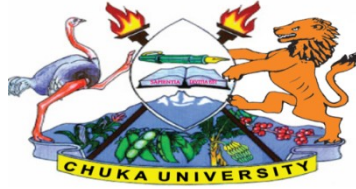


CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST YEAR EXAMINATION FOR THE AWARD OF DIPLOMA IN COMPUTER SCIENCE

PHYS 0111: PRINCIPLES OF PHYSICS

STREAMS: DIP (COMPUTER SCIENCE)

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 5/12/2018

2.30 P.M - 4.30 P.M.

INSTRUCTIONS:

- Answer Question One and Any Other Two Questions

Take;

$$g = 9.8ms^{-2}$$
$$c = 3.0 \times 10^8m/s$$

QUESTION ONE

- a. Define the following terms
- i. Dimensions (1Mark)
 - i. Coordinate system (1 Mark)
 - ii. Physical quantities (1 Mark)
 - iii. System units (1 Mark)
- b. Write the formulae for the scalar and vector products stating a physical quantity that is given by each of them. (4 Marks)
- c. State the principle of energy conservation (2 Marks)
- d. state two conditions for total internal reflection to take place (2 Marks)
- e. A 3.0kg mass undergoes an acceleration given by $a = (2.0\mathbf{i} + 5.0\mathbf{j}) \text{ m/s}^2$. Find the resultant force F and its magnitude. (3 Marks)
- f. Calculate the angle of refraction for a ray of light from air striking an air-glass interface, making an angle of 60° with the interface. ($n_g = 1.5$) (4 Marks)

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- g. Consider a simple pendulum, having a bob attached to a string that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (l), mass of the bob (m) and acceleration due to gravity (g). Derive the expression for its time period using method of dimensions. (4 Marks)
- h. A truck of mass 2,000 kg starts from rest on horizontal rails. Find the speed 3 seconds after starting if the attractive force by the engine is 1,000 N. (4 Marks)
- i. An object is placed 10cm in front of a concave mirror of radius of curvature 15 cm. Find the position, nature, and magnification of the image in each case (3 Marks)

QUESTION TWO

- a. Give two differences between electric and magnetic circuits (2 Marks)
- b. A coil of 200 turns is wound uniformly over a wooden ring having a mean circumference of 600 mm and a uniform cross-sectional area of 500mm^2 . If the current through the coil is 4A, calculate
 - i. The magnetic field strength (2Marks)
 - ii. The flux density (2Marks)
 - iii. The total flux density (3Marks)
- c. The circuit diagram below shows how a student set up a circuit using three identical lamps. Assume that the resistance of each lamp does not change with the brightness of the lamp. Each lamp is labelled 12 V, 2.0 A.

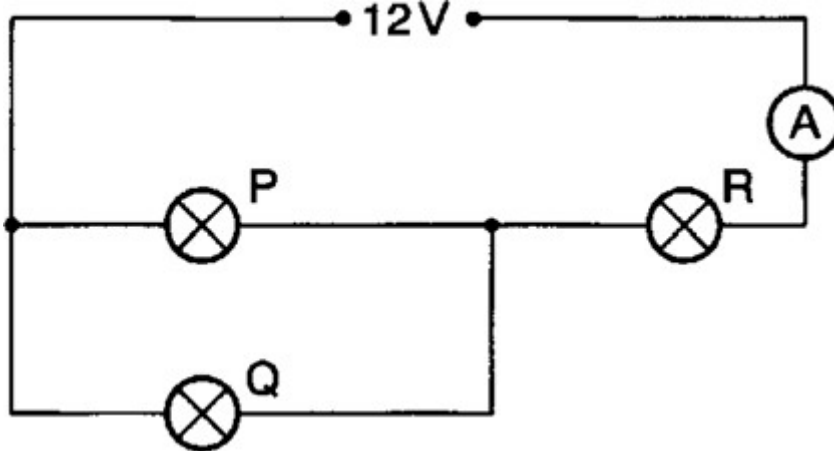


Figure 1

- i. Calculate the resistance of lamp Q (2 Marks)
- ii. Calculate the combined resistance of the three lamps as connected in Fig. 1 (2 Marks)

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iii. Calculate the current which would be shown on the ammeter in Fig. 1

(2 Mark)

iv. Explain why lamp A is less bright than normal and why lamps P and Q are both equally very dim. (3Marks)

v. In the space below draw a circuit diagram which shows P, Q and R connected so that they will all work at normal brightness. (2 Marks)

QUESTION THREE

a. State the three Newton's laws of motion giving the equations governing them (3 Marks)

b. Derive the Newton's second equation of motion. (4 Marks)

c. A wooden box of mass 30 kg rests on a rough floor. The coefficient of friction between the floor and the box is 0.6. Calculate;

i. The force required to just move the box (2 Marks)

ii. If a force of 200 N is applied the box with what acceleration will it move? (2 Marks)

d. Differentiate between elastic and inelastic collisions (4 Marks)

e. Find the distance traveled by a car in the 7th second if it has an initial velocity of 10m/s and accelerating at the rate of 3 m/sec² (5 Marks)

QUESTION FOUR

a. State the two Kirchoffs laws and give the justification of each. (4 Marks)

b. What is the emf ϵ of the battery in the circuit of Figure 1 below?

Figure 2

(8 Marks)

- c. Calculate each of the unknown currents I_1 , I_2 , and I_3 for the circuit of Figure 2 below.

Figure 3

(8 Marks)

QUESTION FIVE

- a. What is total internal reflection (2 Marks)
- b. A light ray incident on a prism is refracted at the first surface, as shown in Figure 3 below. Let ϕ represent the apex angle of the prism and n its index of refraction. Find, in terms of n and ϕ , the smallest allowed value of the angle of incidence at the first surface for which the refracted ray will not undergo total internal reflection at the second surface.

Figure 4

(10 Marks)

- c. A beam of light both reflects and refracts at the surface between air and glass, as shown in Figure 4 below. If the index of refraction of the glass is n_g , find the angle of incidence, θ_i , in the air that would result in the reflected ray and the refracted ray being perpendicular to each other. [Hint: Remember the identity $\sin(90^\circ - \theta) = \cos \theta$.]

Figure 5

(8 Marks)

