THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

031 **PHYSICS**

Time: 2:30 Hours **ANSWERS** **Year: 2023.**

Instructions

1. This paper consists of sections A, B, and C.
2. Answer **all** questions in the spaces provided.
3. Section A and C carry **fifteen (15)** marks each and section B carries **seventy (70)** mark s.
4. All writings must be in **blue** or **black** ink.
5. Communication devices and any unauthorized materials are **not** allowed in the assessment room.
6. Write your **Assessment Number** at the top right hand corner of every page.

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter in the box provided.

(i) A student has an urgent message to send to his/her parents far from school. Which means can be the best?
A. Landline and mobile phone
B. Microphone and telephone
C. Megaphone and mobile phone
D. Megaphone and microphone

Answer: A
Reason: A landline and mobile phone are communication devices that allow sending messages over long distances, unlike megaphones or microphones.

(ii) What is the usefulness of laboratory rules when carrying out experiments in the Physics laboratory?
A. Making students enjoy science
B. Helping students conduct experiments freely
C. Ensuring safety in the laboratory
D. Enhancing communication with other technicians

Answer: C
Reason: Laboratory rules are primarily designed to ensure safety while conducting experiments.

(iii) Why does a piece of steel sink in water but a steel ship floats?
A. The density of the steel ship is less than the density of water
B. Steel is denser than the steel ship
C. Steel ship has the same density as that of steel
D. The average density of the steel ship is less than the density of water

Answer: D
Reason: The steel ship's average density, including the air within its structure, is less than water, allowing it to float.

(iv) Which of the following is a set of effects of forces exerted when you are riding a bicycle?
A. Compressional, viscosity, and stretching
B. Torsional, attraction, and couple
C. Frictional, couple, and pulling
D. Attraction, friction, and restoring

Answer: C
Reason: Riding a bicycle involves friction between tires and the ground, pulling force on the pedals, and the couple that balances the system.

(v) A hydrometer is an instrument for measuring the density or relative density of a liquid. What are you supposed to do to increase its sensitivity?
A. Increase the size of the large bulb
B. Make the stem narrower
C. Reduce the lead shots in the weighted bulb
D. Increase the length of the stem

Answer: B
Reason: Making the stem narrower allows for more precise readings as small changes in density cause greater changes in the hydrometer's position.

(vi) How can you make a rough measure of the size of a molecule?
A. By measuring the height to which water rises in a narrow capillary tube
B. By finding the speed with which Brownian vapor spreads in air
C. By observing Brownian motion of smoke particles
D. By measuring the area of the cycle in which a small drop spreads in water

Answer: D
Reason: The area covered by a single layer of a drop spread on water gives an estimate of molecular size.

(vii) A boy wants to lift a bucket full of water using a handle of metal. Which form of a handle should he use to lift the bucket comfortably?
A. Thick handle
B. Thin handle
C. Long handle
D. Sharp handle

Answer: C
Reason: A long handle reduces the effort required by increasing the lever arm.

(viii) Which of the following is a set of natural sources of light?
A. Sun, star, and fluorescence light
B. Sun, star, and lightning
C. Star, candle, and bioluminescence fly
D. Star, lightning, and wood fire

Answer: B
Reason: Sun, star, and lightning are all natural sources of light, while candles and fluorescence light are artificial.

(ix) Which statement is true about a ball falling freely from a height of 10 m?
A. Its potential energy increases but kinetic energy decreases
B. Its potential energy is equal to the kinetic energy

C. Its potential energy is zero and kinetic energy is maximum
D. Its potential energy decreases and kinetic energy increases

Answer: D
Reason: As the ball falls, potential energy is converted into kinetic energy.

(x) Which method is preferred to use if a student wishes to charge an uncharged body by using a positively charged body to make it acquire positive charge?
A. Friction
B. Contact
C. Induction
D. Heating

Answer: C
Reason: Induction allows a positively charged body to transfer charge to another body without direct contact.

2. Match the uses of instruments in List A with a correct name of the instrument in List B by writing a letter of the correct response below the item number in the table provided.

List A
(i) An instrument used to measure the density of the liquid.
(ii) An instrument used to determine the volume of an irregular substance.
(iii) An instrument used to transfer a specific volume of liquid from one container to another.
(iv) An instrument used to determine the volume of displaced water.
(v) An instrument used to determine the density of insoluble granules.

List B
A. Density bottle
B. Hydrometer
C. Eureka can
D. Pipette
E. Measuring cylinder
F. Burette
G. Test tube

Answers
List A
(i) B
(ii) C
(iii) D
(iv) C
(v) A

3. (a) Describe three ways in which magnets can be destroyed.
1. Heating the magnet to a very high temperature, which disrupts its magnetic domains.
2. Hammering or physically striking the magnet repeatedly, which disorients the magnetic domains.
3. Storing magnets improperly, such as placing like poles together, which can weaken their magnetic strength over time.

(b) Using vivid examples, identify four applications of magnets in our daily life.
1. Electric motors: Magnets are used in the rotors of electric motors in household appliances like fans.
2. Magnetic locks: Used in security systems to ensure doors lock securely.
3. Magnetic compasses: Help with navigation by pointing to the Earth's magnetic north.
4. Hard drives: Magnets are used to store data in computers and other electronic devices.

4. (a) What is the function of the constriction in a clinical thermometer?
The constriction prevents the mercury column from falling back into the bulb after the thermometer is removed from the body, allowing for accurate reading.
(b) Explain the principle on which a liquid-in-glass thermometer works.
A liquid-in-glass thermometer works on the principle of thermal expansion. When the liquid (e.g., mercury or alcohol) inside the thermometer is heated, it expands and rises in the calibrated tube, indicating the temperature.
(c) At what temperature do Fahrenheit and Celsius scales give the same reading?
The Fahrenheit and Celsius scales give the same reading at -40 degrees. This is the point where both temperature scales intersect.

5. (a) (i) Suppose you find a man along the road pushing a motorcycle and it accelerated, but the same man pushed a car and failed to move it. Why did the man fail to push the car? Briefly explain.
The man failed to push the car because the car has a much greater mass compared to the motorcycle. This results in a higher inertia, which requires a greater force to overcome and initiate motion. The man’s applied force was insufficient to overcome the car’s static friction and inertia.

(ii) An object in a state of rest or moving with uniform motion has no forces acting on it. Argue against this statement.
This statement is incorrect. An object in a state of rest or uniform motion may have forces acting on it, but these forces are balanced. For example, a book resting on a table has the force of gravity acting downward and the normal force from the table acting upward. Similarly, an object moving at a constant velocity has balanced forces like friction opposing motion and an applied force maintaining motion.

(b) A car with a mass of 350 kg moving from Kondoa to Babati at a speed of 120 km/hr overtakes a bus with a mass of 1000 kg moving with a speed of 40 km/hr. Determine their momentum.
Momentum is given by:
momentum = mass × velocity
For the car:

mass = 350 kg
velocity = 120 km/hr = 120 × (1000 / 3600) = 33.33 m/s
momentum = 350 × 33.33 = 11665.5 kg·m/s

For the bus:
mass = 1000 kg
velocity = 40 km/hr = 40 × (1000 / 3600) = 11.11 m/s
momentum = 1000 × 11.11 = 11110 kg·m/s

The momentum of the car is 11665.5 kg·m/s, and the momentum of the bus is 11110 kg·m/s.

(c) A boy of mass 50 kg was pushed by a constant force of 20 N for 3 seconds. Determine the acceleration acquired by the body.
Acceleration is given by:
acceleration = force / mass

force = 20 N
mass = 50 kg
acceleration = 20 / 50 = 0.4 m/s²
The acceleration acquired by the body is 0.4 m/s².

6. John started moving the car from rest and the car accelerated uniformly at the rate of 4 m/s² for 5 seconds and maintained a constant velocity for 20 seconds. Afterwards, he applied the brakes and the car retarded uniformly to rest in 3 seconds. Calculate the total distance covered by the car.

Solution:
- Distance during acceleration:
Using the formula:
$S= ut + \frac{1}{2}at^2$ but u = 0 m/s. Then,
distance = 0.5 × acceleration × time²
distance = 0.5 × 4 × (5)² = 50 m
- Distance during constant velocity:
velocity = acceleration × time
velocity = 4 × 5 = 20 m/s
distance = velocity × time
distance = 20 × 20 = 400 m
- Distance during retardation:

Using the formula:
distance = 0.5 × initial velocity × time
distance = 0.5 × 20 × 3 = 30 m
Total distance = 50 + 400 + 30 = 480 m
The total distance covered by the car is 480 m.

7. (a) Why is an inclined plane regarded as a simple machine?
An inclined plane is regarded as a simple machine because it reduces the amount of effort needed to lift or move heavy objects by spreading the force over a longer distance. It allows work to be done with less force, although over a greater distance.
(b) The wheel and axle with an efficiency of 85% is used to raise a load of 6000 N. If the radius of the wheel is 50 cm while that of the axle is 15 cm, calculate:

(i) The velocity ratio of the wheel and axle.
Velocity ratio (VR) is given by:
VR = Radius of wheel / Radius of axle

Radius of wheel = 50 cm
Radius of axle = 15 cm
VR = 50 / 15
VR = 3.33

The velocity ratio of the wheel and axle is 3.33.

(ii) The mechanical advantage of the wheel and axle.
Mechanical advantage (MA) is related to efficiency and velocity ratio by the formula:
Efficiency = (MA / VR) × 100
Efficiency = 85% = 0.85
VR = 3.33
Then,
0.85 = MA / 3.33
MA = 0.85 × 3.33
MA = 2.83
The mechanical advantage of the wheel and axle is 2.83.

8. (a) Why does a body rotate when a certain force is applied on it?
A body rotates when a force is applied because the force creates a turning effect known as torque. Torque depends on the magnitude of the force and the perpendicular distance from the axis of rotation. When these conditions are met, the body begins to rotate around the axis.

(b) Figure 1 shows a uniform meter rule of weight 2 N which is pivoted at the 40 cm mark. If a force of 4 N acts at the end of the meter rule, calculate the value of force \(X \) required to keep the rule in equilibrium.
To solve this, use the principle of moments:
Clockwise moment = Anticlockwise moment

Let the pivot be the 40 cm mark.

Clockwise moment = 4 × (100 - 40) = 4 × 60 = 240 N·cm
Anticlockwise moment = X × (40 - 0) = X × 40

Equating the moments:
$240 = X \times 40$
$X = 240 / 40$
$X = 6$ N

9. (a) Compare natural gas and geothermal energy sources by considering the following:
(i) Environmental safety
- Natural gas emits greenhouse gases like carbon dioxide and methane during combustion, contributing to air pollution and global warming.
- Geothermal energy is cleaner as it releases minimal greenhouse gases and has less environmental impact.
(ii) Sustainability
- Natural gas is a non-renewable resource that depletes over time and is not sustainable in the long term.
- Geothermal energy is a renewable resource and can be sustainably harnessed as long as the Earth's heat is available.

(b) Using two points, state why solar cars are better than petrol cars.
1. Solar cars use renewable energy from the sun, making them more environmentally friendly and reducing dependency on fossil fuels.
2. They produce zero emissions during operation, reducing air pollution and contributing to a cleaner environment.

(c) Give three disadvantages of hydroelectric power.
1. It disrupts aquatic ecosystems by altering water flow and affecting fish migration patterns.
2. Building large dams can displace communities and flood large areas of land.
3. Hydroelectric power generation is dependent on water availability, which can be affected by droughts or seasonal variations.
10. (a) Explain how an ammeter and a voltmeter are connected in a circuit.
1. The ammeter is connected in series with the component whose current is to be measured. This ensures that all the current flowing through the component also flows through the ammeter.
2. The voltmeter is connected in parallel across the component whose voltage is to be measured. This allows it to measure the potential difference without affecting the current flowing in the circuit.
3. Both instruments are designed to have minimal effect on the circuit: the ammeter has very low resistance to avoid reducing the current, while the voltmeter has very high resistance to avoid drawing current.

(b) In the circuit shown in Figure 2, the battery and an ammeter have negligible internal resistance. Determine the ammeter reading.

1. Identify the total resistance in the circuit:
The two 2 Ω resistors are in parallel. Their combined resistance ($R_{parallel}$) is given by:
$1 / R_{parallel} = (1 / 2) + (1 / 2)$
$1 / R_{parallel} = 2 / 2$
$R_{parallel} = 1$ Ω

The 3 Ω resistor is in series with the parallel combination, so the total resistance (R_total) is:
R_total = R_parallel + 3
R_total = 1 + 3
R_total = 4 Ω

2. Determine the total current (I_total) in the circuit using Ohm's law:
I_total = V / R_total
V = 2 V, R_total = 4 Ω
I_total = 2 / 4
I_total = 0.5 A

3. Current through the ammeter:
The ammeter is in series with the circuit, so it measures the total current flowing through the circuit.

The ammeter reading is 0.5 A.