

535/1  
PHYSICS  
Paper 1  
20242 ½ HOURS



**YAAKA EXAMINATIONS**  
**PHYSICS**  
**Paper 1**

**INSTRUCTIONSTO CANDIDATES**

*This paper consists of **two** sections; **A** and **B** It has **seven** examination items..Section **A** has **three** compulsory items. Section **B** has **two** parts; **I** and **II**. Answer **one** item from **each** part. Answer **five** items in all.  
Any additional item(s) answered will not be scored. All answers **must** be written in the booklets provided*

<b>FOR EXAMINER'S USE ONLY</b>			
<b>SECTION</b>	<b>ITEM</b>	<b>SCORE(S)</b>	<b>EXAMINER'S SIGNATURE</b>
<b>A</b>	1		
	2		
	3		
<b>B</b>	4		
	5		
	6		
	7		
<b>TOTAL</b>			

## SECTION A

Answer all the items in this section in the spaces provided.

### Item 1

Uganda faces challenges in generating enough electricity for its growing population and industries. The country has hydroelectric power plants, but during dry seasons, water levels in rivers drop, causing a reduction in power generation. This sometimes results in load shedding, where electricity supply is deliberately cut off in some areas to balance the available power. The government has been working on alternative energy sources, such as solar and wind energy, to meet the growing demand for electricity.

Task:

As a Physics Student, what are the advantages of solar and wind energy compared to hydroelectric power in terms of energy conversion and availability throughout the year in Uganda?

### Item 2

The transportation sector in Uganda heavily relies on petrol and diesel for vehicles. Due to global fluctuations in fuel prices and taxes imposed by the government, the cost of fuel in Uganda has been rising. This increase in fuel prices affects the cost of goods and services across the country, making transportation expensive.

Task:

1. Explain how the increase in fuel prices can be analyzed using the concept of work and energy in physics, focusing on how fuel is used to perform mechanical work in transportation systems.

### Item 3

The transportation sector in Uganda heavily relies on petrol and diesel for vehicles. Due to global fluctuations in fuel prices and taxes imposed by the government, the cost of fuel in Uganda has been rising. This increase in fuel prices affects the cost of goods and services across the country, making transportation expensive.

Task:

1. Explain how the increase in fuel prices can be analyzed using the concept of work and energy in physics, focusing on how fuel is used to perform mechanical work in transportation systems.

## SECTION B

### PART 1

*Answer one item from this part*

Item 4

A student conducted an experiment to measure the effect of mass on the time taken for an object to fall from a height of 2 meters. They used different masses and recorded the time for each.

**Task:**

Use your knowledge of physics to help the student:

- (a) Determine the expected time of fall for different masses.
- (b) Explain why mass does not affect the time of fall in a vacuum.
- (c) Discuss the effect of air resistance on falling objects.

Item 5

An electric kettle with a power rating of 1500 W takes 10 minutes to boil water. A student wants to calculate the energy consumed during this period.

**Task:**

Use your knowledge of physics to:

- (a) Calculate the energy consumed by the kettle in kilojoules.
- (b) Explain how power and energy are related.
- (c) Discuss the efficiency of electrical appliances in energy conversion.

**PART II**  
**Answer one item from this part.**

**Item 6**

In Uganda, there has been a rapid expansion in the use of mobile phones and internet services. Many rural areas are now connected to mobile networks, improving communication and access to information. Mobile communication relies on the transmission of radio waves, which are electromagnetic waves. Recently, there has been debate about the possible health impacts of radiation from communication towers, particularly in densely populated areas.

Task:

Discuss how radio waves are transmitted and received in mobile communication, and analyze whether there are any scientifically supported health risks associated with exposure to these waves in your community.

**Item 7**

A student observed a magnetic field around a current-carrying wire. They noted that changing the direction of the current affected the direction of the magnetic field.

**Task:**

Use your knowledge of physics to:

- (a) Explain how the magnetic field is created around a current-carrying wire.
- (b) Discuss the right-hand rule in relation to magnetic fields.
- (c) Describe how an electromagnet differs from a permanent magnet.

## SOLUTIONS TO THE ABOVE TASKS

### Item 1: Solar and Wind Energy Advantages

**Task:** As a Physics Student, what are the advantages of solar and wind energy compared to hydroelectric power in terms of energy conversion and availability throughout the year in Uganda?

**Answer:**

- **Energy Conversion:**
  - **Solar Energy:** Solar panels convert sunlight directly into electricity using photovoltaic cells. This process has no moving parts, which reduces maintenance costs and increases reliability.
  - **Wind Energy:** Wind turbines convert kinetic energy from wind into electrical energy. The technology has improved significantly, making it efficient and capable of generating power even at low wind speeds.
  - **Hydroelectric Power:** While hydroelectric power is efficient at converting water's potential energy to electrical energy, its output is heavily reliant on water availability, which can fluctuate with seasons and weather.
  
- **Availability:**
  - **Solar Energy:** Solar energy is available throughout the year, particularly in Uganda's sunny climate. Even during dry seasons, solar power generation can remain stable.
  - **Wind Energy:** Wind energy can also be consistently harnessed depending on local wind patterns, providing a more reliable source compared to hydroelectric power, which can be limited by water levels.
  - **Hydroelectric Power:** The availability of hydroelectric power is greatly affected by seasonal variations in rainfall and water levels, leading to potential energy shortages during dry spells.

### Item 2: Fuel Price Increase and Work/Energy

**Task:** Explain how the increase in fuel prices can be analyzed using the concept of work and energy in physics, focusing on how fuel is used to perform mechanical work in transportation systems.

**Answer:**

- The increase in fuel prices can be analyzed through the lens of mechanical work and energy. In physics, work is defined as the force applied to an object multiplied by the distance over which that force is applied ( $W = F \times d$ ).
- In transportation, fuel (petrol/diesel) is used to perform work by converting chemical energy stored in the fuel into mechanical energy. This mechanical energy powers the vehicle, enabling it to move, transport goods, and perform other tasks.
- As fuel prices increase, the cost per unit of energy (derived from the fuel) also rises. Consequently, transportation companies and consumers must allocate more financial resources to perform the same amount of work (moving goods or people), leading to higher transportation costs and, subsequently, higher prices for goods and services.

**Item 3: Fuel Price Increase and Work/Energy (Reiteration)**

**Task:** Explain how the increase in fuel prices can be analyzed using the concept of work and energy in physics, focusing on how fuel is used to perform mechanical work in transportation systems.

**Answer:**

The increase in fuel prices can be analyzed through the relationship between work, energy, and the cost of performing transportation tasks. In physics, work is defined as the product of force and distance ( $W = F \times d$ ), and fuel is used to perform work by converting its chemical energy into mechanical energy.

- **Mechanical Work in Transportation:**

When a vehicle uses fuel, it converts the chemical energy stored in the fuel into kinetic energy to move. This process involves internal combustion engines that burn fuel to create thrust.

The efficiency of this energy conversion determines how much of the fuel's energy is actually used to perform mechanical work, such as moving a vehicle over a distance.

- **Impact of Fuel Prices:**

As fuel prices rise, the cost of the energy required to perform transportation work also increases. This can lead to higher transportation costs for businesses and consumers.

The increase in fuel prices means that more money is spent to obtain the same amount of energy to perform the same amount of work (moving goods and people), leading to increased prices for goods and services throughout the economy.

In summary, the rising fuel prices impact the economics of energy use in transportation, affecting both operational costs and consumer prices based on the fundamental physics of work and energy conversion.

#### Item 4: Falling Objects Experiment

**Task:** Help the student with the following:

(a) Determine the expected time of fall for different masses.

- All objects fall at the same rate in a vacuum regardless of their mass. Using the formula for free fall:  $t = \sqrt{\frac{2h}{g}}$ , where  $h$  is the height (2 m) and  $g$  is the acceleration due to gravity (approximately  $9.81 \text{ m/s}^2$ ), the expected time of fall for any mass is:

$$t = \sqrt{\frac{2 \times 2 \text{ m}}{9.81 \text{ m/s}^2}} \approx 0.64 \text{ s}$$

(b) **Explain why mass does not affect the time of fall in a vacuum.**

- In a vacuum, there is no air resistance. The acceleration due to gravity is constant for all objects, meaning they all fall at the same rate regardless of mass. This is due to the principle that the gravitational force acting on an object (weight) is proportional to its mass, thus resulting in the same acceleration for different masses.

(c) **Discuss the effect of air resistance on falling objects.**

- Air resistance acts as a force opposing the motion of falling objects. Heavier objects tend to experience less relative impact from air resistance compared to lighter objects. This means that, in a non-vacuum environment, lighter objects will fall slower than heavier ones due to the greater influence of air resistance, leading to a longer time of fall for them.

#### Item 5: Energy Consumption of an Electric Kettle

**Task:** Use your knowledge of physics to:

(a) **Calculate the energy consumed by the kettle in kilojoules.**

- Power ( $P$ ) = 1500 W, time ( $t$ ) = 10 minutes = 600 seconds.

$$\text{Energy} = P \times t = 1500 \text{ W} \times 600 \text{ s} = 900,000 \text{ J} = 900 \text{ kJ}$$

(b) **Explain how power and energy are related.**

- Power is the rate at which energy is consumed or produced over time. It is measured in watts ( $1 \text{ W} = 1 \text{ J/s}$ ). Energy is the total work done or the total heat produced and is measured in joules or kilojoules. The relationship is given by the equation:

$$\text{Power} = \frac{\text{Energy}}{\text{Time}}$$

(c) **Discuss the efficiency of electrical appliances in energy conversion.**

- The efficiency of electrical appliances refers to how effectively they convert electrical energy into useful output (like heat or motion) compared to the energy

input. Factors affecting efficiency include heat loss (as waste energy), design quality, and age of the appliance. Typical efficiencies for electric kettles can be around 80-90%, meaning a portion of energy is lost as heat and not used for boiling water.

### **Item 6: Radio Waves in Mobile Communication**

**Task:** Discuss how radio waves are transmitted and received in mobile communication, and analyze whether there are any scientifically supported health risks associated with exposure to these waves in your community.

**Answer:**

- **Transmission and Reception of Radio Waves:**
  - Mobile communication relies on the transmission of radio waves, which are part of the electromagnetic spectrum. Radio waves are generated by antennas and propagate through the atmosphere.
  - When a mobile device sends a signal, it is converted into electromagnetic waves, transmitted to the nearest cell tower, which then relays it to the intended recipient through a series of interconnected towers.
- **Health Risks:**
  - The debate over potential health risks associated with exposure to radio waves is ongoing. Studies have shown that exposure to low-frequency radio waves from mobile phones is generally considered safe, as the levels are significantly below established safety limits.
  - Some studies have raised concerns about long-term exposure leading to possible health effects like headaches or other symptoms, but there is no conclusive scientific evidence directly linking mobile phone radiation to serious health issues, such as cancer, in the general population.

### **Item 7: Magnetic Fields Around a Current-Carrying Wire**

**Task:** Use your knowledge of physics to:

(a) **Explain how the magnetic field is created around a current-carrying wire.**

- A magnetic field is created around a wire when an electric current flows through it. The motion of electric charges (electrons) generates a magnetic field that circles around the wire, with the direction determined by the right-hand rule.

(b) **Discuss the right-hand rule in relation to magnetic fields.**



- The right-hand rule states that if you point your thumb in the direction of the current flow in a straight wire, your curled fingers will indicate the direction of the magnetic field lines circling around the wire. This helps visualize the orientation of the magnetic field.

**(c) Describe how an electromagnet differs from a permanent magnet.**

- An electromagnet is created when an electric current flows through a coil of wire, generating a magnetic field. The strength of the magnetic field can be adjusted by changing the current. In contrast, a permanent magnet is made from materials that maintain a persistent magnetic field without any external current. Electromagnets can be turned on and off and have adjustable strength, while permanent magnets do not.



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