



# Machakos University College

(A Constituent College of Kenyatta University)

UNIVERSITY EXAMINATIONS 2015/201

SCHOOL OF PURE AND APPLIED SCIENCES  
DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR EXAMINATION FOR DIPLOMA IN EDUCATION (SCIENCE)

SPH 0101: MECHANICS 1

DATE: SCHOOLBASED

TIME: 2 HOURS

---

## INSTRUCTIONS:

(a) The paper consists of FIVE questions. Attempt Question ONE and any other TWO

(b) All working must be clearly shown

## SECTION A

### QUESTION ONE

- a) Derive the dimensions of
- i) Acceleration.
  - ii) Force
  - iii) Area
  - iv) Pressure (8 marks)
- b) State the laws of friction (3 marks)
- c) A liquid is contained in a cylinder of base area  $4 \text{ cm}^2$  and covers a height of 5cm. Find
- i) its volume (3 marks)
  - ii) Error in volume (3 marks)
- d) Derive the equation for Newton's 2<sup>nd</sup> law of motion, ( $F=ma$ ) (4 marks)
- e) In an experiment to determine acceleration due to gravity, length of the pendulum is measured as 40.2cm and periodic time T as 2.2sec. Find
- i) gravitational acceleration (3 marks)
  - ii) error in gravitational acceleration (3 marks)
- f) Suppose work required to stretch a spring by 3 cm is given as 300 J. Find the spring constant of the spring? (3 marks)

## SECTION B: (ANSWER ANY TWO QUESTIONS IN THIS SECTION)

### QUESTION TWO

- a) If the angle of inclination for body resting on an inclined plane is  $\theta$ . Show that coefficient of friction is given as  $\mu = \tan \theta$ . (Illustrate with a well labeled diagram). (8 marks)
- b) A crate was pushed a distance of 12.5 m in 10 min. Total work done was 2400joules. Find
- i) mass of the crate (4 marks)
  - ii) error in work done (4 marks)
- c) Distinguish between limiting static friction and sliding friction. (2 marks)
- d) State the condition necessary for a rigid body to be in static equilibrium. (2 marks)

### QUESTION THREE

Using dimensional analysis, show that the periodic time T of a simple pendulum is given by  $T =$

$$2\pi \sqrt{\frac{L}{g}} \quad (8 \text{ marks})$$

- e) Illustrate with a well labeled graph the changes in energy when a body is thrown vertically upwards. (6 marks)
- f) c) An army captain measures the length of a distant war tanker as an angular measure of  $2.1^\circ$  with a divided circle. He knows that the length of the tanker is 200 m. Approximate how far the warship is. (6 marks)

### QUESTION FOUR

- a) A block of mass 0.5 kg travels with a speed of 2 m/s in +x-direction on a flat frictionless surface. On passing through origin the block experiences a constant force of 4 N at an angle  $60^\circ$  relative to y –axis for 1.5 s. Find
- i) Magnitude of the forces in component form (4 marks)
  - ii) Components of acceleration (4 marks)
  - iii) Velocity in components form. (4 marks)
- b) A swimmer maintains a speed of 6 m/s relative to the water when he swims directly towards the opposite shore of the river. The river has a current that flows at 0.8 m/s
- i) How far downstream is he carried in 2 min? (4 marks)
  - ii) What is the velocity he is carried with, relative to an observer on the shore. (4 marks)

## QUESTION FIVE

The current of a 400 m wide straight river (figure 1) has a flow rate of 3 km/hr. A motor boat that travels with a constant speed of 9 km/hr in still water crosses the river

- If the boat's bow points directly across the river towards opposite shore, what is the velocity of the boat relative to the stationary observer standing at the corner of the bridge? (7 marks)
- How far down stream will the boat's landing point be from the point directly opposite its starting point? (7 marks)
- What is the distance travelled by the boat in crossing the river? (6 marks)

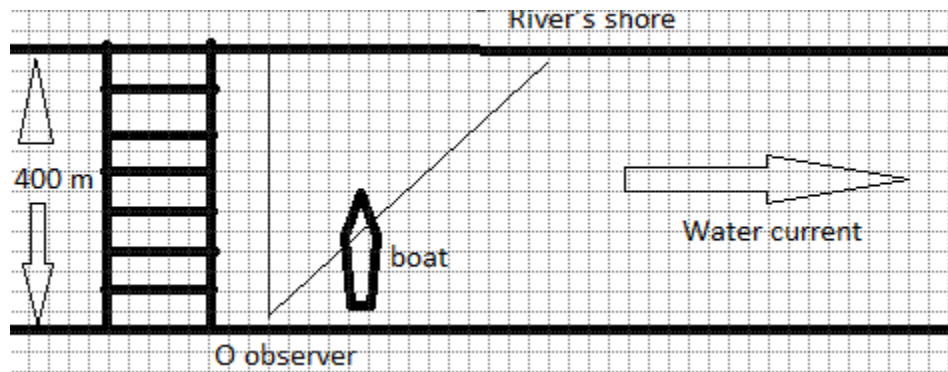


Figure 1