THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

FORM TWO SECONDARY EDUCATION EXAMINATION

0031 **PHYSICS**

Time : 3:30 Hours **ANSWERS** **Year : 2014**

Instructions

1. This paper consists of section A, B and C.
2. Answer all questions.
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).

(i) The study of matter in relation to energy is called

A Chemistry

B Physicists

C Biology

D Physics

Answer: D. **Physics is the branch that studies matter, energy, and their interactions.**

(ii) The force which causes wear and tear between machine parts is known as

A friction

B torsional

C repulsive

D magnetic

Answer: A. **Friction is the contact force that resists relative motion of surfaces, producing wear.**

(iii) As one goes far away from the Earth, the density of air

A becomes bigger

B becomes less

C remains constant

D increases

Answer: B. **Air becomes thinner with altitude, so its density decreases.**

(iv) A ferry boat floats in seawater because its density is

A greater than that of water

B less than that of water

C the same as its weight

D greater than its weight

Answer: B. **An object floats when its average density is less than the fluid's density.**

(v) Study Figure 1. How far from the pivot must the 150 g mass be placed for the system to be in equilibrium?

A 16.7 cm

B 17.6 cm

C 36.6 cm

D 26.7 cm

Answer: D. **Moments balance: 50 g × 80 cm = 150 g × b, so b = (50×80)/150 = 26.7 cm.**

(vi) A patient who is to get an injection when a nurse applied a small force to push a needle feels much pain in his skin due to

A very high pressure

B very low pressure

C weight pressure

D applied force

Answer: A. **A small force on a very small area produces a large pressure, causing pain.**

(vii) The suspended magnetic needle always comes to rest with its axis in a vertical plane called

A geographic meridian

B magnetic meridian

C geographic declination

D magnetic declination

Answer: B. **A freely suspended needle aligns in the plane of Earth's magnetic field, the magnetic meridian.**

(viii) As the angle between two plane mirrors increases, the number of images formed

A decreases

B increases

C remains constant

D goes to infinite

Answer: A. **From $n = 360/\theta - 1$, increasing θ reduces n.**

(ix) Which of the following materials does not allow light to pass through

A glass

B tinted glass

C clear plastics

D human bodies

Answer: D. **The human body is opaque, so it blocks light.**

(x) To view objects that are out of direct vision we can use a

A telescope

B microscope

C periscope

D slide projector

Answer: C. **A periscope uses mirrors to see around obstacles or above/below direct sight.**

(xi) The process by which water soaks through the cells of rice and beans is called

A capillarity

B cohesion

C diffusion

D osmosis

Answer: D. **Osmosis is movement of water through a semipermeable membrane into cells.**

(xii) Which of the following is a property of mercury as a thermometric liquid?

A Boils at 78°C

B Boils at 360°C

C wets glass

D Expands rapidly

Answer: B. **Mercury's boiling point is about 357°C, approximated as 360°C in options.**

(xiii) The area under a velocity-time graph represents

A distance

B acceleration

C reaction

D deceleration

Answer: A. **Area under v–t gives displacement or distance traveled.**

(xiv) If the pitch of a micrometer screw gauge is 0.5 mm, then its thimble has

A 10 equal divisions

B 100 equal divisions

C 50 equal divisions

D 500 equal divisions

Answer: C. **Least count = pitch/number of divisions; 0.01 mm = 0.5 mm / N, so N = 50.**

(xv) Which of the following is a magnetic material?

A Copper

B Cobalt

C Zinc

D Brass

Answer: B. **Cobalt is ferromagnetic, attracted strongly by magnets.**

(xvi) An electrostatic machine which produces an unlimited supply of sparks by induction is called

A a gold leaf electroscope

B an electrophorus

C a generator

D a speedometer

Answer: B. **An electrophorus uses induction to provide repeated charges and sparks.**

(xvii) The quantity of electric current caused by excess electrons is called

A coulomb

B electric charge

C electric current

D electrification

Answer: B. **The amount of excess electrons is electric charge, measured in coulombs.**

(xviii) Which of the following is not a sustainable source of energy?

A Sun

B Generator

C Wind

D Ocean waves

Answer: B. **A generator uses fuel, which is consumable and not sustainable.**

(xix) A temperature of 68°C is equivalent to

A 20°F

B 45°F

C 154.4°F

D 90.4°F

Answer: C. **$F = (9/5)C + 32 = 1.8 \times 68 + 32 = 154.4°F$.**

(xx) "Action and reaction are equal in magnitude but opposite in direction." This statement refers to

A the law of inertia

B Newton's second law of motion

C the principle of moments

D Newton's third law of motion

Answer: D. **This is Newton's third law of motion.**

2. Match each item in List A with a correct response in List B by writing its letter below the number of the corresponding item in the table provided.

LIST A

(i) Measures how much the position has changed.

(ii) Measures the net change in position.

(iii) Rate of change of distance.

(iv) Rate of change of displacement.

(v) The constant rate of change of displacement.

(vi) Rate of change of velocity.

(vii) Motion under the effects of gravity.

(viii) Measures the rate at which position changes.

LIST B

A. Gravitational acceleration.

B. Average speed.

C. Acceleration.

D. Uniform acceleration.

E. Free-fall motion.

F. Distance.

G. Speed.

H. Speed in metres.

I. Velocity.

J. Uniform velocity.

K. Displacement.

Answer with explanations:

(i) K. Displacement. **It measures the overall change in position from the starting point to the ending point.**

(ii) F. Distance. **It measures the total path length covered regardless of direction.**

(iii) B. Average speed. **It is the total distance covered divided by the total time taken.**

(iv) I. Velocity. **It is the rate of change of displacement in a particular direction.**

(v) J. Uniform velocity. **It refers to displacement changing at a constant rate with time.**

(vi) C. Acceleration. **It is the rate of change of velocity with respect to time.**

(vii) E. Free-fall motion. **It is motion influenced only by gravity, with no other forces acting.**

(viii) G. Speed. **It is how fast the position of a body changes per unit time.**

3. Complete each of the following statements by writing the correct answer in the space provided.

(i) The product of mass and velocity of a body is called **momentum.**

Momentum expresses the quantity of motion a body has, and it depends on both mass and velocity.

(ii) Claw hammers and pairs of scissors are in which class of levers? **First class levers.**

In this class, the fulcrum lies between the load and the effort, as in scissors and hammers.

(iii) Weight has the same SI unit as **force (Newton).**

Weight is the force of gravity acting on mass, measured in Newtons (N).

(iv) An instrument used to measure pressure of a gas is known as **a manometer.**

It is a device specifically designed to measure gas pressure in a closed system.

(v) The tendency of a liquid to rise in narrow tubes is called **capillarity.**

This is caused by adhesive and cohesive forces between the liquid and the tube walls.

4. (a) Define the following terms as applied in measurements and give two examples:

(i) Fundamental quantities

These are physical quantities that cannot be derived from any other quantities. They are independent and form the basis of measurement. Examples include length and mass.

(ii) Derived quantities

These are physical quantities obtained by combining two or more fundamental quantities using mathematical relationships. Examples include velocity and density.

(b) Figure 2 shows a graduated cylinder containing water before and after a stone is immersed.

If the mass of the stone is 50 g, calculate:

(i) Volume of the stone.

Initial volume = 200 cm³, Final volume = 300 cm³, Volume displaced = 300 − 200 = 100 cm³. Hence the stone's volume is 100 cm³.

(ii) Density of the stone.

Density = Mass ÷ Volume = 50 g ÷ 100 cm³ = 0.5 g/cm³.

5. (a) (i) List two characteristics of images formed by plane mirrors.

They are virtual, meaning they cannot be formed on a screen.

They are of the same size as the object and laterally inverted.

(ii) Give a reason why the sky appears blue during a clear sunny day.

The blue color of the sky is due to scattering of sunlight by air molecules, where shorter wavelengths like blue are scattered more than longer ones.

(b) Draw the diagram of each of the following:

(i) Parallel rays of light.

Parallel rays travel in straight lines, equally spaced, and never meet.

(ii) Divergent rays of light.

Divergent rays spread out from a single point or source.

(iii) Convergent rays of light.

Convergent rays move towards each other and meet at a single point called the focus.

6. (a) Define the following terms as used in Physics and give their SI units:

(i) Work

Work is the product of force applied on a body and the displacement of the body in the direction of the force. It is done when a force moves an object through a distance. The SI unit of work is the joule (J), where 1 joule is the work done when a force of 1 newton moves a body through 1 meter.

(ii) Energy

Energy is the capacity of a body or system to do work. It exists in various forms such as kinetic energy,

potential energy, chemical energy, and electrical energy. The SI unit of energy is also the joule (J) since energy is essentially the ability to perform work.

(b) A man lifts a load of 20 kg through a height of 4 m in 10 seconds. Calculate the:

(i) Work done.
Work = Force × Distance.
Force = Mass × g = 20 × 9.8 = 196 N.
Distance = 4 m.
Work done = 196 × 4 = 784 J.
The work done by the man is 784 joules.

(ii) Power developed by the man.
Power = Work ÷ Time = 784 ÷ 10 = 78.4 W.
The power developed by the man is 78.4 watts.

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 equal the sum of the anticlockwise moments about the same pivot. This principle is important in balancing systems like levers and seesaws.

(ii) A uniform half metre rule is freely pivoted at the 20 cm mark and it balances horizontally when a body of mass 30 g is hung at 5 cm mark from one end. Calculate the mass of the rule.
The pivot is at 20 cm. The 30 g mass is at 5 cm, so its distance from pivot = 20 − 5 = 15 cm.
Moment of 30 g mass = 30 × 15 = 450 g cm.
Let the mass of the rule be M, acting at its midpoint (25 cm from one end). The distance from pivot = 25 − 20 = 5 cm.
Moment of rule's weight = M × 5.
Equating moments: 30 × 15 = M × 5.
450 = 5M.
M = 90 g.
The mass of the rule is 90 g.

(b) (i) What is meant by equilibrium?
Equilibrium is the state of a body when all the forces and moments acting on it balance out so that it either

remains at rest or continues to move with uniform velocity. In this state, there is no resultant force or turning effect acting on the body.

(ii) List three applications of equilibrium in daily life.
One application is in weighing balances, where the equal moments of weights on either side ensure correct measurements.
Another example is in construction of bridges, where forces must balance to prevent collapse.
A third application is in furniture such as chairs and ladders, which are designed to maintain balance and stability by ensuring forces act in equilibrium.

8. (a) Define the following terms:

(i) Inertia
Inertia is the property of a body to resist any change in its state of rest or uniform motion unless acted upon by an external force. For example, passengers in a moving vehicle tend to continue moving forward when brakes are applied.

(ii) Impulse
Impulse is the product of force and the time interval during which the force acts on a body. It is also equal to the change in momentum of the body. Its unit is newton-second (Ns).

(b) (i) Give two practical examples where impulse and momentum play an important role.
One example is in catching a cricket ball, where the hands are moved backward to increase the time of impact, reducing the force felt due to impulse.
Another example is in airbags in vehicles, which increase the time of collision during accidents, thereby reducing the impact force on passengers.

(ii) A tennis ball of mass 120 g moving at a speed of 10 m/s was brought to rest by one player in 0.02 seconds. Calculate the average force applied by the player.
Mass = 120 g = 0.12 kg.
Initial velocity = 10 m/s, Final velocity = 0.
Change in momentum = $(0 - 0.12 \times 10) = -1.2$ kg m/s.
Impulse = Force × Time = Change in momentum.
Force = $(-1.2) \div 0.02 = -60$ N.
The average force applied is 60 N, opposite to the motion of the ball.

9. (a) (i) What is the function of a rheostat in an electric circuit?

A rheostat is used to vary the current in a circuit by changing the resistance. By adjusting its sliding contact, the effective length of the resistive wire changes, thereby controlling the resistance and hence regulating the flow of current. This makes it useful in applications such as dimming lights or controlling motor speeds.

(ii) List four factors that affect the resistance of a conductor.

The length of the conductor affects resistance, since a longer conductor offers greater opposition to current flow.

The cross-sectional area influences resistance, as a thicker conductor has lower resistance compared to a thin one.

The material of the conductor also affects resistance, with good conductors like copper having lower resistance than poor conductors like nichrome.

The temperature of the conductor plays a role, since in metals resistance increases with rise in temperature due to increased vibrations of atoms.

(b) Study the circuit diagram in Figure 3, then answer the questions that follow:

If the current flowing in 5 Ω resistor is 2 A, calculate the:

(i) Current flowing in the 10 Ω resistor.

The potential difference across resistors in parallel is the same.

Voltage across 5 Ω resistor = Current × Resistance = 2 × 5 = 10 V.

Therefore, the 10 Ω resistor also has 10 V across it.

Current in 10 Ω resistor = V ÷ R = 10 ÷ 10 = 1 A.

The current flowing through the 10 Ω resistor is 1 A.

(ii) Potential difference (p.d.) across the 20 Ω resistor.

The total current entering the parallel branch = 2 A + 1 A = 3 A.

This same 3 A flows through the 20 Ω resistor in series.

Potential difference = Current × Resistance = 3 × 20 = 60 V.

The potential difference across the 20 Ω resistor is 60 V.

10. (a) (i) Define the term pressure and give its SI unit.

Pressure is defined as the force acting normally per unit area of a surface. It explains how a force is distributed over an area. The SI unit of pressure is the pascal (Pa), where 1 Pa = 1 N/m^2.

(ii) Why are dams constructed thicker at the bottom than at the top?

Dams are made thicker at the bottom because pressure in a liquid increases with depth, as given by the formula $P = \rho gh$. At greater depth, the water exerts more force on the dam walls, so a thicker base is needed to withstand this pressure and prevent collapse.

(b) (i) List three applications of hydraulic presses.

Hydraulic presses are used in car braking systems, where force applied on the pedal is transmitted to the brakes.

They are used in lifting heavy loads, such as in hydraulic jacks used for raising vehicles.

They are also applied in industrial machines for pressing, molding, and compressing materials.

(ii) A hydraulic brake has a force of 1000 N applied to a piston whose area is 50 cm^2. Calculate the pressure transmitted throughout the liquid.

Pressure = Force ÷ Area.

Area = 50 cm^2 = 50 × 10^{-4} m^2 = 0.005 m^2.

Pressure = 1000 ÷ 0.005 = 200,000 Pa.

The pressure transmitted throughout the liquid is 2.0 × 10^5 pascals.