Ser. No. EDU 064/17

# GARISSA UNIVERSITY

## UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE FIRST SEMESTER EXAMINATION

## SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

## FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

**COURSE CODE: PHY 110**

**COURSE TITLE: BASIC PHYSICS 1**

**EXAMINATION DURATION: 3 HOURS**

**DATE: 07/12/17** **TIME: 2.00-5.00 PM**

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## INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

**This paper consists of SIX (6) printed pages** ***please turn over***

**QUESTION ONE (COMPULSORY)**

(a) Define the thermal equilibrium **[1 mark]**

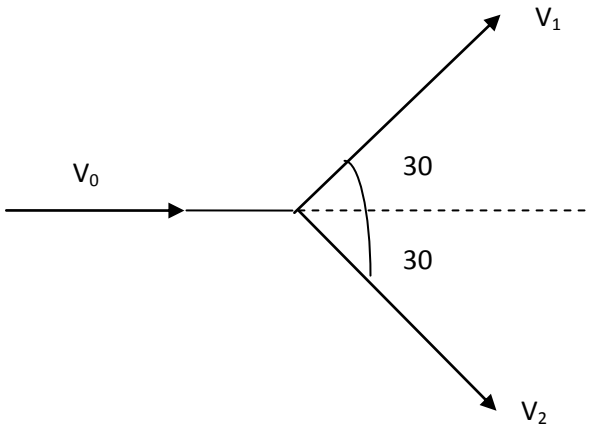
(b) A particle undergoes a displacement given by S = (2i+3j+4k) m, when acted

i. Upon by a force F = (5i+6j-7k) N.

ii. Find the work done by the force **[2 marks]**

iii. Determine angle does the force make with the displacement **[2 marks]**

(c) A ball moving with a speed of 9 m/s strikes an identical stationary ball such that after collision, the direction of each ball makes an angle 30◦ with the original line of motion (see Fig. 1). Find the speeds of the two balls after the collision. Is the kinetic energy conserved in the collision process? **[3 marks]**

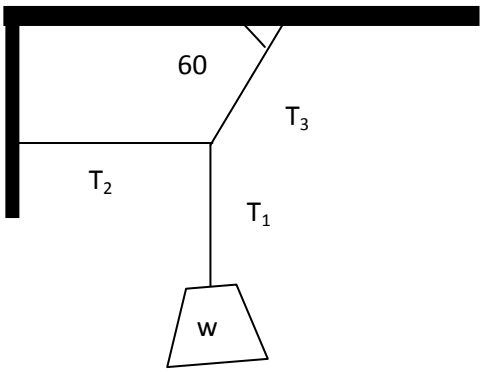



(d) i)In Cartesian co-ordinate system, show that **i·i = j·j = k·k =1 and i**x**i = j**x**j = k**x**k =0**

**[2 marks]**

ii) Prove that the bob of a simple pendulum may move with simple harmonic motion and find an expression for its period. **[2 marks]**

(e) A block of weight W hangs from a cord, which is attached at point O to two other cords, one fastened to the ceiling and the other to the wall. Find the tensions in this three cords(assume the weights of the cords to be negligible **[3 marks]**




(f) Show that the path taken by a projectile is a parabola **[3 marks]**

(g) Show that the coefficient of volume expansivity is given by three times the coefficient of linear expansion **[3 marks]**

(h) i) Define the term viscosity **[1 mark]**

ii) With the aid of a diagram, derive the expression of viscosity

$$\eta = \frac{2gR^{2}(\rho - \sigma)}{9v}$$ **[3 marks]**

**QUESTION TWO**

(a) Define the terms tensile stress and tensile strain **[2 marks]**

(b) An elastic rod 5m long and 0.03m$^2$ in a cross section, stitches by 0.15m when a weight of 270N is hung on it. Calculate

i. The stress **[1 mark]**

ii. Young's modulus of the material **[2 marks]**

(c) A conical pendulum consists of a small massive bob of mass M hung from a string of length L and rotating steadily in a horizontal circle of radius R, the bob is displaced at angle $\theta$ . With the help of diagram

i. Indicate all the forces acting on the bob **[2 marks]**

ii. Show that its period of oscillation is given by $T = 2\pi\sqrt{\frac{LCos\ \theta}{g}}$ **[4 marks]**

(d) A particle of mass *m* with initial velocity *u* makes an elastic collision with a particle of mass *M* initially at rest. After the collision the particles have equal and opposite velocities. Find

(i) The ratio *M/m*; **[2 marks]**

(ii) The velocity of centre of mass; **[2 marks]**

**QUESTION THREE**

(a) Define the term "projectile motion" **[1 mark]**

(b) A ball is thrown forward horizontally from the top of a cliff with a velocity of 10m/s. The height of the cliff above the ground is 45m. Calculate

i. The time to reach the ground **[3 marks]**

ii. The distance from the cliff of the ball on hitting the ground **[3 marks]**

(c) If a projectile at a point O on the ground is projected with a velocity u at an angle $\alpha$ to the horizontal motion separately show that maximum horizontal range is given by $R = \frac{u^2}{g}$

**[4 marks]**

(d) i) State the Newton's law of universal gravitation **[1 mark]**

ii) State the three Kepler's laws of planetary motion **[3 marks]**

**QUESTION FOUR**

(a) i) state the law of conservation of linear momentum **[2 marks]**

ii) Differentiate between elastic and inelastic collisions **[2 marks]**

iii) A 5kg lump of clay that is moving at 10m/s to the left strikes a 6kg lump of clay moving at 12m/s to the right. The two lumps stick together after they collide. Find the final speed of the composite object and the kinetic energy dissipated in the collision. **[4 marks]**

(b) A closed metal vessel contains water at 75 $^{o}$C. the vessel has a surface area of 0.5m$^2$ and a uniform thickness of 4mm. if the outside temperature is 15 $^{o}$C and the thermal conductivity of the metal is 400W/M/K, calculate the heat lost per minute by the metal **[3 marks]**

(c) Using the kinetic theory of gases show that the root-mean square speed is given by

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$ **[4 marks]**

**QUESTION FIVE**

(a) i) state the work-energy theorem **[1 mark]**

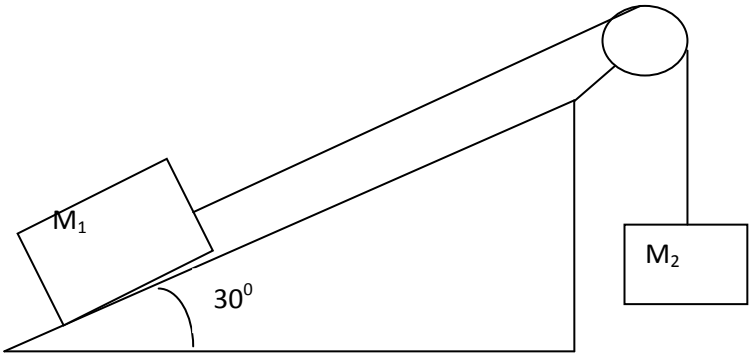
ii) State the three Newton's laws of motion **[3 marks]**

(b) A block of mass $M_1$ lying on inclined plane at an angle of $30^o$ to the horizontal is pulled up the plane by a mass $M_2$. A light inextensible cord passing over a smooth pulley as shown connects the two mass. Given that μ between $M_1$ and the plane is 0.15 and that $M_{1=}$ $M_2$=2kg.

i. Draw the free body diagrams for the two masses **[3 marks]**

ii. Determine the acceleration of the masses **[5 marks]**

iii. Determine the tension in the cord **[3 marks]**




**QUESTION SIX**

(a) Given that mercury in glass thermometer has a mercury thread of lengths 2cm and 10 cm at the ice and steam points respectively, calculate the temperature at a length of 6cm. **[4 marks]**

(b) i. Define the term blackbody **[1 mark]**

ii. What happens to radiant heat when it falls on a body **[3 marks]**

(c) Starting with the first law of thermodynamics and using the $dQ = dU + PdV$ equation of state, $PV = RT$ ; show that the equation of reversible adiabatic change for ideal gas is given by

$$PV^{\gamma} = Cons\tan t$$

**[7 marks]**