



UGANDA BUSINESS AND TECHNICAL EXAMINATIONS BOARD

Business and Humanities Certificate Examinations

APRIL-MAY 2022 SERIES

PROGRAMME

CERTIFICATE IN INFORMATION AND COMMUNICATION TECHNOLOGY

PAPER NAME

INTRODUCTION TO ADVANCED LEVEL PHYSICS I

PAPER CODE

CAP III

YEAR I, SEMESTER I

2½ HOURS

THURSDAY, 5TH MAY, 2022

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **two** sections **A** and **B**.
2. Section **A** is compulsory and carries 20 marks.
3. Section **B** consists of **six** questions. Answer only **four** questions from this section.
4. All answers to each question in sections **A** and **B** should begin on a fresh page.
5. All answers and rough work should be done in the official answer booklet provided.
6. Non-programmable electronic calculators may be used.
7. Read other instructions on the answer booklet.
8. Where necessary assume the following constants;
 - Acceleration due to gravity $g = 9.8\text{m/s}^2$
 - Electronic charge $e = 1.6 \times 10^{-19}\text{C}$
 - Electron volt (ev) $= 1.6 \times 10^{-19}\text{ joules}$
 - Velocity of light in a vacuum $= 3.0 \times 10^8\text{m/s}$
 - Universal gravitation constant $G = 6.67 \times 10^{-11}\text{Nm}^2\text{kg}^{-2}$
 - Plank's constant $h = 6.63 \times 10^{-34}\text{Js}$
 - Mass of the earth $= 6.0 \times 10^{24}\text{Kg}$
 - Radius of the earth $= 6.4 \times 10^6\text{m}$
 - Avogadro's constant $N_A = 6.03 \times 10^{23}\text{mol}^{-1}$
 - Mass of electron $= 9.11 \times 10^{-31}\text{kg}$
 - The ratio $C_P/C_V = \gamma = 1.41$
 - The molar gas constant $= 8.31\text{Jmol}^{-1}\text{K}^{-1}$

SECTION A - (20 MARKS)

Answer all the questions in this section.

Question One

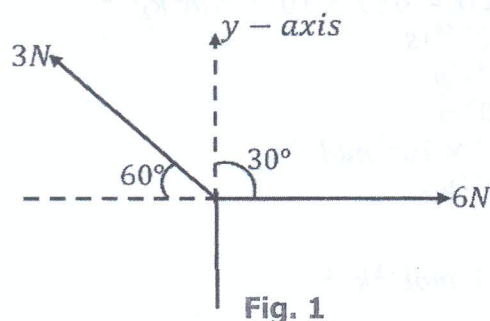
- (a) State the principle of **conservation of mechanical energy**. (01 mark)
- (b) A particle of mass 400g is projected vertically upwards with an initial speed of 5ms^{-1} . Calculate the;
- (i) Kinetic energy possessed by the particle at the point of projection. (03 marks)
 - (ii) Maximum height reached. (03 marks)
 - (iii) Time taken to reach the maximum height. (03 marks)
- (c) (i) State the **two** conditions for mechanical equilibrium of a rigid body. (02 marks)
- (ii) A uniform meter rule of mass 30kg is pivoted at the 80cm mark. Determine where a load of 10kg should be placed for the meter rule to balance horizontally. (03 marks)
- (d) Define the following terms as applied to mechanical properties of matter.
- (i) Tensile stress. (01 mark)
 - (ii) Tensile strain. (01 mark)
- (e) A spring stretches by an extension of 20cm when a force of 40N is applied. Calculate the extension produced by a stretching force of 60N? (03 marks)

SECTION B - (80 MARKS)

Answer only four questions from this section.

Question Two

- (a) (i) State the **principle of moments**. (01 mark)
- (ii) A uniform beam AB of mass 20kg and length 4m is pivoted at A and B . A load of weight 15N is suspended at point C 1m from B . Find the reaction at the supports. (07 marks)
- (b) Explain how you can determine the centre of gravity of an irregular lamina. (06 marks)
- (c) A particle of mass 5kg is acted upon by 3 forces as shown in **Fig.1**



Calculate the magnitude and direction of the resultant force.

(06 marks)

Question Three

- (a) Define the following terms as applied to circular motion.
- (i) Angular velocity. (01 mark)
 - (ii) Period. (01 mark)
 - (iii) Banking. (01 mark)
- (b) A body of mass 56kg moves in a circular circle of radius 20cm at a speed of 25ms^{-1} . Calculate the;
- (i) Centripetal acceleration (03 marks)
 - (ii) Centripetal force (03 marks)
- (c) (i) A car of mass $m\text{kg}$ moves along a smooth track banked at an angle θ to the horizontal. If the radius of the track is r , show that the speed V of the car is given by $\tan \theta = \frac{V^2}{rg}$. (03 marks)
- (ii) A car of mass 100kg moves around a smooth track of radius 62.5m at a speed of 22.5ms^{-1} . Find the angle of banking of the track. (04 marks)
- (d) A particle of mass 8kg is attached to the end of a light string of length 120cm and whirled in a vertical circle at a speed of 14ms^{-1} . Find the maximum tension in the thread. (04 marks)

Question Four

- (a) (i) Define **Young's modulus** of a material and state its S1 unit. (02 marks)
- (iii) With the aid of a well labeled diagram, describe an experiment to determine the young's modulus of material (09 marks)
- (b) A wire of length 2m is stretched by a force of $4.0 \times 10^5\text{N}$. If the Young's modulus of a wire is $2.1 \times 10^9\text{Pa}$ and the extension produced is 50cm, find the;
- (i) Strain of the wire. (03 marks)
 - (ii) Stress of the wire. (03 marks)
 - (iii) Cross sectional area of the wire (03 marks)

Question Five

- (a) Distinguish between **renewable sources of energy** and **non-renewable sources** of energy and state **two** examples of each case. (06 marks)
- (b) (i) Define **power** and state its S1 units. (02 marks)

- (ii) A boy of mass 42kg climbs a hill of length 6m in a time of 2 minutes. Calculate the rate at which he climbs the hill. (03 marks)
- (c) Show that when a particle of mass m kg is projected vertically upwards with an initial velocity u ms⁻¹, the mechanical energy is conserved throughout its motion. (09 marks)

Question Six

- (a) Distinguish between **vector quantities** and **scalar quantities**. Give **two** examples in each case. (06 marks)
- (b) A body changes its velocity from U ms⁻¹ to V ms⁻¹ in a distance s . Given that its accelerating at a ms⁻², find the expression for the distance s in terms of V , U and a . (04 marks)
- (c) A particle is projected from the horizontal ground with a velocity of 21ms⁻¹ at an angle 30° to the horizontal. Calculate the;
- Maximum height reached. (04 marks)
 - Time taken to reach maximum height. (03 marks)
 - Horizontal range covered. (03 marks)

Question Seven

- (a)
 - Define **frictional force**. (01 mark)
 - State **two** properties of friction. (02 marks)
- (b) A block of mass 200g slides on a rough horizontal surface. Calculate the frictional force experienced on the block if the coefficient of friction between the block and surface is 0.25. (04 marks)
- (c) Distinguish between **kinetic energy** and **potential energy**. (02 marks)
- (d) State **work energy theorem**. (01 mark)
- (e) A particle of mass 4kg slides on a rough horizontal surface. Its speed decreases from 8ms⁻¹ to 6ms⁻¹ in a distance of 5m. Calculate the;
- Work done against friction. (03 marks)
 - Coefficient of friction (03 marks)
- (f) A particle is projected at an angle θ to the horizontal with a velocity of u ms⁻¹. Show that the time of flight is given by $\frac{2u \sin \theta}{g}$. (04 marks)

END