



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF
EDUCATION

SPH 350: PRINCIPLES OF ENVIRONMENTAL PHYSICS

DATE: 3/8/2017

TIME: 2:00 – 4:00 PM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

Required data and constants:

- Take Relative biological Equivalent (RBE) for both gamma and beta as 1 and 20 for alpha particles

SECTION A: (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) Draw an electromagnetic spectrum and clearly show the position of gamma and x-rays (4 marks)
- b) Find the intensity level of sound with intensity of $2.4 \times 10^{-6} \text{W/m}^2$. (4 marks)
- c) Explain the principle behind instruments used to detect ionization radiations like gamma rays. (2 marks)
- d) Describe two ways in each case on how radiations
- i. cause damage to human body (4 marks)
 - ii. Can be used to our advantage (4 marks)
- e) Name some two areas of a human body which are
- i. Very sensitive and (4 marks)
 - ii. Less sensitive to ionizing radiations have (4 marks)
- f) Name two factors which determine the magnitude of biological effects of radiation (4 marks)

SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Given that I_1 and I_2 are the intensities of sound from two point sources at a distance R_1 and R_2 respectively, show that $\frac{I_2}{I_1} = \frac{R_1^2}{R_2^2}$ (5 marks)
- b) A factory emits about 800 W of energy as sound waves. What is the sound intensity level in a village 2 km away (6 marks)
- c) In a geothermal field three wells are being discharged into the atmosphere. The wells produce sounds of $4.0 \times 10^7 \text{W}$, $12.0 \times 10^6 \text{W}$ and $1.6 \times 10^4 \text{W}$ respectively. Find the intensity level of sound they exert onto a nearby hospital 2 km away. (9 marks)

QUESTION THREE (20 MARKS)

- a) Some three machines crushing rocks and grinding metals are running near a hospital producing 60dB, 120dB and 80dB respectively.
- Calculate the combined intensity level of sound as received in the hospital. (9 marks)
 - If the hospital is 1 km from the factories, calculate the sound power generated by the factory with 120 dB. (3 marks)
- b) Give a reason why geothermal energy is referred as to as renewable energy (2 marks)
- c) Distinguish between binary and ordinary geothermal power plants using well labeled diagrams (6 marks)

QUESTION FOUR (20 MARKS)

Derive the differential form of the continuity equation (20 marks)

QUESTION FIVE (20 MARKS)

- a) Gamma rays with energies of $3.0 \times 10^{12} \text{ eV}$ are occasionally observed from distant astrophysical sources. What are their wavelengths and frequencies (6 marks)
- b) An animal swallows a radioactive isotope which provides a dose of 0.20 Gy. Which type of radiation will give the highest dose equivalent in mSv among gamma, beta and alpha? (9 marks)
- c) A nuclear plant worker is exposed to 3 mJ of neutron radiation and receives a dose of 3 mSv. Calculate the RBE of the neutron radiation. (5 marks)