EMBU UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

FIRST SEMESTER EXAMINATIONS 2013/2014

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN WATER RESOURCES MANAGEMENT

AEM 104: ENVIRONMENTAL PHYSICS

DATE: DECEMBER 9, 2013 **TIME: 2.00 – 4.00PM**

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

Constants

Acceleration due to gravity, g = 9.81 m/s^2

Density of water = 1 g/cm^3

Stefan constant is $5.7 \times 10^{-8} Wm^{-2}k^{-4}$

Thermal conductivity of a brick is $0.13\ WM^{-}K^{-1}$

QUESTION ONE

a) What is air? (1mk)

b) Give three types of ingredients of air. Explain each by composition. (6mks)

c) Why is carbon dioxide considered a standard composition of air? (2mks)

d) Give two applications of the following gases:-

i) Oxygen

ii) Nitrogen

iii) Rare gases (6mks)

e) Explain how moisture affects air density. (2mks)

f) What is global warming? (1mk)

g) Explain why carbon dioxide is an important greenhouse gas. (3mks)

h) Give 5 global warming impacts. (5mks)

i) The terminal velocity of a steel sphere falling in a liquid is $0.03\ m/s$. The sphere is $1mm$ in diameter and the density of the steel is $7830\ kg/m^2$. The density of the liquid is $800\ kg/m^2$. Calculate the dynamic and kinematic viscosity of the liquid. (4mks)

j) Explain the meaning of the terms with respect to terrestrial radiation. (3mks)

i) Sun at zenith

ii) Absorption

iii) Scattering

k) A gun fires a shell of mass $5\ kg$ in horizontal direction. The gun recoils at $0.4\ m/s$ and its mass is $3\ tonnes$. Calculate the velocity of the shell. (3mks)

l) Calculate the quantity of heat conducted through $2\ m^2$ of a brick wall $12\ cm$ thick in one hour if the temperature on one side is 28^oC and on the other side is 8^oC .

(4mks)

QUESTION TWO

a) What is a boundary layer? (1mk)

b) Calculate the drag force on each side of a thin smooth plate $2\ m$ long and $1\ m$ wide with the length parallel to a flow of fluid moving at $30\ m/s$. The density of the fluid is $800\ kg/m^2$ and the dynamic viscosity is $8\ cp$. (4mks)

c) Explain 3 main processes involved in hydrological cycle. (6mks)

d) Show that the mean velocity in a pipe with fully developed turbulent flow is $(49/60)^{u_1}$ of the maximum velocity. Assume the $1/7\ ^{th}$ law. (4mks)

QUESTION THREE

a) What is the difference between radiation and convection modes of heat flow? (2mks)

b) Explain three ways by which water can be polluted. (6mks)

c) The solar constant which is the energy arriving per second at the earth from the sun, is about $1400\ Wm^{-2}$. Estimate the surface temperature of the sun, given that the sun's radius

is $7 \times 10^5 km$, the distance of the sun from the earth is $1.5 \times 10^8 km$

(5mks)

d) Explain the impact of science and technology on resources. (2mks)

QUESTION FOUR

a) What is energy conservation? (3mk)

b) Explain three ways by which energy can be conserved. (6mks)

c) A metal sphere with a black surface and a radius $30mm$ is cooled to -73^oC (200k) and placed inside an enclosure at a temperature of 27^oC (300k). Calculate the initial rate of temperature rise of the sphere, assuming the sphere is a black body. (assume density of metal is $8000\ kg/m^2$, specific heat capacity of metal is $400\ Jkg^{-1}$and Stefan constant is $5.7 \times 10^{-8} Wm^{-2}k^{-4}$) (6mks)

QUESTION FIVE

a) What is momentum? (1mk)

b) Consider a body of mass m , moving with an initial velocity $\vec{u}$ and after being subjected to a force $\vec{F}$ the body changes its velocity to$\vec{v}\ m/s$ in t seconds. Show that $\vec{F} = ma$ for the body. (4mks)

c) A lorry of mass $5\ tonnes$ travels along a level road at $75\ kmh^{-1}$ and collides with a pickup of mass $15\ tonnes$ travelling in opposite direction at $20\ kmh^{-1}$. After impact the lorry is seen to travel in the same direction as before with a speed of kmh^{-1} . Find the speed of the pickup (10mks)

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