MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SPH 350: PRINCIPLES OF ENVIRONMENTAL PHYSICS

DATE: 30/8/2022   **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).

<u>**Useful information**</u>

Radiation	RBE
x- rays, gamma rays, beta particles	1
Protons	5
Neutrons	5.20
Alpha particles	20

SECTION A (30 MARKS)

QUESTION ONE (30 MARKS)

a) A nuclear plant worker is exposed to 0.3 mJ neutron radiation and receives a dose of 3 mSv. Calculate the RBE of the neutron radiation. (4 marks)

b) Give a reason why geothermal energy is referred to as renewable energy (2 marks)

c) Distinguish between binary and ordinary geothermal power plants using well labelled diagrams (4 marks)

d) An animal swallows a radioactive isotope which provides a dose of 0.30 Gy. Which type of radiation will give the highest dose equivalent in mSv among gamma, beta and alpha?

(4 marks)

e) Define the sound intensity referred to as
    i.   Thresh hold of hearing
    ii. Thresh hold of pain (4 marks)

f) Explain the principle behind instruments used to detect ionization radiations like gamma rays. (2 marks)

g) What is the intensity of sound with intensity level of 40 dB (4 marks)

h) Hearing damage depends on two factors. Explain the two factors. (3 marks)

i) Draw an electromagnetic spectrum and clearly show the position of gamma and x-rays.

(3 marks)

SECTION B

QUESTION TWO (20 MARKS)

a) State the principal of conservation of mass (3 marks)

b) Derive the differential equation of continuity (8 marks)

c) Using a well labelled diagram, show the main components of a geothermal reservoir system.

(3 marks)

d) Distinguish between binary power plant and the flash power plant. (4 marks)

e) With aid of a diagram define the term "Dew Point" (2 marks)

QUESTION THREE (20 MARKS)

a) State the principle of conservation of linear momentum   (2 marks)

b) Derive differential equation of continuity of momentum   (8 marks)

c) Some three machines crushing rocks and grinding metals are running near a hospital producing 80 dB, 140 dB and 50 dB of sound respectively.

    i.   If the hospital is 1 km from the factories, calculate the sound power generated by the factory with 140 dB.   (3 marks)

    ii.   Calculate the combined intensity level of sound as received in the hospital.

                    (7 marks)

QUESTION FOUR (20 MARKS)

a) State mathematically the principal of conservation of heat energy   (3 marks)

b) Derive the differential equation of continuity of heat energy   (7 marks)

c) Distinguish between x-rays and gamma rays   (3 marks)

d) Find the intensity level of sound with intensity of 6.4 x 10^{-6}W/m^2 (4 marks)

e) Given actual vapour density in Nairobi as 10 g/m^3 at 23 °C. Calculate relative humidity. Take saturation vapour density 17.9 g/m^3 (3 marks)

QUESTION FIVE (20 MARKS)

a) State the principle of conservation of flow of chemical species in a system and express it mathematically   (3 marks)

b) Write down the divergence theorem   (3 marks)

c) Explain two factors which determine how much damage is done on a biological organ by ionizing radiation   (4 marks)

d) Residents within 5 km radius, during the Chernobyl disaster in Ukraine, were exposed to neutron radiation with an RBE of 15. Calculate the dose in mSv for a 70 kg resident.

                    (5 marks)

e) Given that the saturation vapor density is 17.3 g/m^3 at 11 °C, on top of Ivyeti mountain in Machakos county, determine the likelihood of it raining in this mountain on a day when actual vapor density is 0.0158 Kg/m^3 at 13 °C.   (5 marks)