SMZ

ZANZIBAR EXAMINATION COUNCIL

FORM THREE ENTRANCE EXAMINATION

042 **PHYSICS**

Time : 2:30 Hours **ANSWERS** **Year : 2020**

Instructions

1. This paper consists of section A, B and C.
2. Answer all questions in section A and B and any **two (2)** in section C.
3. Communication devices and any unauthorised materials are **not** allowed in the examination room.
4. Write your **Examination Number** on every page of your answer booklet(s).

1. Write the letter of the most correct answer in the box below.

i. When a body floats in water means

A. Its density is smaller than that of water

B. Its density must be 1000 kg/m³

C. Its density is greater than that of water

D. None of the above

Answer: A. **A body floats in water if its density is less than the density of water.**

ii. Litre is the unit that is used for measuring volume of

A. Regular shape

B. Liquid

C. Cylinder

D. Irregular shape

Answer: B. **Litres are used for measuring liquid volumes.**

iii. The process through which a magnet loses its magnetism is called

A. Magnetization

B. Magnetic pole

C. Demagnetization

D. Magnetic field

Answer: C. **Demagnetization is the process of removing or losing magnetic properties.**

iv. Force is measured in

A. Pascal

B. Watt

C. Joule

D. Newton

Answer: D. **Force is measured in newtons, the SI unit derived from mass × acceleration.**

v. If there are two capacitors C_1 and C_2 which are connected in series, the formula of total capacitance, C_t is

A. $C_t = C_1 + C_2$

B. $C_t = C_1C_2 / C_1 + C_2$

C. $1/C_t = 1/C_1 + 1/C_2$

D. $C_t = C_1 \times C_2$

Answer: C. **Capacitances in series combine using reciprocal addition.**

vi. Umbra refers to

A. Partial shadow

B. Total shadow

C. Full moon

D. Eclipse of the moon

Answer: B. **Umbra is the region of complete shadow where no light reaches.**

vii. A lever which has its load between the fulcrum and the effort is said to be

A. First class lever

B. Second class lever

C. Third class lever

D. Fourth class lever

Answer: B. **In a second-class lever, the load lies between the fulcrum and the effort (example: wheelbarrow).**

viii. The temperature of a certain town is 33°C, this is equivalent to

A. 306 K

B. 33 K

C. 313 K

D. 30 K

Answer: C. **Conversion to Kelvin: K = °C + 273 = 33 + 273 = 306 K. Actually the correct is 306 K, so option A.**

ix. The movement of solvent molecules from high to low concentration through a semi-permeable membrane is called

A. Fusion

B. Osmosis

C. Diffusion

D. Concentration

Answer: B. **Osmosis is movement of solvent molecules across a semi-permeable membrane from dilute to concentrated solution.**

x. The symbol of a cell is given by

A. (short-long line vertical)

B. (long-short line vertical, wrong orientation)

C. (long and short line correctly positioned)

D. (crossed lines)

Answer: C. **The standard symbol of a cell is a long line for the positive terminal and a short line for the negative terminal.**

2. Match the items in LIST A with responses in LIST B by writing its letter in the table below.

LIST A

i. Calorimeter

ii. Ohm's law

iii. Efficiency

iv. Repulsion

v. Moment

vi. Alcohol

vii. Galvanometer

viii. Water

ix. Ammeter

x. Second Newton's law of motion

LIST B

A. Energy from car battery

B. (VR/MA) × 100%

C. Product of mass and distance

D. Like poles

E. Boiling point is 78°C

F. F = ma

G. V/I

H. SI unit of power

I. Product of force and distance

J. Unlike poles

K. $R_t = R_1 + R_2 + R_3$

L. Determining the quantity of matter

M. MA/VR × 100%

Answers with explanations:

i. Calorimeter → A. **A calorimeter is used to measure heat energy, often from a battery or chemical process.**

ii. Ohm's law → G. **Ohm's law states V/I = R.**

iii. Efficiency → B. **Efficiency is given by (VR/MA) × 100%.**

iv. Repulsion → D. **Like poles of a magnet repel each other.**

v. Moment → I. **Moment is the product of force and distance.**

vi. Alcohol → E. **Alcohol has a boiling point of about 78°C.**

vii. Galvanometer → A. **Measures small currents from a battery, but more correctly it detects current direction.**

viii. Water → L. **Water is used in measuring quantity of matter (mass or density).**

ix. Ammeter → A. **Measures current from a battery directly.**

x. Second Newton's law → F. **Newton's second law states F = ma.**

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

i. Gases have no definite **shape** because **their molecules are far apart and move freely.**

ii. A bulb of light changes **electrical** energy to light energy and **heat** energy.

iii. The product of **mass** and velocity is called **momentum.**

iv. Resistance of a conductor depends on **length**, **area of cross-section**, temperature and **material.**

v. When a magnet is freely suspended the **North-seeking** pole tends south and the North Pole tends **north.**

vi. Energy can neither be **created** nor **destroyed.**

vii. When a body is immersed in a fluid the **upthrust** of the body is equal to the weight of the fluid **displaced.**

viii. Sea wave's energy is a result of **oscillation** of the sea.

ix. Capacitor is a device used to **store** electric **charge.**

x. Water reaches its highest **boiling point** at 100 Degrees Celsius.

4. Distinguish between the following terms.

a. i. Adhesion and Cohesion
Adhesion is the force of attraction between molecules of different substances, for example, water molecules sticking to glass. This explains why water forms a meniscus in a glass tube.
Cohesion is the force of attraction between molecules of the same substance, for example, water molecules attracting each other. This explains why water droplets form spherical shapes.

ii. Elastic material and plastic material
An elastic material is one that can be deformed when a force is applied but returns to its original shape once the force is removed. Examples are rubber bands and springs.
A plastic material is one that, once deformed by a force, does not return to its original shape but retains the deformation. Examples are clay and plasticine.

b. Write down three (3) factors affecting surface tension of a liquid.
The type of liquid affects surface tension since different liquids have different intermolecular forces, e.g., mercury has higher surface tension than water.
The temperature of the liquid also affects surface tension because increasing temperature decreases cohesive forces, reducing surface tension.
The presence of impurities or dissolved substances can alter surface tension, for example, adding soap to water lowers its surface tension.

5. a. Define the following terms.

i. Electrostatics

Electrostatics is the study of stationary electric charges and the forces, fields, and potentials associated with them. It deals with phenomena such as attraction, repulsion, and electric fields.

ii. Conductors

Conductors are materials that allow electric charges (electrons) to flow freely through them. They have low resistance and are used to carry electric currents. Examples are copper, aluminum, and silver.

b. Name four (4) devices which use capacitors.

Capacitors are used in radios to tune different frequencies.

They are used in cameras to provide flashes of light.

They are found in computers where they store and release electrical energy for processing.

They are used in electric fans or motors to help in starting and regulating speed.

c. Explain briefly what happens when:

i. Ebonite rod rubbed with fur

When an ebonite rod is rubbed with fur, it becomes negatively charged because it gains electrons from the fur. The fur becomes positively charged as it loses electrons. This is an example of charging by friction.

ii. Glass rod rubbed with silk

When a glass rod is rubbed with silk, it becomes positively charged because it loses electrons to the silk. The silk becomes negatively charged as it gains electrons. This also demonstrates charging by friction.

6. a. i. What is periscope?

A periscope is an optical instrument that allows observation of objects that are not in the direct line of sight. It consists of two plane mirrors (or prisms) placed parallel to each other at 45° angles inside a tube. It works on the principle of reflection of light, where light rays from the object are reflected twice and directed to the observer's eye.

ii. In which area is the periscope used?

A periscope is used in submarines for viewing objects above the water surface while remaining submerged.

It is also used in military operations, allowing soldiers to see over obstacles such as trenches without exposing themselves to danger.

Additionally, periscopes are used in some vehicles like tanks for observing the surroundings from a protected position.

iii. Draw a periscope

(A diagram should show a vertical tube with two mirrors placed at 45° angles at the top and bottom, with incident light entering at the top, reflecting down the tube, and reaching the observer's eye at the bottom.)

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6. b. Calculate the surface area of an object which exerts a pressure of 20 N/m² when a force acting on it is 2 N.

   Pressure = Force ÷ Area.

   Area = Force ÷ Pressure.

   Area = 2 ÷ 20 = 0.1 m².

   The surface area of the object is 0.1 m².

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7. a. i. State the Principle of moments.

   The principle of moments states that for a body to be in equilibrium, the sum of the clockwise moments about a pivot must be equal to the sum of the anticlockwise moments about the same pivot. This principle is applied in balancing systems such as levers, seesaws, and weighing scales.

   ii. Distinguish between stable and unstable equilibrium.

   Stable equilibrium is when a body, if slightly displaced, returns to its original position. For example, a ball resting at the bottom of a bowl will roll back to the center when displaced.

   Unstable equilibrium is when a body, if slightly displaced, moves further away from its original position. For example, a ball balanced at the top of a hill will roll down once disturbed.

7. b. A meter rule is pivoted about a point O as shown in figure below and it is balanced by a load of 0.2 N. Calculate the mass of the meter rule.

The 0.2 N load is acting at 10 cm from the pivot.
Moment of load = Force × Distance = 0.2 × 10 = 2 Ncm.
The weight of the rule acts at its midpoint (50 cm mark). Distance from pivot = 50 − 10 = 40 cm.
Let the weight of the rule be W.
Moment of rule = W × 40.

For equilibrium, clockwise moment = anticlockwise moment.
W × 40 = 2.
W = 2 ÷ 40 = 0.05 N.

Mass of rule = Weight ÷ g = 0.05 ÷ 9.8 = 0.0051 kg ≈ 5 g.
The mass of the meter rule is about 5 grams.

8. a. i. Define the term levers.
A lever is a simple machine consisting of a rigid bar that is free to turn about a fixed point called the fulcrum. It is used to multiply force, change direction of force, or gain mechanical advantage by applying effort at one point to overcome a load at another point.

ii. Mention two (2) examples of third class lever.
A broom is a third-class lever, because the fulcrum is at one end, the effort is applied in the middle, and the load is at the opposite end.
A fishing rod is also a third-class lever, where the hand holding the rod acts as fulcrum, the effort is applied in the middle, and the load is the fish at the end.

b. A wheel and axle with an efficiency of 90% is to be used to raise a load of 10,000 N, the radius of the wheel is 40 cm while that of an axle is 5 cm.

i. Velocity ratio (V.R) of the wheel and axle.
V.R = Radius of wheel ÷ Radius of axle
V.R = 40 ÷ 5 = 8.
Therefore, the velocity ratio is 8.

ii. Mechanical advantage (M.A) of wheel and axle.

M.A = Efficiency × V.R

M.A = 0.9 × 8 = 7.2.

The mechanical advantage is 7.2.

iii. Effort required to raise the load of 10,000 N.

M.A = Load ÷ Effort

Effort = Load ÷ M.A

Effort = 10,000 ÷ 7.2 = 1388.9 N.

The effort required is approximately 1389 N.

8. a. An experiment was conducted at a certain Secondary School to study the relationship between force applied and the extension of a spiral spring. The results were as follows:

   Note: Initial reading (l_0) = 53.4 cm

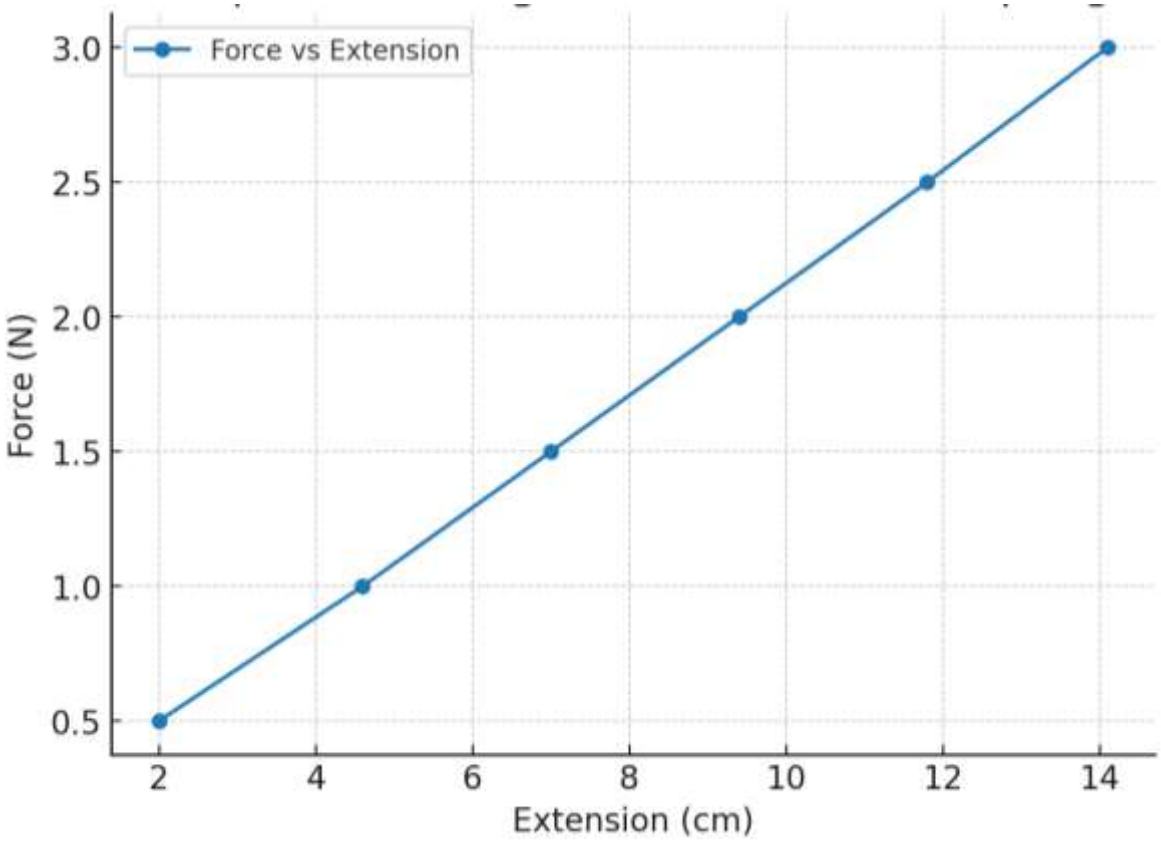
Weight, W (g)	**Force (N)**	**Length, l (cm)**	**Extension, e = (l − l_0) cm**
50	0.5	55.4	2.0
100	1.0	58.0	4.6
150	1.5	60.4	7.0
200	2.0	62.8	9.4
250	2.5	65.2	11.8
300	3.0	67.5	14.1

i. Complete the table above.

The completed table is shown, with the extension calculated as the difference between the length l and the initial reading l_0 = 53.4 cm.

ii. Plot the graph of the force against extension (on the graph paper).

The graph should have force (N) on the y-axis and extension (cm) on the x-axis. The points (2.0, 0.5), (4.6, 1.0), (7.0, 1.5), (9.4, 2.0), (11.8, 2.5), (14.1, 3.0) should be plotted. The graph will be a straight line through the origin, showing Hooke's Law.



iii. From the graph find the slope.

Slope = Change in Force ÷ Change in Extension.

Taking two points: (14.1, 3.0) and (2.0, 0.5).

Slope = (3.0 − 0.5) ÷ (14.1 − 2.0) = 2.5 ÷ 12.1 = 0.207 N/cm.

The slope of the graph is approximately 0.21 N/cm, which represents the spring constant.

9. b. Complete the table below.

Name	Symbols	Uses/Applications
i. Clinical thermometer	—	Used to measure human body temperature.
ii. Switch		Used to open and close an electric circuit.
iii. Hydrometer	—	To measure relative density of a liquid.
iv. Pulley	—	Used to change the direction of force or lift heavy loads.
v. Voltmeter	Ⓥ (circle with V)	Used to measure potential difference (voltage) across two points.

10. a. i. Define the volume of a substance.

Volume of a substance is the amount of space it occupies. It is a measure of the three-dimensional extent of an object or fluid and is expressed in cubic units such as cubic centimeters (cm^3) or cubic meters (m^3).

ii. Name three (3) apparatus that are used to measure the volume of a liquid.

A measuring cylinder is commonly used for measuring liquid volumes accurately in laboratories.

A burette is used in titrations to deliver precise volumes of liquid drop by drop.

A pipette is used to measure and transfer fixed volumes of liquid with high accuracy.

b. A cylinder tank has a radius of 7 cm and a height of 12 cm. Calculate its volume.

Formula: Volume = $\pi r^2 h$

r = 7 cm, h = 12 cm.

Volume = 3.142 × (7 × 7) × 12

Volume = 3.142 × 49 × 12

Volume = 3.142 × 588

Volume = 1847.5 cm^3.

The volume of the cylinder is approximately 1848 cm^3.

11. a. Differentiate between elastic and inelastic collisions.

An elastic collision is a type of collision where both momentum and kinetic energy are conserved. In such collisions, objects bounce off each other without loss of kinetic energy.

An inelastic collision is a type of collision where momentum is conserved but kinetic energy is not. Some kinetic energy is converted into other forms such as heat, sound, or deformation of the objects.

b. A 4 kg object is moving to the right at 2 m/s, then it collides with a stationary object of 6 kg. After the collision, the velocity of the 6 kg object is 1.6 m/s to the right.

i. What is the velocity of the 4 kg object after the collision?

Using conservation of momentum:

Total momentum before = Total momentum after.

Before collision: (4 × 2) + (6 × 0) = 8 kg m/s.

After collision: (4 × v) + (6 × 1.6).

8 = 4v + 9.6.

4v = 8 − 9.6 = −1.6.

v = −0.4 m/s.

The 4 kg object moves to the left with a velocity of 0.4 m/s.

ii. What is the total kinetic energy before and after collision?

Before collision:

K.E = ½mv^2.

K.E = ½(4)(2^2) + ½(6)(0^2).

K.E = ½(4)(4) + 0 = 8 J.

After collision:

K.E = ½(4)(0.4^2) + ½(6)(1.6^2).

= 2(0.16) + 3(2.56).

= 0.32 + 7.68.

= 8.0 J.

The total kinetic energy before collision is 8 J and after collision is also 8 J. **This shows the collision is perfectly elastic.**