SMZ

ZANZIBAR EXAMINATONS COUNCIL

FORM THREE ENTRANCE EXAMINATION

031 **PHYSICS**

Time: 2:30 Hours **ANSWERS** **Thursday 30th November, 2021.**

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. Choose the correct answer and write its letter in the table below:
(i) Matter is anything which has:
A. Direction and occupies space
B. Mass and occupies space
C. Magnitude and occupies space
D. Weight and occupies unit
Answer: B
Reason: Matter is defined as anything that has mass and occupies space. Other options are incorrect because they do not include both mass and space.

(ii) The rate of doing work is:
A. Energy
B. Force
C. Power
D. Impulse
Answer: C
Reason: Power is defined as the rate of doing work. Energy is the ability to do work, force is a push or pull, and impulse involves momentum change.

(iii) In order to have low resistance, the wire should be:
A. Longer and thicker
B. Longer and thinner
C. Shorter and thicker
D. Shorter and thinner
Answer: C
Reason: Resistance decreases with increased thickness and decreases with reduced length. Thicker and shorter wires have the lowest resistance.

(iv) Which of the following is a derived unit?
A. Kilogram
B. Ampere
C. Kelvin
D. Newton
Answer: D
Reason: Newton is a derived unit for force, represented as \(kg \cdot m/s^2 \). Kilogram, ampere, and kelvin are base units.

(v) Force = mass × acceleration. This obeys:
A. Newton's second law of motion
B. Law of inertia
C. Newton's third law of motion
D. Momentum change
Answer: A

Reason: Newton's second law states that force is the product of mass and acceleration. The other options describe different laws.

(vi) A solid box weighing 120 N has a surface area of 0.5 m². The pressure which can be exerted on the box is:
A. 60 N/m²
B. 24 N/m²
C. 600 N/m²
D. 240 N/m²
Answer: C
Reason: Pressure is calculated as \(P = F / A = 120 / 0.5 = 600 \, N/m^2 \). Other options are incorrect calculations.

(vii) A Vernier caliper is used to measure:
A. Mass of a thin wire
B. Volume of a thin wire
C. Diameter of a thin wire
D. Length of a thin wire
Answer: C
Reason: A Vernier caliper is designed to measure small dimensions such as diameters and thicknesses.

(viii) In order to decrease the pressure in a bicycle tire, one normally:
A. Decreases the temperature of the tire
B. Increases the friction of the tire
C. Increases the density of the air in the tire
D. Decreases the number of air molecules in the tire
Answer: D
Reason: Pressure decreases when the number of air molecules decreases, reducing the collisions inside the tire.

(ix) Translucent is a medium which:
A. Allows some of the light to pass through it
B. Allows all the light to pass through it
C. Produces light by itself
D. Does not allow all light to pass through it
Answer: A
Reason: Translucent materials allow partial light to pass through, making objects behind them partially visible.

(x) A force of 50 N is used to lift a load of 100 N. What is the mechanical advantage?
A. 50
B. 5000
C. 2
D. 0.5
Answer: C
Reason: Mechanical advantage is calculated as \(MA = Load / Effort = 100 / 50 = 2 \). Other options are incorrect calculations.

2. Match the item in list A with a correct response in list B by writing its letters in the table below.

list a
(i) Apparent loss in weight
(ii) Earth magnetic field
(iii) Spring balance
(iv) 10 N/kg
(v) Apparent weight
(vi) North and south poles
(vii) Least count
(viii) The resistance of the fluid to flow
(ix) Parallax error
(x) Lever
list b
A. A rigid body when in use turns about a fixed point
B. Weight of an object measured in air
C. Heavy winds
D. Weight of an object measured in liquids
E. Upthrust
F. It gives useful information in the search for minerals
G. Acceleration due to gravity
H. Occurs when the observer takes measurements from the wrong position
I. It is used to measure the length of an object
J. Viscous force
K. The difference between the main scale division and vernier scale division
L. It is used to measure weight
M. Occurs when the observer takes measurements from the right position
N. Attracts each other

answers:

i	ii	iii	iv	v	vi	vii	viii	ix	x
E	F	L	G	B	N	K	J	H	A

3. Fill the correct answer in the blank spaces provided.

i. Simple pendulum moves to and fro.
ii. In liquid pressure forces act equally to all directions.
iii. The deviation from the true reading is called as parallax error.
iv. The rate of change of velocity is called acceleration.
v. In the first-class lever, the fulcrum is located between the effort and the load.
vi. Mercury has an inverted meniscus.
vii. Bandages and cotton wool are used to clean and cover wounds.
viii. Liquid and gas are made up of particles that are in random motion.
ix. The frictional force causes the machine parts to tear and wear.
x. The SI unit of turning effect of a force is Newton-meter (Nm).

4. a. i. State Archimedes' principle:
Archimedes' principle states that when a body is fully or partially submerged in a fluid, it experiences an upward buoyant force equal to the weight of the fluid displaced by the body.

ii. Why does a stone sink in water:
A stone sinks in water because its density is greater than the density of water, making its weight exceed the buoyant force acting on it.

b. The mass of an empty density bottle was 50 g. When filled with the volume of 20 cm^3 of petrol, its mass becomes 75 g. Calculate:

i. Density of petrol:
Density = Mass of petrol / Volume of petrol
Mass of petrol = 75 g - 50 g = 25 g
Density = 25 g / 20 cm^3 = 1.25 g/cm^3

ii. Relative density of petrol:
Relative density = Density of petrol / Density of water
Density of water = 1 g/cm^3
Relative density = 1.25 g/cm^3 / 1 g/cm^3 = 1.25

5. a. i. Differentiate between luminous and non-luminous objects:
Luminous objects emit their own light, for example, the Sun and a bulb. Non-luminous objects do not emit light but reflect it from other sources, for example, the Moon and a book.

ii. State the laws of reflection of light:
- The angle of incidence is equal to the angle of reflection.
- The incident ray, reflected ray, and the normal to the surface at the point of incidence all lie in the same plane.

iii. Write two characteristics of an image formed in a plane mirror:
- The image is upright and virtual.
- The image is laterally inverted.

b. Identify the name of the beam shown in the figures below:
i. Parallel beam
ii. Convergent beam

6. a. Define the following terms:

i. Joule:
Joule is the SI unit of work or energy, defined as the work done when a force of 1 Newton displaces an object by 1 meter in the direction of the force.

ii. Watt:
Watt is the SI unit of power, defined as the rate of doing work or transferring energy, equivalent to 1 Joule per second.

b. List two requirements for work to be done:
- There must be an applied force.
- The object must be displaced in the direction of the applied force.

c. A body of mass 8 kg is pulled by a force of 4 N along a smooth floor through a distance of 8 m for 4 seconds. Find:

i. The work done by a force:
Work done = Force × Distance
Work done = 4 N × 8 m = 32 Joules

ii. Power:
Power = Work done / Time
Power = 32 J / 4 s = 8 Watts

7. a. State Newton's first law of motion:
Newton's first law of motion states that an object at rest will remain at rest, and an object in motion will continue in uniform motion in a straight line unless acted upon by an external force.

b. With examples, distinguish between elastic and inelastic collision:

- Elastic collision: In an elastic collision, both momentum and kinetic energy are conserved. For example, the collision of billiard balls.
- Inelastic collision: In an inelastic collision, momentum is conserved, but kinetic energy is not conserved as it is converted into other forms of energy, such as heat or sound. For example, a car crash.

c. A trolley A of mass 3 kg is traveling at 12 m/s. It collides with a stationary trolley B of mass 4 kg. After the collision, the two continue traveling together at 6 m/s.

i. Calculate the momentum of trolley A before the collision:
Momentum = Mass × Velocity
Momentum of trolley A = 3 kg × 12 m/s = 36 kg·m/s

ii. Calculate the momentum of trolley A after the collision:
Since both trolleys travel together after the collision:
Combined mass = 3 kg + 4 kg = 7 kg
Velocity after collision = 6 m/s
Momentum = Mass × Velocity
Momentum after collision = 7 kg × 6 m/s = 42 kg·m/s

iii. Why is there a change in the momentum of trolley A?
There is a change in momentum because of the force exerted during the collision, which results in a transfer of momentum between trolley A and trolley B.
8. a. i. What is the meaning of First Aid kit?
A First Aid kit is a collection of supplies and equipment used to provide immediate medical treatment for injuries or illnesses before professional medical help is available.

ii. Complete the table below:

No.	**Item**	**Uses**
1	Antiseptic soap	Cleaning wounds to prevent infections
2	Liniment	Relieving muscle pain or stiffness
3	Scissors and razor blade	Cutting bandages or other medical needs
4	Petroleum jelly	Protecting and soothing dry or injured skin

b. By using a chart, name all steps involved in a scientific investigation:

a) Identify the problem or question.
b) Conduct background research.
c) Formulate a hypothesis.
d) Design and conduct an experiment.
e) Collect and analyze data.
f) Draw a conclusion.
g) Communicate the results.

9. a. i. What is the physical quantity that the instrument measures?
Temperature.
ii. What is the name of this device?
Clinical thermometer.
iii. Name the part labeled by letter M:
Bulb.
iv. Name the part labeled by letter P:
Capillary tube.
v. What is the reading in °C that shows the condition of the student?
37 °C.

b. i. Plot the graph of the potential difference (V) against current (I).
(Kindly use a graph paper to plot the points: V on the y-axis and I on the x-axis.)

ii. From the graph, determine the slope, s.
Slope (s) = (Change in Voltage) ÷ (Change in Current)
For example, using the data from 1.0 V and 3.5 V:
s = (3.5 - 1.0) ÷ (2.0 - 0.5) = 2.5 ÷ 1.5 = 1.67 Ω

iii. What is the physical significance of the slope, s?
The slope represents the resistance of the conductor as per Ohm's Law.

iv. Write the SI unit of the slope in 9 (b) ii above.
The SI unit of the slope is Ohms (Ω).

10. a. i. List two ways in which resistors can be connected.
- Series connection.
- Parallel connection.

ii. With two examples, give the meaning of conductor and insulator.
Conductor: A material that allows electricity to pass through it easily.
Examples: Copper, Aluminum.
Insulator: A material that resists the flow of electricity.
Examples: Rubber, Plastic.

b. i. Calculate the current flowing through the circuit.
Total Resistance (R) = $R_1 + R_2 + R_3 = 5\ \Omega + 4\ \Omega + 6\ \Omega = 15\ \Omega$
Using Ohm's Law:
Current (I) = Voltage ÷ Resistance
I = 30 V ÷ 15 Ω = 2 A
ii. Potential difference (p.d.) across 5 Ω, 4 Ω, and 6 Ω resistors.
Voltage across each resistor:
$V_1 = I \times R_1 = 2\ A \times 5\ \Omega = 10\ V$

$V_2 = I \times R_2 = 2\ A \times 4\ \Omega = 8\ V$
$V_3 = I \times R_3 = 2\ A \times 6\ \Omega = 12\ V$

11. a. Define inertia.
Inertia is the property of an object that resists any change in its state of motion or rest unless acted upon by an external force.

b. i. Why does a passenger sitting in a moving bus tend to fall forward when the bus suddenly stops?
Explanation: A passenger sitting in a moving bus has inertia of motion, meaning their body is in motion along with the bus. When the bus suddenly stops, the lower part of the body that is in contact with the bus comes to rest, but the upper part continues moving forward due to inertia, causing the passenger to fall forward.

ii. List two conditions for a body to be stable.
1. The center of gravity of the body should be as low as possible.
2. The base area of the body should be as wide as possible.
c. A train of mass 22,400 kg moving at the rate of 112 km/hr is brought to rest in 24 seconds by the action of the brakes. Calculate the braking force applied.
Solution:
First, convert the velocity to m/s:
112 km/hr = 112 × (1000/3600) = 31.11 m/s

Using Newton's second law of motion:
Force (F) = (Mass × Change in velocity) ÷ Time
Change in velocity = Final velocity - Initial velocity = 0 - 31.11 = -31.11 m/s
Mass = 22,400 kg, Time = 24 s

F = (22,400 × -31.11) ÷ 24
F = -697,264 ÷ 24
F = -29,052.67 N

The braking force applied is approximately 29,053 N (negative sign indicates it is a retarding force).