SMZ

ZANZIBAR EXAMINATONS COUNCIL

FORM THREE ENTRANCE EXAMINATION

042 **PHYSICS**

Time: 2:30 Hours **ANSWERS** **Thursday 30th November, 2018.**

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. Write the letter of the most correct answer in the table below:

i) The aim of Physics is to understand the
A. Man and his surroundings
B. Moon, sun, stars, and planets
C. Behavior of the universe
D. Matter and energy

Correct answer: D. Matter and energy
Explanation: Physics studies the fundamental principles governing matter and energy, unlike options A, B, and C, which focus on specific entities or surroundings.

ii) Which of the following is a derived unit?
A. Kilogram
B. Ampere
C. Kelvin
D. Newton

Correct answer: D. Newton
Explanation: Newton is derived from the fundamental units of mass (kg), length (m), and time (s) as $kg \cdot m/s^2$, while options A, B, and C are base units.

iii) The weight of a body in air is
A. Floating of a body
B. Apparent weight
C. Swinging of a body
D. Real weight of a body

Correct answer: D. Real weight of a body
Explanation: Weight in air is unaffected by buoyancy forces, representing the real weight as opposed to options A or B.

iv) A load of 100N is lifted by a force of 50N using a lever. What is the Mechanical advantage of the lever?
A. 150
B. 50
C. 2
D. ½

Correct answer: C. 2
Explanation: Mechanical advantage = Load/Force = 100N/50N = 2. Options A, B, and D are incorrect calculations.

v) An image formed in a plane mirror is always

A. Virtual
B. At infinity
C. In front of the mirror
D. Real

Correct answer: A. Virtual
Explanation: Plane mirrors always form virtual images, unlike real images formed by concave mirrors or lenses.

vi) Potential energy depends on
A. Volume
B. Height
C. Area
D. Time

Correct answer: B. Height
Explanation: Potential energy is given by mgh, where h is height. Options A, C, and D do not directly influence potential energy.

vii) Which phenomenon is taking place when kerosene rises up a wick?
A. Surface tension
B. Elasticity
C. Capillarity
D. Meniscus

Correct answer: C. Capillarity
Explanation: The rise of kerosene through the wick is due to capillary action, unlike surface tension or elasticity.

viii) Magnets are often fitted on the doors of freezers so as to
A. Keep away heat
B. Keep the inside environment warm
C. Keep away cold
D. Keep iron away

Correct answer: A. Keep away heat
Explanation: Magnets ensure an airtight seal, preventing heat entry, unlike other options which misinterpret the purpose.

ix) The reason for the stone and piece of iron in the air to fall down at the same time
A. They have the same weight
B. There is usually no resistance in the air
C. Acceleration due to gravity is the same

D. None of the above

Correct answer: C. Acceleration due to gravity is the same
Explanation: Objects fall with the same acceleration (gravity) irrespective of weight in a vacuum.

x) Which of these resources of energy is non-renewable?
A. Wave energy
B. Biofuel
C. Radiant energy
D. Fossil fuel

Correct answer: D. Fossil fuel
Explanation: Fossil fuels take millions of years to form and cannot be replenished, unlike renewable resources listed in options A, B, and C.

2. Match the item in LIST A with responses in LIST B by writing the letter of the correct response in the table below:

LIST A
i) Time
ii) Pascal
iii) Temperature
iv) Force × velocity
v) Mechanical energy
vi) Electromotive force
vii) Hydrometer
viii) Stores charge
ix) Neutral point
x) Electrophorus

LIST B
A. Magnetic field is zero
B. Degree of hotness or coldness
C. Kinetic energy
D. Derived quantity
E. Capacitor
F. Momentum
G. Fundamental quantity
H. N/m^2
I. Used to measure relative density of liquid
J. Used as a matchbox
K. Weight
L. The driving force of electric cell

M. Cylinder
N. N/kg

Answers:

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

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

i) Weight has the same unit as _____.
Answer: Newton (N)

ii) In the velocity time graph, the slope represents _____.
Answer: Acceleration

iii) The type of force which causes the size and volume of an object to decrease is known as _____.
Answer: Compressive force

iv) Human skin is an _____ that are sensitive to temperature.
Answer: Organ

v) The angle between magnetic north and geographical north is _____.
Answer: Magnetic declination

vi) A block of copper, size 5 cm × 5 cm × 10 cm, has a capacity of _____.
Answer: 250 cm^3

vii) Power is the rate at which _____ is being done.
Answer: Work

viii) The rate of change of momentum is _____.
Answer: Force

ix) The beam balance used to measure _____ of an object.
Answer: Mass

x) The partial shadow is called _____.
Answer: Penumbra

4. a) Define the following terms:

i) Elasticity
Elasticity is the property of a material to return to its original shape and size after being deformed when the applied force is removed.

ii) Osmosis
Osmosis is the movement of water molecules from a region of low solute concentration to a region of high solute concentration through a selectively permeable membrane.

b) Why are dams constructed thicker at the bottom than at the top?
Dams are constructed thicker at the bottom because the pressure exerted by the water increases with depth. The thicker bottom provides the strength needed to resist the higher pressure.

c) The mass of a cuboid is 60 kg. If it measures 50 cm by 30 cm by 20 cm, what is the maximum pressure that it can exert?

Solution:
Pressure = Force / Area
Force = Mass × Acceleration due to gravity = 60 × 9.8 = 588 N
Area = Length × Width = 50 cm × 30 cm = 0.5 m × 0.3 m = 0.15 m^2
Pressure = 588 N / 0.15 m^2 = 3920 Pa
Answer: 3920 Pa

5. a) Define the term power and state its S.I. units.
Power is the rate at which work is done or energy is transferred. The S.I. unit of power is the Watt (W), where 1 Watt = 1 Joule/second.

b) Mention three areas where power is applied.
- Operating electrical devices like motors and generators.
- Running mechanical systems like vehicles.
- Generating and transmitting electricity in power grids.

c) A truck for transporting sand is filled to its capacity. If the digger had to move through a height of 2 metres and the total load was 5000 kg, calculate:

i) The work done in loading the sand.
Work done (W) = Force × Distance
Force = Mass × Acceleration due to gravity = 5000 kg × 9.8 m/s^2 = 49,000 N
Distance = 2 m
W = 49,000 N × 2 m = 98,000 Joules
Answer: 98,000 Joules

ii) The power developed in 5 seconds.
Power (P) = Work done / Time
P = 98,000 J / 5 s = 19,600 Watts

Answer: 19,600 Watts

6. a) State Newton's first law of motion.
Newton's first law of motion states that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external force. This law is also known as the law of inertia.

b) Differentiate between inertia of motion and inertia of direction.

Inertia of Motion: The tendency of a body to maintain its state of uniform motion in a straight line unless acted upon by an external force.
Inertia of Direction: The tendency of a body to maintain its direction of motion unless an external force changes it.

c) Briefly explain the following situations:

i) Mangoes fall down when the mango tree is shaken.
Explanation: When the tree is shaken, the trunk moves, but due to inertia, the mangoes tend to stay in their original position and fall due to gravity.

ii) Dust particles are removed from a carpet by beating with a stick.
Explanation: Beating the carpet applies a force to the carpet, causing it to move. The dust particles, due to inertia, remain stationary and separate from the carpet.

iii) When a passenger jumps into a moving train, he falls backward.
Explanation: The train is in motion, and when the passenger jumps in, his body tries to maintain its original state of rest relative to the ground. The motion of the train causes him to fall backward.

7. a) Define the following terms:

i) Thermometer
A device used to measure temperature.

ii) Constriction
The narrowing of a passage or channel, often used in the context of fluid dynamics or biological systems.

b) Name three types of thermometers.
- Mercury thermometer
- Digital thermometer
- Alcohol thermometer

c) State three reasons why mercury is preferred for use as a thermometer liquid.

- Mercury expands uniformly with temperature changes.
- It does not stick to the walls of the thermometer.
- Mercury remains in liquid form over a wide temperature range.

8. a) Define the following terms:

i) Efficiency: The ratio of the useful output work to the total input work, often expressed as a percentage. It indicates how effectively a machine or system converts energy into useful work.

ii) Fulcrum: The fixed point around which a lever pivots or rotates. It is the support point for the lever.

b) List down three most common types of simple machines:

- Lever
- Pulley
- Inclined plane

c) A handle of the screw jack is 40 cm long and the pitch of the screw is 0.5 cm. What force must be applied to the end of the handle when lifting a load of 2400 N if the efficiency of the jack is 40%.

Solution:
The mechanical advantage (MA) of the screw jack is given by:

MA = Circumference of the handle / Pitch of the screw

Circumference = $2 \times \pi \times$ radius
Radius = 40 cm = 0.4 m
Circumference = $2 \times 3.1416 \times 0.4 = 2.513$ m

MA = 2.513 / 0.005 = 502.6

- Considering efficiency:

Efficiency = (Useful work output / Work input) × 100
Efficiency = (MA / VR) × 100
VR (Velocity Ratio) = MA / Efficiency
VR = 502.6 / 0.4 = 1256.5

- The effort (E) is calculated using the formula:

Effort = Load / MA
E = 2400 / 502.6 = 4.78 N

The force required to lift the load is approximately 4.78 N.

9. a) In an experiment to determine the density of an irregular object, the following results were obtained:

i) Complete the table:

Mass (g)	Volume (cm^3)	Density (g/cm^3)
100	100	1.0
150	150	1.0
200	200	1.0
250	250	1.0
300	300	1.0

ii) Plot a graph of mass against volume (on the graph paper).
[This requires graph plotting, which cannot be physically drawn here, but the points (Mass, Volume) are (100, 100), (150, 150), (200, 200), (250, 250), (300, 300). Plot these points and draw a straight line passing through them.]

iii) State the nature of the graph:
The graph is a straight line passing through the origin, indicating a linear relationship between mass and volume.

iv) Find the slope of the graph:
Slope = Change in Mass / Change in Volume
= (300 - 100) / (300 - 100) = 1 g/cm^3.

v) What does the slope of the graph indicate?
The slope indicates the density of the irregular object, which is 1 g/cm^3.

b) Complete the table:

SN	Name of Device	Sketch	Application / Uses
i)	Micrometer Screw Gauge	[Sketch]	
ii)		[Sketch]	To measure body temperature.
iii)	A ruler	[Sketch]	
iv)	Spring Balance	[Sketch]	
v)		[Sketch]	

SN	Name of device	Sketch	Application / Uses
i)	Micrometer screw gauge		**To measure small thicknesses or diameters.**
ii)	**Thermometer**		To measure body temperature
iii)	A ruler		**To measure lengths or distances.**
iv)	Spring balance		**To measure force or weight.**
v)	**Weights**		**Used for calibration and measuring mass.**

10. a) Explain briefly the relationship between:

i) Physics and chemistry:
Physics explains the behavior of matter at the atomic and molecular levels, which forms the foundation for chemical reactions. Examples include thermodynamics and quantum mechanics that are applied in chemistry to understand reaction mechanisms.

ii) Physics and biology:
Physics helps explain biological processes such as blood flow dynamics, respiration, and muscle movements. Biophysical tools like X-rays and MRIs are applications of physics in biology.

iii) Physics and mathematics:
Physics uses mathematical tools and concepts, such as calculus, algebra, and statistics, to describe and predict physical phenomena. Mathematical models and equations are essential in formulating physical laws.

b) i) Give two examples of items in chemistry that use the application of physics:
- Spectrophotometer (measures absorption of light in chemical solutions).
- Calorimeter (measures heat changes in chemical reactions).

ii) Give two concepts in mathematics that are relevant to the study of physics:
- Calculus (used in motion analysis, e.g., velocity and acceleration).
- Vectors (used in understanding forces and fields).

11. a) i) What is meant by sustainable energy sources:
Sustainable energy sources are those that can be replenished naturally and do not deplete over time. They have minimal impact on the environment and contribute to reducing greenhouse gases.

ii) List three sources of sustainable energy:
- Solar energy
- Wind energy
- Geothermal energy

b) i) Two advantages of wind energy:
- It is renewable and inexhaustible.
- It produces no greenhouse gas emissions during operation.

ii) Two disadvantages of wind energy:
- Wind turbines can be noisy and affect local wildlife.
- Energy production depends on wind availability, which can be inconsistent.

c) Mention two areas where geothermal energy can be harnessed:
- Rift Valley regions with volcanic activity.
- Hot springs and geysers found in geothermal fields.