



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF SCIENCE AND BACHELOR OF EDUCATION

SPH 350: PRINCIPLES OF ENVIRONMENTAL PHYSICS

DATE: Tuesday, 3rd April, 2012

TIME: 8.00 a.m. – 10.00 a.m.

INSTRUCTIONS: Answer question **ONE** and any other **TWO** questions.

- Q1.(a) How does the sun generate energy ? (3 marks)
- (b) Define the term solar wind and the magnetosphere. (4 marks)
- (c) State and explain what determines the average temperature of the earth at nay moment. (3 marks)
- (d) Explain the meaning of the terms:
- (i) The ozone
 - (ii) The green house effect (5 marks)
- (e) A certain amount of material e.g. gas has volume V_0 when the temperature is T_0 and pressure is P_0 . If the volume is V at a different pressure P and temperature T , write an equation for V . (2 marks)
- (f) There are four types of radiation measurement namely, the **source activity**, **Exposure**, **absorbed dose and biologically equivalent dose**. Explain how of each of this is measured. (8 marks)
- (g) A monochromatic green light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. (a) what is the energy of a photon in the beam?

(iii) How many photons pass a particular point in the beam per second

(5 marks)

Q2 (a) Name any and explain the nature of any three layers of the earth's atmosphere.
(6 marks)

(b) The following information is provided; the solar constant $S = 1375 \text{ W/m}^2$, the earth is a black body, the Stefans constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$ and the global annual mean value of albedo is estimated to be 30%. On the basis of this information and using the two available earth's models, calculate the mean

temperature of the earth. How do the two models compare? (14 marks)

Q3 (a) Given that both the sun and the earth can be considered as black body, the Stefans – Boltzmann constant $K_{sb} = 2898 \text{ K-}\mu\text{m}$, the surface temperature and earth are 6000K and 288 K respectively, calculate the wavelength at which the black body radiation intensity in each case. (6 marks)

(b) What information do the results in (a) above provide? Provide this information in a sketch of wavelength (λ) intensity $I(\lambda)$. (5 marks)

(c) Why is CO_2 one of the most recognized gases in as far as climate change is Concerned. (2 marks)

(d) Explain in detail how CO_2 and O_2 are closely linked through the process of Photosynthesis and respiration. (7 marks)

Q4(a) Estimate the amount of carbon in the atmosphere corresponding to a Concentration of 360ppm of CO_2 . Assume the total mass of air equals $5.1 \times 10^{18} \text{ Kg}$ and the density of air at STP is 1.29 Kg/m^3 . (6 marks)

(b) Consider an idealized model with a bird emitting constant sound power with Intensity inversely proportional to the square of the distance from the bird. By How many dB does the sound intensity level drop when one move twice as far away from the bird? (6 marks)

(c) An experiment in a certain physics class uses a 10 microcurie ^{137}Cs source. Each decay emits a 0.66 MeV of gamma rays.

(i) How many decays occur per hour?

(ii) A 60 Kg student standing nearby absorbs 10% of the rays. What is What is his absorbed dose in rads in one hour?

(iii) If the quality factor is 0.8, find his biologically absorbed dose in rems (8 marks)

Q5 (a) What is meant by the term black body radiation? (2 marks)

(b) Provide a sketch of versus wavelength (λ) intensity $I(\lambda)$ at various temperatures for a black body. (2 marks)

(c) Many attempts were made to explain black body radiation using classical theories among Them the Rayleigh –Jeans law but all failed. The correct explanation was given by mark Plank. Provide a sketch to explain how Rayleigh –Jeans law failed and how Planks theory Provided the correct explanation on the black body radiation. (8 marks)

(d) A 1 Kg mass is suspended from a spring with a constant of 16 N/m. Its amplitude of oscillation is 0.01m.

(i) What is the quantum number associated with its energy?

(ii) If n changes by one, what is the fractional change in the energy of the spring?

(iii) If the spring constant for an atom in a molecule is the same but the mass is the same but the mass is 10^{-26} Kg, and the amplitude is 3.25×10^{-11} , what is the fractional Energy change when n changes by one. (8 marks)