UNIVERSITY OF EMBU

2017/2018 ACADEMIC YEAR

SECOND SEMESTER EXAMINATIONS

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION

SPH 104: MAN AND THE PHYSICAL WORLD

DATE: APRIL 4, 2018 **TIME: 2:00-:4:00PM**

INSTRUCTIONS:

Answer Question ONE and ANY other two Questions

QUESTION ONE (30 MARKS)

a) Explain the three types of plate boundaries in relation to motion of lithospheric plates (3 marks)

b) Define the following terms (2 marks)

i) Cosmology

i) Observable universe

c) Identify and explain three evidences for the existence of Big bang theory (3 marks)

d) Distinguish between terrestrial and Jovian planets. Give an example in each case. (2 marks)

e) Describe the main motions of the earth and their effects (2 marks)

f) With an aid of a diagram explain the properties of the wave (3 marks)

g) State three Kepler's laws for orbital dynamics. (3 marks)

h) Distinguish between power and energy? (2 marks)

i) Write the laws of reflection and refraction (3 marks)

j) Outline three reasons why there is no magnetic field in the mantle (3 marks).

k) List the three states of matter in order of increasing kinetic energy (1 mark)

l) Use the particle theory to briefly explain the characteristics of solids, liquids, and gases (3 marks)

QUESTION TWO (20 MARKS)

a) Steve exerts a steady force of magnitude 210 N on the stalled car and pushes it a distance of 18 m. The car also has a flat tire, so to make the car track straight Steve must push at an angle of 30° to the direction of motion.

i) How much work does Steve do in Kilojoules? (3 marks)

ii) In a helpful mood, Steve pushes a second stalled car with a steady force $\mathbf{F} = (160\ \text{N})\mathbf{i} - (40\ \text{N})\mathbf{j}$. The displacement of the car is $\mathbf{s} = (14\ \text{m})\mathbf{i} + (11\ \text{m})\mathbf{j}$. How much work does Steve do in this case? (4 marks).

b) Define kinetic energy? Show that the work done by a constant force, **F**, in the x-direction of displacement **S**, on an object of mass m, is equal to the change in kinetic energy. (6 marks).

c) A 1.50 kg book is sliding along a rough horizontal surface. At point *A* it is moving at 3.21m/ s, and at point *B* it has slowed to 1.25 m/s.

i) How much work was done on the book between *A* and *B*? (3 marks)

ii) If -0.750j of work is done on the book from *B* to *C*, how fast is it moving at point *C*? (4 marks).

QUESTION THREE (20 MARKS)

a) With an aid of a diagram, briefly describe the composition of the internal structure of the earth. (6 marks).

b) Explain the Origin of the universe using Big Bang Theory (6 marks)

c) Distinguish between longitudinal and transverse waves. (2 marks)

d) On December 26, 2004, a great earthquake occurred off the coast of Sumatra and triggered immense waves (tsunami) that killed some 200,000 people. Satellites observing these waves from space measured 800 km from one wave crest to the next and a period between waves of 1.0 hour. What was the speed of these waves in Km/h and in m/s? (6 marks)

QUESTION FOUR (20 MARKS)

a) Explain the difference between refraction and reflection of light. (2 marks)

b) A light ray of wavelength 589 nm traveling through air is incident on a smooth, flat slab of crown glass at an angle of 30.0° to the normal. (Refractive index of glass = 1.52, Refractive index of air = 1.00)

i) Find the angle of refraction (3 marks)

ii) Find the speed of this light once it enters the glass (2 marks)

iii) The wavelength of the light in the glass (2 marks).

c) An electric heater is constructed by applying a potential difference of 120V across a Nichrome wire that has a total resistance of 8.00Ω. Find the current carried by the wire and the power rating of the heater in kilowatt. (5 marks).

d) A spacecraft of mass (m) in orbit about a planet of mass (M) is acted upon by the gravitational force F_1 expressed by $F_1 = \frac{GMm}{r^2}$. A spacecraft in circular orbit around a planet is also acted upon by the centrifugal force F_2 depending on its velocity (v) given by $F_2 = \frac{mv^2}{r}$. If the spacecraft is in a stable circular orbit, then $F1 = F2$. Solve this equation first for the velocity (v) and then for the orbital radius (r) (3 marks).

e) Using the values obtained in (d) above, calculate the velocity of the Earth in its orbit around the Sun in km/s given:

$M = 1.99 \times 10^{30}$ kg (mass of the Sun)

$r = 149.6 \times 10^{9}$ m (radius of the orbit of the Earth)

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2 (gravitational constant) (3 marks)

QUESTION FIVE (20 MARKS)

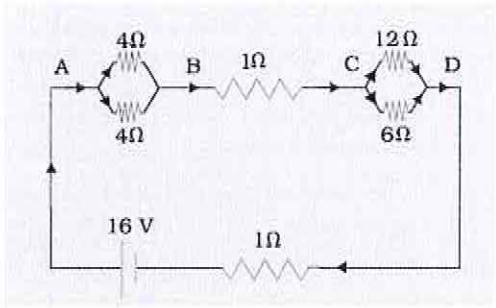
a) With an aid of a single diagram explain the following terms as used in electric circuits. (7 marks)

i) Branch.

ii) Node

iii) A loop

b) A network of resistors is connected to a 16V battery with internal resistance of 1Ω, as shown in the figure below.



Compute:

i) The equivalent resistance of the network. (3 marks)

ii) Obtain the voltage drops V_{AB}, V_{BC} and V_{CD}. (6 marks)

c) Explain the uses of the following Electromagnetic waves (4 marks).

i) Radio waves

ii) Microwaves

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