks)
- (c) Write the decay equations for each of the following:
- (i) alpha (α) decay of ${}^{238}_{92}\text{U}$
 - (ii) beta (β^-) decay of ${}^{212}_{82}\text{Pb}$
 - (iii) positron (β^+) decay of ${}^{15}_8\text{O}$ (6 Marks)
- (d) State the relationship between *magnetic flux* and *magnetic flux density* and give the SI unit of each. A loop of wire having a diameter of 20 cm is in a magnetic field of 0.25 T. What is the flux through the loop if its plane is at an angle of 37° to the field? (6 Marks)

Useful information

The acceleration due to gravity is $g = 9.8 \text{ ms}^{-2}$