THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

031 **PHYSICS**

Time: 2:30 Hours **ANSWERS** **Year: 2022.**

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) Which one of the following arguments describes the mathematical language used in Physics?
A. Matter occupies space
B. Density is mass per volume
C. Volume is the amount of space occupied by the body
D. Physics is a branch of science

Answer: B
Reason: Density is expressed mathematically as mass per unit volume, making it part of the mathematical language in Physics.

(ii) A student has got an electric shock and fell unconscious in the Physics laboratory. Which decision would you take to help the victim immediately?
A. Administer breath exercise
B. Call the physicist
C. Call other students
D. Contact a medical doctor

Answer: D
Reason: Contacting a medical doctor is the immediate and appropriate response to a medical emergency such as an electric shock.

(iii) An empty glass cup was placed on a digital balance and its mass was 43.63 g. Water was then added into the cup and the balance recorded a new mass of 71.06 g. What was the exact mass of the water added into the cup?
A. 114.69 g
B. 27.43 g
C. 71.06 g
D. 43.63 g

Answer: B
Reason: Mass of water = Final mass - Initial mass = 71.06 g - 43.63 g = 27.43 g.

(iv) Why are machine engines filled with lubricant oil?
A. To reduce friction between moving particles
B. To increase the viscosity between moving particles
C. To balance the forces acting between moving particles
D. To return the twisted solids to their former state

Answer: A
Reason: Lubricant oil reduces friction between moving parts, improving efficiency and reducing wear.

(v) A ship sinks lower in fresh water than in sea water. What can you conclude about the density?
A. Fresh water is denser than sea water
B. The density of the sea water is the same as that of the ship
C. Sea water is denser than fresh water
D. Sea water and fresh water have the same density

Answer: C
Reason: Sea water is denser than fresh water, providing greater buoyant force, causing the ship to float higher.

(vi) Why does it take a shorter time for a perfume to diffuse in air than in water?
A. Air molecules are fresh compared to water
B. Air molecules are packed closer compared to those of water
C. Water molecules are less far apart compared to those of air
D. Water molecules move with higher speed compared to those of air

Answer: C
Reason: The particles in water are closer together, restricting diffusion, while air molecules are farther apart, allowing faster diffusion.

(vii) What is the relationship between pressure and area?
A. On decreasing area, pressure decreases
B. On increasing area, pressure increases
C. On decreasing area, pressure increases
D. On changing area, nothing happens

Answer: C
Reason: Pressure is inversely proportional to area; reducing the area increases pressure.

(viii) What name is given to the process in which a parallel beam of incident light is reflected as a parallel beam in one direction?
A. Diffuse reflection
B. Internal reflection
C. Regular deflection
D. Regular reflection

Answer: D
Reason: Regular reflection occurs when light reflects off a smooth surface and maintains a parallel beam.

(ix) An object has a mass of 5 kg. What is its kinetic energy when it is moving at a speed of 10 m/s?
A. 50 J
B. 250 J
C. 150 J

D. 100 J

Answer: B
Reason: Kinetic energy = 0.5 × mass × velocity²
KE = 0.5 × 5 × 10² = 0.5 × 5 × 100 = 250 J.

(x) Which value of a capacitor would you advise your friend to use in order to replace a set of 3 µF, 6 µF, and 9 µF capacitors connected in parallel?
A. 1.64 µF
B. 16.4 µF
C. 18.0 µF
D. 1.80 µF

Answer: C
Reason: In a parallel connection, the total capacitance is the sum of all capacitances:
C_total = 3 + 6 + 9 = 18 µF.
Here are the solutions for the questions in the image:

2. Match each of the descriptions of the terms used in simple machines in List A with the corresponding concept used in simple machines in List B by writing a letter of the correct response below the item number in the table provided.

List A
(i) The ratio of the distance moved by effort to the distance moved by the load.
(ii) The ratio of the load raised steadily by a machine when an effort or force is applied.
(iii) A fixed wheel with a rope passing round a groove in the wheel's circumference.
(iv) The ratio of the work output to the work input times 100%.
(v) Consists of a rigid bar that moves about a fixed point.

List B
A. A simple pulley
B. Combination pulley
C. Efficiency
D. Lever
E. Mechanical advantage
F. Single fixed pulley
G. The block and tackle pulley system
H. Velocity ratio

Answers

i	**ii**	**iii**	**iv**	**v**
H	E	F	C	D

3. (a) Differentiate ferromagnetic materials from paramagnetic materials by giving their typical examples and uses.
- Ferromagnetic materials:
These materials are strongly attracted by a magnetic field and can retain magnetism after the external field is removed.
Examples: Iron, cobalt, nickel.
Uses: Used in electromagnets, transformers, and magnetic storage devices.

- Paramagnetic materials:
These materials are weakly attracted by a magnetic field and do not retain magnetism once the external field is removed.
Examples: Aluminum, platinum.
Uses: Used in magnetic resonance imaging (MRI) and temperature sensors.

(b) Advise a laboratory technician on three appropriate ways of storing magnets so that they can last longer.

- Store magnets in pairs with opposite poles facing each other to maintain their magnetic properties.
- Use keepers (soft iron bars) across the poles to prevent loss of magnetism.
- Avoid exposing magnets to high temperatures or strong impacts, as these can weaken their magnetic strength.

4. (a) A Form Two student was arguing that temperature is the degree of hotness and coldness of a body, and it is impossible to explain this concept by using the kinetic theory of matter. How can you refute this argument?
Temperature can be explained using the kinetic theory of matter, as it is directly proportional to the average kinetic energy of particles in a substance. The higher the temperature, the faster the particles move, which correlates to the degree of hotness, and slower movement corresponds to coldness. Thus, temperature measures particle motion at the molecular level.

(b) (i) You wake up in the morning and find your classmate at the school kitchen shouting, "The morning porridge is very hot! Its temperature is 350 K." What temperature is this on the Celsius scale?
The relationship between Kelvin and Celsius scales is:
C = K - 273
C = 350 - 273
C = 77°C
The temperature on the Celsius scale is 77°C.

(ii) Your aunt is preparing water for a newborn baby to bathe. There are two pots of water which are equal in mass. One is at 15°C and the other is at 45°C. If the water from the two pots is mixed so as to get an equilibrium temperature suitable for the baby to bathe, what will be the equilibrium temperature in Kelvin after mixing?
Solution:
The equilibrium temperature (T_eq) is given by:
T_eq = (T1 + T2) / 2

T1 = 15°C, T2 = 45°C
T_eq = (15 + 45) / 2
T_eq = 60 / 2
T_eq = 30°C
Converting to Kelvin:
T_eq = 30 + 273
T_eq = 303 K
The equilibrium temperature is 303 K.

5. (a) Consider a book placed on the table, what are the forces acting on it?

- The force of gravity (weight) acts downward on the book.
- The normal force acts upward from the table, balancing the downward force of gravity.

(b) (i) An athlete standing in a boat throws an object out of the boat, and the boat tends to move in the opposite direction to that of the object. What is the suitable law of motion that explains this phenomenon?
This phenomenon is explained by Newton's third law of motion, which states: "For every action, there is an equal and opposite reaction." When the athlete throws the object, the force exerted on the object (action) results in an equal and opposite force exerted on the boat (reaction), causing the boat to move backward.

(ii) A boy in a stationary boat with a mass of 55 kg jumps onto a trolley of mass 90 kg. If the initial speed of the boy is 5 m/s, at what initial speed will the trolley move?
Solution:
Using the principle of conservation of momentum:

Initial momentum = Final momentum
The boy and the trolley will have common velocity because the boy will be in the trolley.
Mass of boy = 55 kg, velocity of boy = 5 m/s
Mass of trolley = 90 kg, velocity of trolley = v
From, momentum = mass x velocity

Initial momentum: 55kg x 5 m/s
Final momentum: (55 + 90)kg x v m/s

Equating the momenta:
55 x 5 = (55 + 90)v
275 = 145 v
v = 1.896~ 1.90
The initial speed of the trolley is 1.90 m/s.

6. (a) On your way back home, you hear two Form Two students arguing that acceleration is a scalar quantity because it describes the rate of change of speed of an object. How will you correct their argument?
Acceleration is a vector quantity, not a scalar. This is because it has both magnitude and direction. While the rate of change of speed (magnitude) is a part of acceleration, acceleration also includes changes in the direction of motion, making it a vector.

(b) Suppose a bird is on a tree at a certain height above the ground, and a boy at rest threw a stone to hit the bird on the tree. If the bird falls and strikes the ground with a velocity of 80 m/s:
solution:
(i) What will be the height of the bird from the ground?
Using the equation of motion:
$v^2 = u^2 + 2gh$
Where:
$v = 80$ m/s, $u = 0$ m/s $g = 10$ m/s^2 $h = ?$

Substitute values:
$80^2 = 0 + (2 \times 10 \times h)$
$6400 = 20h$
$h = 6400/20$
$h = 320$ m
The height of the bird from the ground is 320 m.

(ii) Calculate the time taken by the bird to hit the ground.
Using the equation of motion:
$v = u + gt$
Where:
$v = 80$ m/s, $u = 0$ m/s, $g = 10$ m/s^2 , $t = ?$
Substitute values:
$80 = 0 + 10t$
$t = 80 / 10$
$t = 8$ seconds

The time taken by the bird to hit the ground is 8 seconds.

7. (a) (i) If you want to lift a heavy load vertically to the roof, which simple machine will be used?
A pulley system is the ideal simple machine for lifting heavy loads vertically. It allows for the application of less force to lift the load, depending on the configuration of the pulleys.

(ii) How is the mechanical advantage and velocity ratio of an inclined plane related to the angle of inclination?
- Mechanical advantage (MA): It is inversely proportional to the angle of inclination. A smaller angle provides a greater mechanical advantage as it spreads the required force over a longer distance.

- Velocity ratio (VR): It is directly proportional to the ratio of the length of the incline to its height. A gentler slope (smaller angle) increases the velocity ratio by increasing the length of the incline relative to its height.

(b) A Physics teacher was driving on a rough road. The right front tyre of the car ran over a sharp object and got a puncture. The teacher used a screw-jack with a handle which has a length of 40 cm long and a pitch of 0.5 cm to lift a car whose mass is 350 kg. If the efficiency of the screw-jack is 45%, calculate the amount of force applied at the end of the handle when lifting the car.

- Calculate the velocity ratio (VR):

VR = (Circumference of the handle's rotation)/(Pitch of the screw)
Circumference = $2\pi r = 2\pi \times 40 = 251.2$ cm
Pitch = 0.5 cm
VR = 251.2 / 0.5 = 502.4

- Calculate the mechanical advantage (MA):

Efficiency = (MA / VR) × 100
45 = (MA / 502.4) × 100
MA = (45 × 502.4) / 100
MA = 226.08

- Calculate the force applied (Effort):

Load = Weight of car = 350 x 10 = 3500 N
MA = Load / Effort
Effort = Load / MA
Effort = 3500 / 226.08
Effort ≈ 15.48 N

The amount of force applied at the end of the handle is approximately 15.48 N.

8. (a) Explain the following terms as applied in forces in equilibrium:
(i) Centre of mass
The centre of mass is the point in a body or system where the entire mass can be considered to be concentrated. It is the point where the body balances evenly in all directions.

(ii) Moment of force
The moment of force (torque) is the turning effect produced by a force acting at a distance from a pivot or axis. It is given by:
Moment = Force × Perpendicular distance from the pivot.

(b) A light beam AB rests on supports at CD. A load of 9 N is placed at O, where DO is 30 cm, CO is 70 cm as shown in Figure 1. Find the reactions P and Q at the supports.
Solution:

Using the principle of moments:
Taking moments about D:
Q x 100 = 9 x 30
Q = (9 x 30) / 100
Q = 2.7 N

Using the equilibrium condition (sum of vertical forces = 0):
P + Q = 9
P + 2.7 = 9
P = 9 - 2.7
P = 6.3 N

The reactions are:
P = 6.3 N , Q = 2.7 N

9. (a) Suppose your school has a plan to develop a mini power plant project from either water or wind sources, and the school management is seeking scientific advice from you. What will you advise them on this matter? Use two points.

- For water sources, if water is used, ensure there is a consistent and sufficient water flow, such as from a river, to guarantee a reliable power supply. A dam or reservoir may also be required to store water for use during dry seasons.
- For wind sources, if wind is chosen, the area should have strong and consistent wind patterns. Installing wind turbines in open spaces free from obstructions like tall buildings or trees will maximize efficiency.

(b) People are warned by geophysicists not to build houses near geothermal power plants. Give two reasons for this warning.

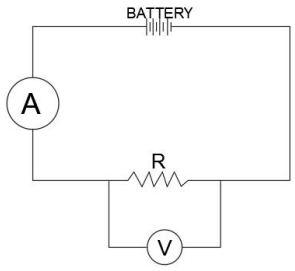
- Risk of seismic activity: Geothermal power plants are often located in regions with underground geothermal activity, which could lead to earthquakes, posing a danger to nearby houses.
- Emission of harmful gases: Geothermal plants can release gases like hydrogen sulfide, which is toxic and poses health risks to people living nearby.

10. Suppose you are asked by your teacher to prepare electrical components and instruments for an experiment to determine the relationship between voltage and current:

(a) Give five electrical components that can be used in this experiment.

- Ammeter – to measure the current in the circuit.
- Voltmeter – to measure the voltage across a component.
- Resistor or variable resistor – to control the current in the circuit.
- Battery or power supply – to provide electrical energy for the circuit.
- Connecting wires – to complete the circuit and make connections between components.

10. (b) Draw a simple electric circuit which will be suitable for that experiment.



(c) From the simple electrical circuit drawn in 10 (b), how will you connect the electrical devices used for measuring the current and the potential difference?

- The ammeter is connected in series with the resistor. This ensures that the current flowing through the resistor also flows through the ammeter, allowing it to measure the current accurately.
- The voltmeter is connected in parallel across the resistor. This configuration allows it to measure the potential difference (voltage) across the resistor without interfering with the flow of current in the circuit.