



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATIONS 2017/2018
APS 4211: PRINCIPLES OF ENVIRONMENTAL PHYSICS

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

Instructions to candidates:

You should have the following for this examination:

Answer booklet, Examination paper, Examination Pass and Student ID.

This examination paper contains Five questions.

Given onstants:

Molar constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

molecular weight of air = 28.96

- Answer question **ONE and any TWO** other questions.
 - Question **ONE** carries **30 marks** while the rest of the questions carry **20 marks** each.
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QUESTION ONE (30 MKS)

a). The density of the gas is 0.09 kg m^{-3} and the mean square velocity is $3.37 \times 10^6 \text{ m}^2 \text{ s}^{-2}$.

Find the value of the kinetic energy and the pressure per unit volume.

(4marks)

b). Explain the meaning of term “models” as used in environmental physics.

(2marks)

c). On suitable axes show a sketch diagram showing the relation between saturation vapour pressure, absolute humidity and temperature.

(4marks)

d). What is Dew-point Temperature? (2marks)

e). Microorganisms adapt to survive in extremely low temperatures but larger animals face difficulties. Explain. (2marks)

f). Describe the three classes of Geothermal Regions. (6marks)

g). Explain the atmosphere green house effect. (2marks)

h). What is artificial illumination? (2marks)

i). Name the three components which determine the survival of human species in the physical environment. (3marks)

j). What is the resistance to water vapor diffusion by molecular agitation for a pathlength of 1mm of air at 20°C and 101.3kPa of pressure. (take molecular diffusion coefficient of water vapour in air at this temp and pressure as $24.9 \times 10^{-3} \text{ m}$). (3marks)

QUESTION TWO. (20MKS)

a). (i) What are hybrid renewable energy systems?

(2marks)

(ii) Why are hybrid renewable energy systems becoming popular?

(2marks)

b). Biomass burning may contribute to global warming. Explain.

(2marks)

c). By taking the geothermal temperature gradient at $40^{\circ}\text{Ckm}^{-1}$ and the minimum useful temperature as 140K above the surface temperature T_0 , $\rho_r=2700\text{kgm}^{-3}$, c_r of rock $=820\text{Jkg}^{-1}\text{K}^{-1}$, calculate the useful heat content per square kilometer of dry rock granite to a depth of 7 km .

(5marks)

d). By means of a well labeled sketch graph of the variables, show how the atmospheric pressure varies with height from 0km to 5 km above the earth surface. Take into account that the hydrostatic equation is represented as $g\rho dz=-dp$.

(6marks)

e). For an aquifer of thickness 0.5 km , depth 3 km , porosity 5% , under sediments density 2700kgm^{-3} , specific heat capacity $840\text{Jkg}^{-1}\text{K}^{-1}$ and temperature gradient $30^{\circ}\text{Ckm}^{-1}$ calculate the initial temperature and heat content per square kilometer above 40°C .

(3marks)

QUESTION THREE (20MKS)

a). There are several methods of converting biomass into biofuel. Give three . (3marks)

b). How sequestering carbon done by biomass crops? (3marks)

c). Identify the difference between Green power and Green energy. (2marks)

d). How are Carbon Credits obtained? (2marks)

e). By stating year and country of occurrence name two major global energy disasters of recent times. (2marks)

f). How is chemical energy storage done? Describe three methods. (3marks)

g). (i) Explain the term- Resilience. (2marks)

(ii) Hydrogen can be used as a form of stored energy. Explain. (3marks)

QUESTION FOUR (20MKS)

- a). Name three basic noise mitigation technologies (3marks)
- b). What are hearing standards? (2marks)
- c). Explain the term: noise-induced hearing loss. (2marks)
- d). Name two uses and two dangers of ionizing radiation. (4marks)
- e). Describe a black body. (2marks)
- f). On an axis of, E_λ against wavelength, λ graphically sketch the solar radiation characteristics in the range 0 to 2.0 micrometers. (4marks)
- g). Describe briefly three of the current climate change forcing. (3marks)

QUESTION FIVE (20 MKS)

a). Find the value of the molar constant, R Given that the molar volume V_m , occupied by a mole at standard pressure and temperature (STP, i.e. 101.325 kPa and 273.15 K) is 0.0224 m³

(3marks)

b). Differentiate between, adiabatic and isobaric changes

(2marks)

(c). For dry air of molecular mass 28.96 whose the ratio: $c_p/c_v = 7/5$, find c_p .

(3marks)

d). Explain the following terms as used in relation to atmosphere.

(i) latent heat?

(2 marks)

(ii) Relative humidity

(2marks)

e). (i). What is Dry Adiabatic Lapse Rate?

(2marks)

(ii). If the specific heat capacity at constant pressure is $1.01 \times 10^3 \text{ Jkg}^{-1}\text{K}^{-1}$. Find the value of DALR in air.

(2marks)

f). Express the concentration of 1ppm CO₂ in mgm^{-3} if Carbon dioxide has a molecular mass of 44g/mol^{-1} .

(2marks).

g). Giving one example, explain the term: Ionizing radiation.

(2marks)