

**UGANDA ADVANCED CERTIFICATE OF EDUCATION (UACE)
PHYSICS – CHRISTMAS OFFER TRIAL PAPER 🎄**

Paper: Advanced Level Physics (Theory)

Time: 3 Hours

Instructions to Candidates

Answer ALL SIX (6) items.

Show all working clearly; credit is given for correct method.

Use standard symbols, units, and physical constants.

Non-programmable calculators may be used.

🎁 CHRISTMAS OFFER LABEL

This paper is specially prepared as a Christmas academic challenge for UACE Physics students. Attempt all items seriously and submit full solutions for marking and guidance.

ITEM 1: THERMOMETRY, HEAT AND CALORIMETRY

A copper block of mass 0.80 kg is heated to a temperature of 120 °C and then quickly transferred into a well-insulated calorimeter containing 0.50 kg of water at 25 °C. The heat capacity of the calorimeter is negligible.

Task

- Define a thermometric property and give one example.
- State and explain the principle of calorimetry.
- Assuming no heat loss to the surroundings, calculate the final equilibrium temperature of the mixture.
- State two possible sources of error in this experiment.
- Explain why the final temperature of the mixture is less than 120 °C.
(Specific heat capacity of copper = 390 J kg⁻¹ K⁻¹, water = 4200 J kg⁻¹ K⁻¹)

ITEM 2: WORK, ENERGY AND POWER

A motor is used to raise a load of mass 120 kg vertically through a height of 18 m in a time of 30 s at constant speed.

Task

- Define work and power.

- (b) Calculate the work done on the load.
 - (c) Determine the useful power output of the motor.
 - (d) If the efficiency of the motor is 70%, calculate the power input to the motor.
 - (e) Explain why the speed of the load remains constant even though forces are acting on it.
- (Take acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$)

ITEM 3: LIGHT – REFRACTION AND LENSES

A ray of light passes from air into a glass block of refractive index 1.50 at an angle of incidence of 40° .

Task

- (a) State Snell's law of refraction.
- (b) Calculate the angle of refraction in the glass.
- (c) Define the critical angle and determine its value for the glass-air boundary.

A thin converging lens of focal length 20 cm is used to form an image of an object placed 30 cm from the lens.

- (d) Draw a labelled ray diagram to show the formation of the image.
- (e) Calculate the position of the image and state its nature.

ITEM 4: FLUIDS – WATER PUMPING MACHINE

A water pump is used to raise water from a well to a storage tank 12 m above the water level. The pump delivers water at a constant rate of $0.020 \text{ m}^3 \text{ s}^{-1}$.

Task

- (a) Explain the principle on which a water pump operates.
- (b) Calculate the mass of water pumped per second.
- (c) Determine the minimum power required to raise the water to the tank.
- (d) If the pump operates with an efficiency of 60%, calculate the actual power supplied by the motor.
- (e) State two reasons why the actual power required is greater than the theoretical minimum.

(Density of water = 1000 kg m^{-3} , $g = 9.8 \text{ m s}^{-2}$)

ITEM 5: ELECTROSTATICS AND CAPACITORS

A parallel-plate capacitor consists of two plates each of area 0.030 m^2 separated by a distance of 2.0 mm in air.

Task

- Define capacitance.
 - Calculate the capacitance of the capacitor.
 - When the capacitor is connected to a 200 V DC supply, calculate the charge stored on each plate.
 - Determine the energy stored in the capacitor.
 - Explain the effect on the capacitance when a dielectric material is inserted between the plates.
- (Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$)

ITEM 6: MEASUREMENT AND EXPERIMENTAL PHYSICS

A student measures the length of a metal rod several times using a metre rule and obtains slightly different readings.

Task

- Distinguish between accuracy and precision.
- Explain the difference between random errors and systematic errors.
- State two methods of reducing experimental errors.
- Explain why repeated measurements are important in physics experiments.
- State two reasons why experiments are carried out under controlled conditions.

END OF CHRISTMAS OFFER TRIAL PAPER

 ***Merry Christmas and best wishes in your Physics revision.***

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