**535|1**
**PHYSICS**
**Paper 1**
**(Theory)**
**Nov 2026**
**$2\frac{1}{2}$ Hours**

# KALEGE HIGH SCHOOL

**End of Year Examination 2026**

**Senior Two**

**Physics**

**Paper 1**

**(Theory)**

**INSTRUCTIONS TO STUDENTS.**

This examination paper consists of 4 items.

All items are compulsory.

Responses to each item should start on a fresh page.

Indicate the item number you are responding too.

Use a graph paper where necessary.

Mathematical tables and silent non programmable calculators may be used.

## ITEM 1:

A town council installed a tall watchtower fitted with a high-powered searchlight to improve night security. During maintenance, a technician replaced the searchlight's original **small-aperture** concave mirror with a **wide-aperture concave mirror** of the same focal length. After the change, security guards observed that the beam failed to clearly illuminate the boundary areas on the ground.

As concerns about safety compliance for tall structures increased, regulations required that all buildings above **20 m** in height must have a high-visibility warning light installed at the top of the structure. The town council was therefore required to select a suitable warning light. To establish whether the tower met the height requirement, the council requested an investigation.

Senior Four Physics students from a nearby school were engaged to assist in the assessment. They used a **20 cm** long pinhole camera placed **100 m** from the base of the tower and obtained an inverted image of the tower measuring **5 cm** on the screen.

The students were required to use the results obtained using the method to advise the town council.

**TASK:**

a) Help the tower owner understand how the change in the mirrors affected the reflected beam.
b) Determine the height of the tower using the pin hole method, and advise the town council on whether the tower requires a high-visibility warning light.

## ITEM 2:

Musa, who owns a salon in a school, replaced some of the plane mirrors with concave mirrors of focal length **80 cm**, knowing that concave mirrors are commonly used as shaving mirrors.

Annet visited the salon for the first time after the replacement of the mirrors and sat **120 cm** in front of the concave mirror along its principal axis. Her vertical height above the principal axis was **60 cm**.

Annet observed her image and realised that it had different characteristics from those of the image of a **20 cm** tall sanitiser bottle placed **40 cm** in front of the same mirror. She asked Musa why the two images appeared different, but Musa could not explain.

Annet has approached you for assistance.

**TASK:**

a) Illustrate the formation of the images Annet observed in the concave mirror.
b) Provide a detailed explanation of the characteristics of each image formed. Include relevant calculations where necessary.

## ITEM 3:

Students from a certain school went on a study trip to a hydroelectric power plant. The person in charge at the plant guided them around the facility.

They first visited the dam wall. The person in charge explained that the wall of such a dam is always constructed **thicker and wider at the bottom than at the top**. The students were curious about why the wall had to be designed in this way, but they were afraid to ask the person in charge for an explanation.

Later, the person in charge took the students to a nearby construction site. At the site, a **mixture of sand, gravel, cement, water and steel bars** was being used to construct columns for a multi-storey building.

The person in charge informed the students that each of the steel bars being used had a length of **3.2 m**, a diameter of **2.5 cm** and would stretch by **0.2 mm** when a tensile force of **$7.7 \times 10^5$ N** was applied.

The students wondered whether the steel bars met the required standards for use in the structure, considering the heavy weight of the building.

Upon returning from the trip, the students approached you for assistance.

**HINT:**

Steel bars are considered to be of good quality if the ratio of stress to strain exceeds $\mathbf{2.1 \times 10^{11}\ N\ m^{-2}}$.

**TASK:**

a) Explain to the students why the dam wall they observed was designed to be thicker and wider at the bottom than at the top.
b) Help the students determine whether the steel bars used at the construction site were of good quality.

## ITEM 4:

A number of issues arose at a construction site after the laying of a concrete slab. One of the site supervisors, who was **wearing sharp-pointed shoes**, found it difficult to walk on the newly laid wet concrete surface compared to other workers wearing flat-soled shoes.

The builder suggested that the concrete slab on the first floor should be **reinforced**, unlike the one on the ground floor. However, the site owner disagreed, and the builder was unable to give a clear explanation for his proposal.

In addition, lifting concrete blocks to the first floor became difficult and tiresome. The workers reported that a height of **6 m** was too high for them to safely throw the blocks upwards. Some workers who attempted to do so ended up breaking the blocks when they hit the ground, producing a loud sound.

In response to these challenges, an engineer proposed the use of a pulley system with **three wheels** connected to a platform carrying two concrete blocks, each of mass **6 kg**. The engineer was concerned that the efficiency of the pulley system might be less than **100%** and was uncertain whether it would effectively reduce the workers' effort.

The following information was provided:

- Both supervisors have a mass of 70 kg.

- Acceleration due to gravity, g = 10 m $s^{-2}$.
- 18% of the work input is wasted during the operation of the pulley system.

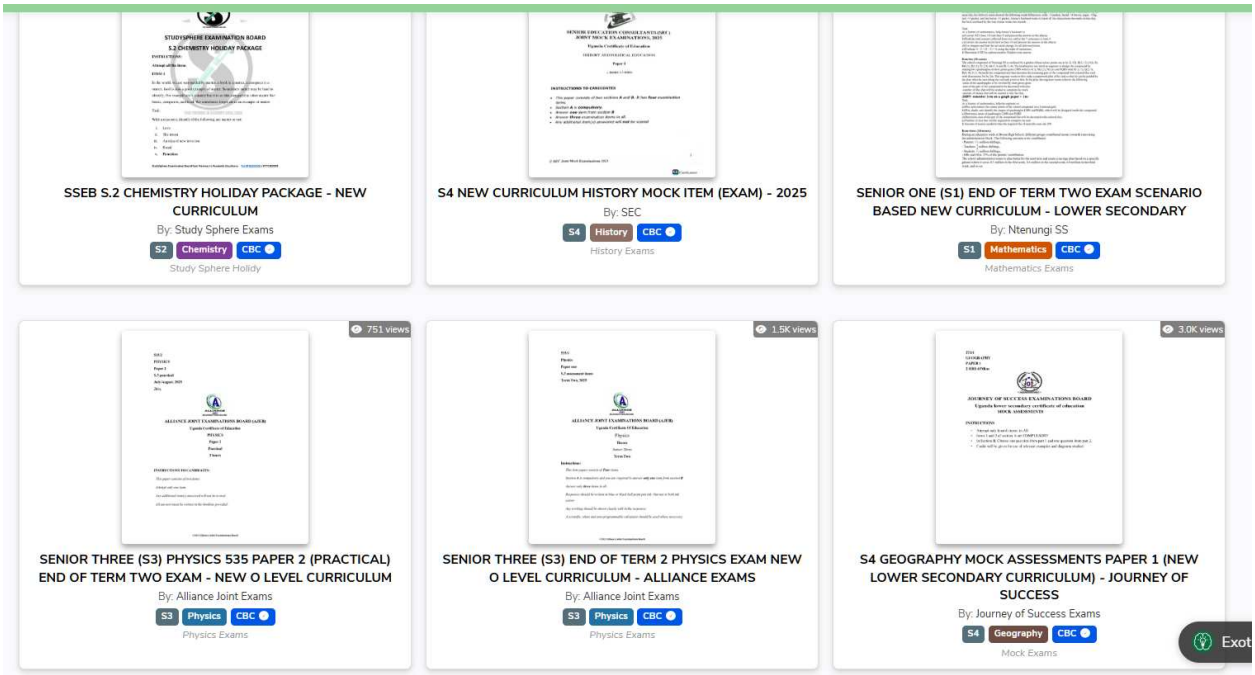
**TASKS**

Help the supervisors to understand the following:

a) Why it was difficult for one of them to walk on the newly laid wet concrete surface.
b) The benefit of the builder's proposal to reinforce the concrete slab on the first floor.
c) Why the concrete blocks produced noise when they hit the ground.
d) Whether the proposed pulley system would make their work easier.

**END… SUCCESS & HAPPY NEW YEAR 2027**

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