



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE
(AGRICULTURE, CROP IMPROVEMENT AND CROP PROTECTION)

KST 103: PHYSICS FOR AGRICULTURE

DATE: THURSDAY, 29TH MARCH 2012

TIME: 8.00 A.M. – 10.00 A.M.

INSTRUCTIONS

Answer ALL questions in section A and any TWO questions in section B

Where necessary use acceleration due to gravity, $g = 10 \text{ m/s}^2$

SECTION A: (40 MARKS)

- Q1. a) During a laboratory experiment, the temperature of a gas is varied and the volume of the balloon is measured. State the independent and the dependent variables. (2mks)
- b) Fig.1 shows the relationship between the circumference and diameter of circular slices of potatoes. Could the slices be described by a different straight line? What is the significance of the slope? (3mks)

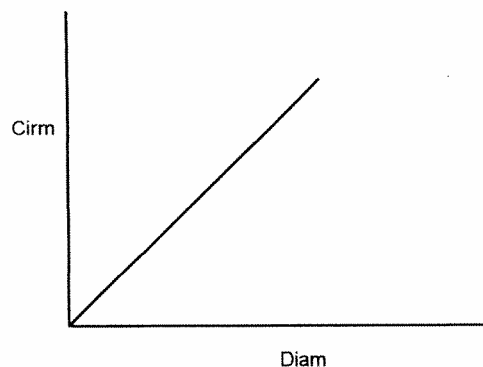


Fig.1

- Q2. a) A sample used in an agriculture laboratory has a rectangular shape of length $21.3 \pm 0.2 \text{ cm}$ and width $9.80 \pm 0.1 \text{ cm}$. Find the area of the sample. (3mks)
- b) The equation for air resistance force, F , is $F = kv^2$, where k is a constant and v is the speed of the object. What are the units of k ? (2mk)

- Q3.** a) A student recorded the initial temperature of a liquid as $15.2 \pm 0.1^\circ \text{C}$. After heating the liquid for some time the temperature rose and was recorded as $39.8 \pm 0.1^\circ \text{C}$. What is the temperature change of the liquid? (2mks)
- b) Differentiate between precision and accuracy as applied to measurements. (3mks)
- Q4.** a) State Newton's second law of motion. (2mks)
- b) A balloon filled with a gas strikes a sharp needle as it moves around a room. State and explain what is observed. (3mks)
- Q5.** Derive the equation $F = ma$, where F is the resultant force on a mass of m kg having acceleration a m/s^2 . (5mks)
- Q6.** A space craft used in an agricultural research station has a mass of 2.0×10^6 kg. At lift-off the engines generate an upward force of 3.0×10^6 N. What is
- i) the weight of the space craft? (2mks)
- ii) its acceleration when launched? (3mks)
- Q7.** A mass M kg is placed on a flat surface. Indicate on a diagram all the forces acting on the mass and use this as a basis to show that Newton's third law of motion is a special case of the second law. (5mks)
- Q8.** The density of a substance is the mass per unit volume of that substance.
- i) List possible units of density. (3mks)
- ii) Does density have a fundamental or derived unit? (1mk)
- iii) What is the SI unit of density? (1mk)

SECTION B: (30 MARKS)

- Q9.** a) i) Define kinetic energy of an object. (1mk)
- ii) Suppose a body of mass m kg is moved by a constant force F from rest through a distance S . What is the work done on the body? Determine the expression for the kinetic energy of the mass. (4mks)
- iii) How much work is required to accelerate a 1000 kg car from 20 ms^{-1} to 30 ms^{-1} ? (2mks)
- b) Some agricultural waste products can be used in the production of energy.
- i) State two such waste products. (1mk)
- ii) Discuss how such waste can be used in the production of large scale energy. (6mks)
- c) Name two sources of renewable energy not related with agriculture. (1mk)
- Q10.** a) The equation $P = \epsilon\sigma AT^4$ is one of the equations that govern thermal energy by a source.
- i) What is the name of this equation? (1mk)
- ii) What do the symbols in the equation represent? (3mks)
- iii) What mode of energy transfer does the equation apply? (2mk)
- iv) A cow is resting in an enclosure whose temperature is less than that of its body. If its energy transfer is governed by the equation $P = \epsilon\sigma AT^4$, what is the cow's net energy exchange? (3mks)
- b) A major source of heat loss from a house is through the windows. Calculate the rate of heat flow through a glass window 2.0 m x 1.5 m in area and 3.2 mm thick if the temperatures at the inner and outer surfaces are 15.0°C and 14.0°C , respectively? (Thermal conductivity of glass is 0.84 J/s.m.C^0) (4mks)
- c) Why are the walls of a thermos flask silvered and why does it have a vacuum between the walls? (2mks)

- Q11**
- a) i) What is absolute zero of temperature of a gas? (1mk)
 - ii) Convert the boiling point of helium, 4.22 K, to degree Celsius. (2mks)
 - b) i) Define specific latent heat of fusion. (1mk)
 - ii) How much heat must be transferred to 100.0 g of ice at 0.0°C until it forms water at 20°C ? (Take the specific heat capacity of water = 4200 J/kgK and the specific latent heat of fusion of ice = $3.34 \times 10^5 \text{ J/kg}$) (4mks)
 - c) i) State Boyle's law. (2mks)
 - ii) 240 cm^3 of a gas are collected at 25°C and 770 mmHg pressure. Calculate the volume of the gas at s.t.p. (5mks)
- Q12.**
- a) State the first law of thermodynamics. (2mks)
 - b) i) Distinguish clearly between transverse and longitudinal waves. Give an example of each. (3mks)
 - ii) Differentiate mechanical and electromagnetic waves. (2mks)
 - c) i) Discuss application of radioisotopes in agriculture. (6mks)
 - ii) An isotope of oxygen has a mass number of 15. The atomic number of oxygen is 8. How many neutrons are in the nuclei of this isotope? (2mks)
