P510/1
PHYSICS THEORY
PAPER 1
JULY 2026
3 Hours

ACEITEKA JOINT MOCK EXAMINATIONS 2026

Uganda Advanced Certificate of Education

Physics

Paper 1

Theory

Time: 3 Hours

INSTRUCTIONS TO CANDIDATES:

This examination paper consists of two sections, A and B. It has six items

Section A has two compulsory items

Section B has two parts, I and II. Respond to only one item from each part

Respond to four items in all

Any additional item(s) responded to will not be scored.

Responses to each item should start on a fresh page

Silent non-programmable scientific calculators may be used

Indicate the items responded to on the first page of the answer booklet

SECTION A

(PARTICLES)

ITEM 1

In the factory, a worker found some sealed object left in one of the rooms some time ago. The sealed object was taken in their laboratory for investigation and it emitted entirely beta particles. Plato one of the intern and the engineer used a Geiger counter and measured an activity of 1600 counts per minute, and its half-life was 20 days from the last moment. After some time, the engineer and Plato found that the counter had reduced to 40 counts per minute, and the mass of the radioactive substance had not reduced. They wondered why and how the reading reduced and also how the count rate can be determined.

The manger found Plato asking the engineer why the emitted beta particles come from the nucleus even though the nucleus contains no electrons before decay, but she did not get a clear explanation. Near the sealed radioactive source there was a metal strip. Pato wanted to know its ability to emit radiations, so she performed a photoelectric effect experiment using a charged gold leaf electroscope which had a clean zinc plate placed on its cap. When a lamp was made to face the zinc plate, he made some observations which he failed to explain, and also wanted to know the work function of zinc metal such that he can tell other forms light which cause the same effect.

When the intensity of the light was increased, the stopping potential could not increase. Plato wondered why this was so, and when the laser pointer was directed to zinc, no observation was made, which confused Plato the more.

When Plato was moving he found students from one of the schools which had come to tour the factory talking about Rutherford's model how it's confusing to explain, and the model that makes electrons to be in specific energy levels. When Patricia heard them she asked them how the specific charge of ions that entered a magnetic field was determined and if there is any application of the effect that occurred in the scenario.

Support Material

Planck's constant $h = 6.63 \times 10^{-34}$ Js
Wavelength of light = 200 nm
Stopping potential = 2.5 V
Accelerating potential (voltage) = 400 V
Magnetic field = 0.02 T
Radius of the electron = 3 cm

Task:

As a learner of physics at a level of senior six.

(a) Carefully analyze the scenario and help Plato to address all her concerns.

(b) Examine Patricia's concern.

ITEM 2 (MOTION AND FORCE)

In certain school, a group of students went for a tour by bus. One of the learners told a friend that the tires of the bus had flattened and he did not know why. The turn boy worked on them and they continued with the journey.

On their way to Entebbe airport, the bus moved over a hump which made them to move up and down and a learner wondered why it happened like that. When they reached the airport another learner saw an areophane and imagined how it's able to fly He could also not tell the amount of force that can lift it, however when he asked the guide about it. He said the airplane can only fly if the lift force is 6.9kN and above.

When they were coming back to school the bus slid into a trench, the driver brought a tow car to pull it. The leaners were amused on seeing the tow car pulling the bus and one asked why the tow car was not sliding. A friend said may be due to friction. One of the Students said their teacher talked about molecular explanation of friction however he could not just explain to the colleagues.

The driver said that for the tow car to be efficient, its engine should have a force of 9.7kN but he did not know how to calculate. A leaner told the driver that to calculate it, he also needs to know the coefficient of friction which confused the driver the more. Since he could not tell how to determine its value. After towing, the driver opened the bus and told the students to enter, one learner who was near him heard the door making noise and he asked how that noise can be stopped but the drive could not give an answer. When they reached school, their teacher briefed them about what they had leant and he asked Muzafaru a learner to explain any other application that uses the same principle like that of the airplane when starting to fly but he could not.

Support material

Speed of air above the wings of the areophane	$= 81ms - 1$
Speed of air below the wings of the areophane	$= 57ms^{-1}$
Total area of the wings of the aero plane	$= 3.2m^2$
Density of air	$= 1.3kgm^{-3}$
Mass of the bus	$= 2000kg$
Mass of the tow car	$=1000kg$

The tow accelerates at rate of	$=0.8ms^{-2}$
Coefficient of friction	$= 0.25$
Acceleration due to gravity	$=9.81ms^{-2}$

Task:

As a learner of physics;

a) Analyze the scenario and address the challenges.

b) Examine Muzafaru's warry.

SECTION B

PART I (ENERGY)

ITEM 3

At a rural health centre in Kuwero, Dr. Anna and her intern Peter are struggling with a damaged solar-powered vaccine refrigerator. The refrigerator uses a thermodynamic cycle to remove heat from the vaccine compartment (maintained at 2°C) and releases it to the outside air at 27°C. The compressor does 500 J of work per cycle, and the refrigerator absorbs 1500 J of heat from the cold compartment each cycle. Peter wonders, "How much heat is released to the room" and "whether this is working as efficiently as it should" He calculates the coefficient of performance but worries because the actual performance is lower than the ideal coefficient value.

Nearby, a broken window allows humid outside air (relative humidity 80% at 27°C) to enter. The doctor explains that water vapour in the air condenses on the cold evaporator coils, forming ice. Peter could not explain why ice forms even when the air temperature is above freezing. She reminds him of latent heat of vaporization and condensation, which Peter could not determine.

To check the vaccine vials, Peter uses a compound microscope in normal adjustment but could not tell the magnification of the system. The doctor told him to use a small refracting telescope (objective 80 cm, eyepiece 10 cm focal length) to spot a distant ambulance across the valley. Peter could not tell whether the telescope produces an upright or inverted image in normal adjustment.

Later, Peter helps fix a solar panel that powers the refrigerator. The panel provides 150 W of power for 6 hours of sunlight per day, but he wanted to know whether the power it produces is enough for the refrigerator. The compressor runs 30% of the time. When Musa saw Peter, he asked how the device can be operated, which Peter failed to explain.

Support Material

Specific Latent heat of vaporisation $L = 2.26 \times 10^6$ J/kg

Ideal gas constant for water vapour $R = 461.53$ J/kg · K

Compound microscope of object lens focal length = 1.5 cm

Compound microscope of eye piece of focal length=5.0 cm

Tube length = 18.0cm

Tasks:

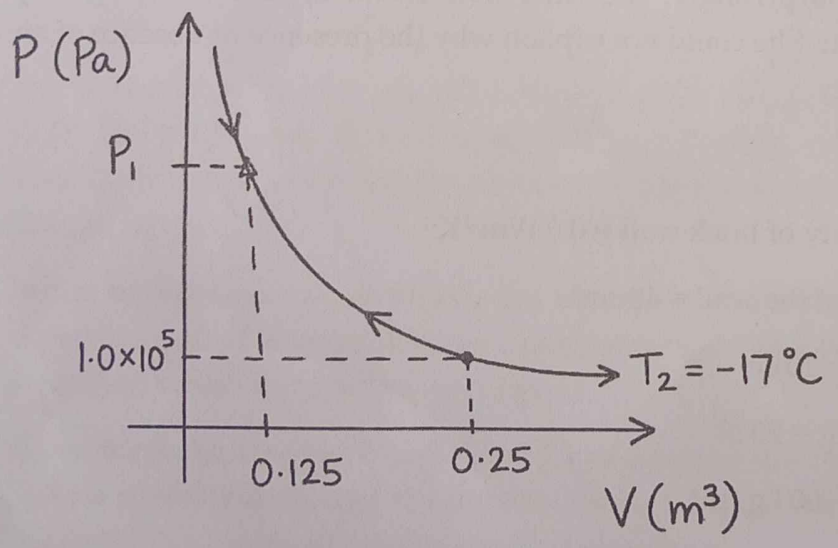
As a learner of Physics at Senior Six level:

a) Analyze the scenario to help Peter solve his puzzles.

b) Address Musa's concern.

ITEM 4

In a mountainous area of Uganda, community members face challenges leading to nose bleeding due to high air currents. A group of researchers went to this area to study the changes in atmospheric pressure and volume of the air current. The findings were plotted on a graph showing the variation of pressure with volume at a temperature of 17 °C.



The graph helped the researchers understand the variation of pressure and volume of the air current in the community. They noted that the energy carried by the air current at a given temperature of –17 °C forces community members to enter their rooms for 9 hours for safety. The members were forced to stay indoors such that the temperature

difference between the surroundings and the inner room should be 28.1 °C for them to be safe from nose bleeding.

The researcher asked the community leader about the material of the bricks used to construct the houses and their thermal conductivity, but the leader failed to determine it.

When the researcher entered one of the members' rooms, he found them playing music using an instrument that uses a string to produce sound. He wondered how sweet the music was. Musa, the person playing the instrument, told the researcher that for the music to be nice, the string should be under tension and vibrating at a frequency of 300 Hz and above, which was the third harmonic. This confused the researcher. When Musa touched the string, it was hot, which made him wonder how heat energy is generated in the string.

Joan, one of the researchers, observed that the sound pitch produced by the string instrument depends on the variation of frequency in the string and the tension. She wanted to know how this variation can be determined.

Later, in a separate laboratory experiment, a researcher set up a sonometer to investigate the relationship between frequency and tension. A paper rider was placed on the string. The string was plucked, and the rider vibrated. When she increased the tension, the rider still vibrated but at a different frequency. She was confused because she expected a simple relationship, but the results seemed inconsistent. She also wanted to determine the speed of the wave in the string when the tension was 20 N and the linear density was 0.5 Kgm^{-1}. To understand further, she placed the sonometer in a vacuum chamber. Surprisingly, the rider still vibrated, and the frequency remained the same as in air. She could not explain why the presence or absence of air did not affect the frequency.

Support Material

- Thermal conductivity of brick wall = 0.6 $Wm^{-1}K^{-1}$
- Cross-section area of the wall = 40 cm^2
- Thickness of brick = 10 cm
- Tension in the string = 20 N
- Density of string = 600 kg/m^3
- Length of string = 1 m
- Diameter of the string = 1.03×10^{-3} m

Task:

a) Analyze the scenario and help the researcher address their challenges.

b) Examine Joan's task.

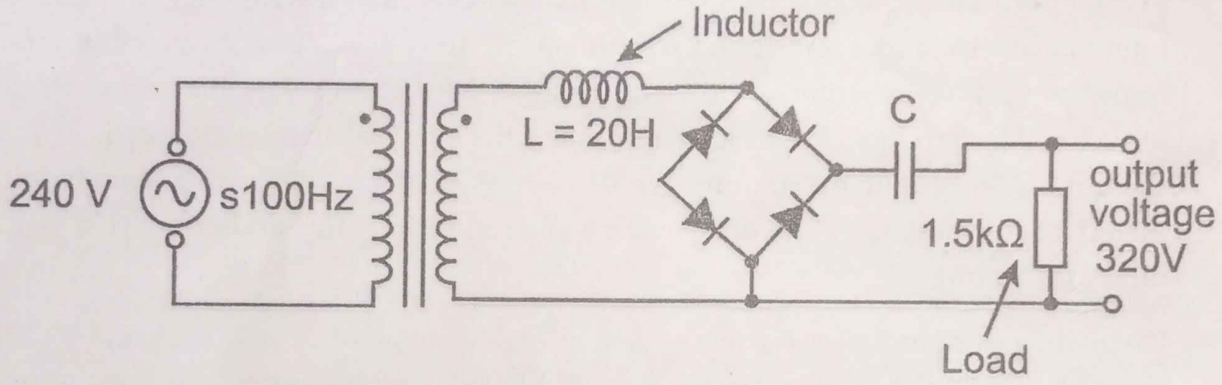
PART II

(FIELDS AND CHARGES)

ITEM 5

A certain school has a challenge of electricity fluctuations. The school management is planning to design a system which will solve the problem. To achieve this, their technician told them that they need a switch which can turn the generator on and off in case of power fluctuation, but the technician lacked the knowledge of how it works.

The circuit board of the school electricity distribution was shown in a diagram.



The technician consulted the engineer on how the circuit should be done to solve the electricity fluctuation. The engineer told him that the voltage should be improved since the hospital had many electric devices, but the technician could not explain how this can be done.

In the technician's circuit board, the technician was told to include a capacitor of capacitance 50 μF and an inductor of inductance 2H, but the capacitor was to act as a smoother, which he failed to understand.

When the technician went to the electronics shop, he wanted to buy a transformer but had no specifications, and the hospital devices required an output voltage of 400 V, but could not carry out calculations to determine it.

Marth told the technician that at the school, they had devices which could also use d.c voltage, she wondered how this could be adjusted to work on them.

Support material

Transformer should be of output voltage of 400v and more

Task:

(a) Analyze the scenario and help the technician to address the challenges.

(b) Examine Marth' challenge.

ITEM 6

In our communities people listen to radios for many reasons among them are to promote emotional comfort, mental stimulation and to be informed of what is going on. John visited his parents with his child who was doing physics in s6. The parent complained to John of the challenge they had with radio set which often failed to tune in their favorable religious program the radio operated at a frequency of 0.755MHz John opened the radio and found it's tuning circuit consisting of a capacitor and an inductor very weak. John decided to install a new strong variable capacitor and inductor. He purchased materials and made the two small capacitor each of plate separation 2mm and maximum area of overlap $0.005m^2$ filled with a material of dielectric constant 4. The two capacitor were found in series and connected with a motor for tuning.

He made a pure inductor L from a 15cm air-cored solenoid of 100 turns and $0.012m^2$ cross sectional area John requested his child to perform the necessary calculation to establish whether the new circuit can tune in to desired channel.

John's parent also took the presence of their grandchild and asked for the explanation of the structure and mode of operation of radio charging device being used, because the grandparent had always wondered how the charger can be connected in the socket which was labeled 240 V to charge a radio whose input required only 12V

Support Material

Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

Dielectric strength of air $= 3.0 \times 10^6$ V/m

Task:

As a Physics student at Senior six level:

a) Analyze the scenario and help John to address the challenges.

b) Assess the concern of the grandparent about the structure of the device.

END