THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATION COUNCIL OF TANZANIA.
FORM TWO NATIONAL ASSESSMENT

031   **PHYSICS**

Time: 2:30 Hours   **Year: 2019**

Instructions

1. This paper consists of sections A, B and C with a total of **ten (10)** questions.
2. Answer **all** questions.
3. All answers must be written in the spaces provided.
4. All writing must be in blue or black ink **except** drawings which must be in pencil.
5. All communication devices, calculators and any unauthorized materials are **not** allowed in the examination room.
6. Write your **Examination Number** at the top right-hand corner of every page.
7. Where necessary the following constants may be used:
   (i)   Acceleration due to gravity, $g = 10$ m/s^2.
   (ii)   Density of water $= 1g / cm^3$ or $1000kg/m^3$.

QUESTION NUMBER	FOR ASSESSOR'S USE ONLY	
	SCORE	**ASSESSOR'S INITIALS**
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SECTION A (30 MARKS)

1. For each of the items (i) - (xx), choose the correct answer from the given alternatives and write its letter in the box provided.

   (i) Why Physics, Chemistry and Biology are natural science subjects?
      A. They need practical and theory work for learning.
      B. They need only theory for learning.
      C. They need practical work only.
      D. They need only observation.

(ii) Which of the following is a safety precaution in the Physics laboratory?
   A. Doing experiment in the laboratory
   B. Handling of apparatus in the laboratory
   C. Use equipment with care in the laboratory
   D. Do anything in the laboratory

(iii) Which instrument will you use to measure accurately the inside diameter of a bottle neck?
   A. tape measure.   C. metre rule
   B. micrometer screw gauge.   D. Vernier calipers.

(iv) Which of the following statements is correct about mass?
   A. It is measured by beam balance
   B. It is measured by spring balance
   C. It varies with place
   D. It can be zero.

(v) A hydrometer is an instrument used to measure
   A. the volume of liquids.   C. the density of solids
   B. the density of liquids.   D. the volume of solids.

(vi) When a body of mass M, is lifted through a height h, it possesses the energy known as
   A. kinetic energy.   C. light energy
   B. chemical energy.   D. potential energy.

(vii) If the angle between two plane mirrors is 60°, what will be the number of images?

   A. 2   B. 3   C. 4   D. 4

(viii) The presence of charge in a material can be demonstrated by
   A. electrophorus.   C. gold leaf
   B. earth wire.   D. electroscope

(ix) A current of 0.2 A flows through a resistor of 4Ω. The potential difference across a resistor is;
   A. 20 V   B. 0.8 V   C. 0.05 V   D. 8 V

(x) The process of removing magnetism from a material is known as

   A polarization.   B demagnetization.
   C magnetization.   D magnetizing.

(xi) How can a real image be distinguished from a virtual image?
   A. Real image is inverted while virtual image is upright
   B. Real image is upright while virtual image is inverted
   C. Virtual image is formed by a convergent rays while real image is formed by divergent rays.

D. Real image is formed by a convergent rays while virtual image is by divergent rays

(xii) Why an atom is electrically neutral?
    A. It consists of equal number of electrons
    B. It consists of equal number of protons and electrons
    C. It consists of equal number of electrons and neutrons
    D. It consists of equal number of protons and neutrons

(xiii) A potential difference of 12V is applied across a resistor of resistance 24 Ω. The current in a circuit is

    A 0.5 A   B 2 A   C 0.5 Ω   D 288 Ω

(xiv) If a North pole is used in the stroking method of magnetization, the end where the stroking begins is
    A. South pole.   B North pole.   C West.   D East.

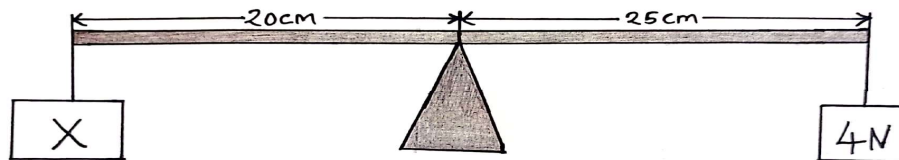(xv) Figure 1 shows a ruler balanced by placing the loads at its ends. What is the weight of X?

Figure 1
    A. 5N   B. 0.5 N   C. 100N   D. 200N

(xvi) Which of the following is an example of a third-class lever?
    A. Scissors   C. Pliers
    B. Fishing pole   D. Nut cracker

(xvii) Distance between two moving objects will change if
    A. both are moving with the same velocity.
    B. both have the same acceleration.
    C. both have different acceleration.
    D. both have no acceleration.

(xviii) Which of the following best illustrates Newton's third law?
    A. Inertia   C. Rocket propulsion
    B. Momentum   D. Circular motion

(xix) The temperature of a body of −40°C in Kelvin (K) scale is
    A. 313 K   B. 233 K   C. 272 K   D. −40 K

(xx) Which of these resources of energy is non-renewable?

A. Wave energy   C. Radiant energy
B. Biofuels   D. Fossil fuel

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

List A	List B
(i) An instrument that measures length, depth, internal and external diameters.	A. Measuring cylinder
(ii) An instrument that measures volumes of liquid.	B. Pipette
(iii) An instrument that measures force of pull.	C. Vernier caliper
(iv) An instrument that transfers a specific amount of liquid from one container to another.	D. Glass tumbler
(v) An instrument that measures body temperature.	E. Spring balance
	F. Clinical thermometer
	G. Magdeburg experiment

3. Complete each of the following statements by writing the correct answer in the space provided.
   (i)   Basic physical proportions of measurement which cannot be obtained from any other proportions by either multiplication or division are called ……………
   (ii) Staircases, winding roads uphill, wedges and a screw are physical examples of ……………………………………
   (iii) The resistance of a body to change its state of rest is called …………………
   (iv) Objects which emit light when they are hot are called ...……………………..
   (v)   Materials which obey Hooke's law are known as …………….……………

SECTION B (50 MARKS)

4. (a) What do you understand by the following terms?
        (i) Work   (ii) Energy   (iii) Power

   (b) Calculate the power of a pump which can lift 200 kg of water through a vertical height of 6 m in 10 seconds.
   (c) A 1000 kg car is travelling down the road at a speed of 15 m/s. How much kinetic energy does it have?

5. (a) (i) Briefly explain the motion of an object under gravity by taking an example of a ball thrown straight up into the air.
       (ii) A car with a velocity of 60 km/h is uniformly retarded and brought to rest after 10 seconds. Calculate its acceleration.
   (b) (i) Distinguish between distance and displacement
       (ii) Provide one example of the law of inertia of a body

(c) What mass will be given to a body with an acceleration of 7 m/s^2 by a Force of 3N?

6. (a) State Pascal's principle of pressure
   (b) What are the three factors that affect the liquid pressure?
   (c) Calculate the area of an object if the pressure exerted is 0.2 N/m^2 and its force is 2N.

7. (a) Light is a form of energy. State any two characteristics of it which can be distinguished from other forms of energy.
   (b) With the aid of a diagram, state the laws of reflection.
   (c) How many images can be formed if two mirrors are set?
      (i) At an angle of 60°
      (ii) Parallel to each other.

8. (a) State the principle of moments.
   (b) Distinguish between stable equilibrium and unstable equilibrium.
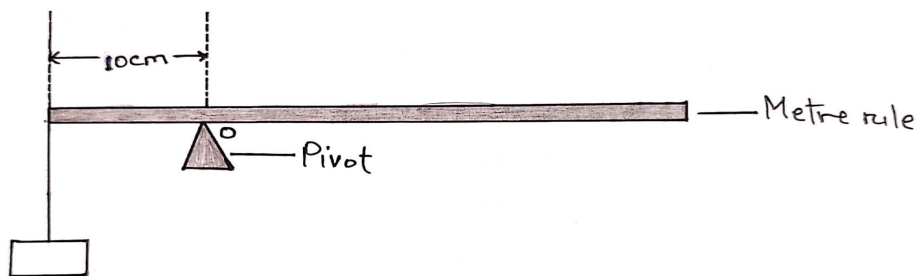   (c) A metre rule is pivoted about a point O as shown in Figure 2 and it is balanced by a load of 0.2N.

Figure 2

Calculate the mass of the rule.

SECTION C (20 MARKS)

9. (a) What are the uses of the following devices?
      (i)   Manometer
      (ii)   Hare's apparatus (inverted U-tube)
      (iii) U-tube
      (iv)   Barometer

   (b) Why a big Elephant manages to walk comfortably in muddy soil without sinking while a human being may sink easily?
   (c) Draw a well labeled diagram which demonstrates that liquid pressure depends on depth.

10. (a) Mention three uses of current electricity
    (b) Why is it advised to connect bulbs in parallel arrangement during installation of electricity in most buildings?
    (c) Form one students at Saku Secondary School who were conducting an experiment to verify Ohm's Law in the laboratory, were given the following instructions: *Connect in series a resistor R, a battery B of two cells, a switch K, an ammeter A and rheostat*

S. Then connect a voltmeter V across resistor R. Draw a well labelled circuit representing this experiment.

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031   **PHYSICS**

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SECTION A (30 Marks)
Answer **all** questions in this section.

1. For each of the items (i) - (xx), choose the correct answer from among the given alternatives and write its letter in the box provided.

   (i)   Physics is the study which deals with matter. What does it relate to?
           A. Power   B. Energy   C. Force   D. Work

(ii)   What does someone pay for if he/she buys sugar from the shop?
A. Mass   B. Density   C. Volume   D. Weight

(iii) What is a 20,000 g mass equal to?
A. 2 tonnes.   B. 2 kg.   C. 2000 kg.   D. 20 kg.

(iv)   Which one will need much force to pull or push than the other between 10 kg of stone and 10 kg of cotton?
A. 10 kg of stone will need much force than 10 kg of cotton.
B. 10 kg of cotton will need much force than 10 kg of stone.
C. Same force will be needed in both.
D. 10 kg of stone is heavier than 10 kg of cotton.

(v)   Relative density of a substance is 2.5. What is its density?
A. Equal to the density of water.
B. Greater than the density of water.
C. Equal to the volume of water displaced.
D. Less than the density of water.

(vi)   Why does a body float in a fluid?
A. Because its density is greater than the density of the fluid displaced.
B. Because its density is less than the density of fluid.
C. Because the weight of the fluid displaced is equal to its weight.
D. Because the weight of the fluid displaced is less than its weight.

(vii) Which of the following forces can cause the mosquito larva to float on water?
A. Surface tension.   C. Friction forces.
B. Adhesive forces.   D. Cohesive forces.

(viii) Which phenomenon explains the assertion that the narrower the tube the further the water rise?
A. Capillarity   C. Osmosis
B. Diffusion   D. Brownian movement

(ix)   Which pair of the following parameters affects pressure at any point in a liquid at rest?
A. Density and volume   C. Area and volume
B. Depth and area   D. Depth and density

(x)   What is the SI unit for power?
A. Joule per metre   C. Metre per second^2
B. Metre per second   D. Joule per second

(xi)   What will be the number of images formed when two plane mirrors are set perpendicular to each other?

A. 4   B. 3   C. 5   D. 2

(xii) Which device is used for detecting small electric charges?
A. Proof plane   B. Capacitor   C. Electrophorus   D. Gold leaf electroscope

(xiii) What is the equivalent resistance of two resistors of 4 Ω and 6 Ω connected in parallel?
A. 0.66 Ω   B. 10 Ω   C. 2.4 Ω   D. 1.5 Ω

(xiv) What is the name of the region surrounding a magnet in which the magnetic force is exerted?
A. Magnetic field   C. Magnetic pole
B. Magnetic shielding   D. Magnetic domain

(xv) The moment of a force about a point is 1120 Nm. If the magnitude of the force is 5600 N, what is the perpendicular distance between the point and the line of action of the force?
A. 5 m   B. 6720 m   C. 0.2 m   D. 4480 m

(xvi) Which of the following groups of machines represents the first-class levers?
A. Wheel barrow and bottle openers
B. Fishing rod and sugar tongs
C. Crowbar and claw hammer
D. Nutcracker and pair of scissors

(xvii) Which of the following will be a suitable graph to represent the motion for a body moving in a straight line with a uniform acceleration?
A. Distance against time graph.
B. Acceleration against time graph.
C. Velocity against time graph.
D. Displacement against time graph.

(xviii)   What force is required to give a mass of 40 kg an acceleration of 0.2 m/s^2
A. 200 N   B. 0.005 N   C. 8 N   D. 20 N

(xix) Which of the following devices is used for measuring the upper fixed point of a thermometer scale?
A. Hydrometer   C. Thermometer
B. Hypsometer   D. Barometer

(xx) Which of the following is not one of the sources of sustainable energies?
A. Water   B. Wind   C. Sun   D. Dry cell

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

List A	List B
(i) The energy which is associated with the volcanic areas. (ii) The energy due to afforestation and deforestation. (iii) Natural resources that are used in the production of electricity without damaging the environment. (iv) The energy generated by means of large propeller on tall tower. (v) The energy produced by the Sun	A. Wind energy. B. Solar energy. C. Hydroelectric energy. D. Wood energy. E. Tidal energy. F. Geothermal energy. G. Sustainable energy sources.

3. Complete each of the following statements by writing the correct answer in the spaces provided:
    (i)   A complete measurement is called _____
    (ii)   Efficiency of a machine is always less than 100% due to _____
    (iii)   The linear momentum of a body of mass 5 kg moving with a velocity of 2 m/s is _____
    (iv)   A region of total shadow on a screen is _____
    (v)   The shape of the surface of water in a clean glass tube is _____

SECTION B (50 Marks)
Answer **all** questions in this section.

4. (a) Write down the second and third equations of motion in a straight line.
    (b) Explain the following terms as they are applied in motion in a straight line:
    (i). Velocity.   (ii). Retardation.

    (c) A stone is thrown vertically upwards with an initial velocity of 50 m/s.
        (i) Calculate the time that the stone will take to return back to the thrower.
        (ii) What will be the maximum height reached?

5. (a) Which kind of energy is stored in objects like springs as a result of reversible deformation?
    (b) Why there is no work done on the books when carried horizontally?
    (c) A ball of 0.2 kg is dropped from a height of 20 m. On impact with the ground, it loses 30 J of energy. Calculate the height it reaches on the rebound.

6. (a) Why is it easier to cut a bar of soap using a thin piece of wire than a thick one?
    (b) State four applications of atmospheric pressure.

(c) A car of mass 8000 kg has one of its tyres having an area of 50 cm^2 in contact with the ground. If this is four-wheel drive vehicle, calculate the pressure exerted on the ground by the car.

7. (a) How does the centre of gravity of an extended body differ from the centre of mass of an object?
    (b) Why a person climbing up a mountain is observed to bend forward?
    (c) A moment of force of 320 Nm is formed when a force of 120 N is applied at right angle on the end of a spanner. How long is the spanner?

8. (a) State Newton's second law of motion.
    (b) Give two examples of the application of the Newton's third law of motion.
    (c) A ball A of mass 100 g moving with a velocity of 5 m/s makes a "head-on" collision with a ball B of mass 500 g moving with a velocity of 1 m/s in the opposite direction. If A and B stick together after the collision;
       (i) Calculate their common velocity V.
       (ii) Identify the type of collision.

SECTION C (20 Marks)
Answer **all** questions in this section.

9. (a) Explain how the inclined plane makes it easier to move a load from a lower to a higher position.
    (b) Draw a diagram of combined pulley system with velocity ratio of 4.
    (c) A pulley system is made up of 8 pulleys. An effort of 200 N is applied on the pulley system. If the pulley has an efficiency of 80%, find the:
       (i) Mechanical advantage of pulley?
       (ii) Maximum load that can be raised by the effort?

10. Three resistors of 2 Ω, 4 Ω and 6 Ω are connected in series to a battery of e.m.f 24 V and have negligible internal resistance.
    (a) Draw the circuit diagram including the battery, ammeter, switch and the three resistors.
    (b) Find the current flowing in the circuit drawn in 10(a) above.
    (c) Find the potential difference at the ends of each resistor in 10 (a).

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031   **PHYSICS**

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SECTION A (30 Marks)
Answer **all** questions in this section.

1. For each of the items (i) - (xx), choose the correct answer from among the given alternatives and write its letter in the box provided.

    (i)   What is the name given to the people who study and work professionally in the field which relates matter and energy?
    A. Scientists   C. Physicists
    B. Gastronomists   D. Geophysicists

(ii)   Which of the following experiments is the process of assigning numbers in measurement?
      A. Qualitative experiment   C. Scientific experiment
      B. Quantitative experiment   D. Physics experiment

(iii)   What is the implication of the statement that when a body floats, its apparent weight is zero?
      A. The weight of a floating body is less than the upthrust acting on it.
      B. The weight of a floating body is less than the weight of the fluid displaced.
      C. The weight of a floating body is equals to the weight of the fluid displaced.
      D. The weight of a floating body is greater than the upthrust acting on it.

(iv)   Why particles in a solid state are closely packed together?
      A. Because they have weak force of attraction.
      B. Because they have very weak force of attraction.
      C. Because they have moderate force of attraction.
      D. Because they have very strong force of attraction.

(v)   Why do beans seem to swell up when soaked in water for overnight?
      A. Due to diffusion action   C. Due to adhesive force
      B. Due to capillarity action   D. Due to osmosis process

(vi)   Which statement correctly explains the term power?
      A. Rate of doing work measured in watts.
      B. Rate of doing work measured in watts per second.
      C. The product of energy and time measured in joule-seconds.
      D. Energy divide by time measured in joules.

(vii)   Which of the following materials was the earliest natural magnet to be discovered?
      A. A bar magnet   C. Lodestone
      B. Marble stone   D. An electromagnet

(viii)   What differentiates a single moving pulley from a single fixed pulley?
      A. A single movable pulley, load is double the effort.
      B. In single fixed pulley, load is double the effort.
      C. In single movable pulley, effort is the same as load.
      D. In single fixed pulley, effort is double the load.

(ix)   Which quantity describes the temperature at which pure ice melts at standard atmospheric pressure?
      A. Vapour pressure   C. Latent heat of fusion
      B. Ice point   D. Melting point

(x)   What criterion supports the argument that potential and kinetic energies are similar?

A. Both produce heat
B. Both are forms of mechanical energy.
C. One is the substitute of the other.
D. Both are forms of electrical energy.

(xi)   Why do the racing cars designed in such a way that their centres of gravities are lowered?
A. To increase the centre of gravity.
B. To decrease the stability.
C. To lower the stability.
D. To increase the stability.

(xii)   What happens when the body moves with a constant speed?
A. Its acceleration is zero.
B. Its acceleration increases.
C. Its acceleration decreases.
D. Its deceleration increases.

(xiii) Which class of levers do wheel barrows, nut-crackers and bottle openers belong?
A. Third class   C. First class
B. Second class   D. Fourth class

(xiv)   How would the formation of image in the plane mirror be described?
A. Same size as object, virtual and upright.
B. Larger, real, and upside down.
C. Smaller, virtual and upright.
D. Larger, virtual and upright.

(xv)   What parameter(s) affects the magnitude of the energy of a moving body?
A. The speed of moving body.
B. The mass of moving body.
C. The speed and mass of the moving body.
D. The force of gravity.

(xvi)   The following observations are **correct** on the concept of structure and properties of matter **except**
A. A drop of water on clean glass spreads over the surface of glass.
B. Water wets glass but mercury does not.
C. A pond skater is capable of walking on the surface of water.
D. Water falls inside the tube but mercury rises when poured in the same tube.

(xvii) Why the weight of a body is greater at the poles than at the equator?
A. Because the earth is not perfectly spherical.
B. because weight is not constant.
C. Because weight is measured by spring balance.

    D. Because gravity is grater at the poles.

(xviii) Which of the following devices work by the help of atmospheric pressure?
    A. Flushing tanks and Hydraulic press.
    B. Lift pumps and Hydrometers.
    C. Bicycle pumps and Syringes.
    D. Lactometers and Thermometers.

(xix) What is the function of a capacitor in electronic devices?
    A. Detect charges on materials.
    B. Produce electrostatic charges through induction.
    C. Store electric charges.
    D. Produce electrostatic charges through rubbing.

(xx) The amount of current flowing in the circuit is 4.0 Amperes. If a potential difference is 48 V, what is its resistance?
    A. 12 V   C. 12 A
    B. 12 Ω D. 24 Ω

2. Match the descriptions of the magnetic terms in **List A** with the correct magnetic terms in **List B** by writing a letter of the correct response below the corresponding item number in the table provided.

List A	List B
(i) Keep magnet away from the source of heat. (ii) The substance which cannot be magnetized or attracted by magnet. (iii) The point in which the magnetic field is zero. (iv) The region around magnet which can attract magnetic materials. (v) The arrangement of magnetic dipoles in groups.	A. Magnetic field B. Magnetic induction C. Storage of magnet D. Storage of point charge E. Neutral point F. Magnetic domain G. Non-magnetic material

3. Complete each of the following statement by writing the correct answer in the space provided.
(i) Quantities like length, mass, amount of substance and time in Physics are known as …………………………..
(ii) The velocity ratio of a block and tackle pulley system which contains 3 fixed and 2 movable pulleys is ………………………..
(iii) If a force of 12 N acts on a body of 1.2 kg, the acceleration of a body will be ………..
(iv) The instrument used to detect and identify the presence of electric charges on an object is known as …………………………

(v)   During respiration, oxygen enters into blood stream by the process known as
………

SECTION B (50 Marks)
Answer **all** questions in this section.

4. (a) Briefly, explain the following terms:
      (i) Joule   (ii) Energy   (iii) Watt

    (b) State the principle of conservation of energy.
    (c) A bus of 10,000 kg is travelling from Musoma to Mwanza with a speed of 25 m/s.
        Calculate its kinetic energy.

5. (a) Apply the Newton's first law of motion to explain why an object pulled along the
        ground with constant velocity has zero net force but the force exerted on it is not zero.
    (b) State the principle of the conservation of linear momentum.
    (c) A ball of mass 0.15 kg moving at a speed of 20 m/s increases the speed to 80 m/s in
        0.5 second. What is the average force applied.

6. (a) Why efficiency of a pulley system is always less than 100%? Give two reasons.
    (b) Draw diagrams of lever system to show:
        (i) First class lever.
        (ii) Second class lever
        (iii)Third class lever

7. (a) How does static equilibrium differ from dynamic equilibrium?
    (b) Why mechanics prefer to use a spanner of longer stem than spanner of shorter stem
        to tight or loosen a nut on a bolt?
    (c) The moment of a force about a point is 12,000 Nm. If the magnitude of the force is
        6,000N, find the perpendicular distance between the point and the line of action of
        the force.

8. (a) Use the concept of pressure to explain why buildings are constructed with wide
        foundations.
    (b) Mention two experiments which show the evidence that atmospheric pressure exists.
    (c) A woman of mass 64 kg is standing on sand soil with heel shoes of area 2 cm^2;
        (i) Find the pressure exerted by the woman on the ground.
        (ii) Why does her heel sink into the ground?

SECTION C (20 Marks)
Answer **all** questions in this section.

9. (a) Write down three equations of uniform acceleration of motion and explain the
        meaning of each symbol used in the equation.

(b) The football **P** of mass 0.5 kg was kicked by a goalkeeper at 12 m/s and collides with another football **Q** of mass 0.45 kg which was at rest. After the collision both balls move off together at 10 m/s. Calculate:

   (i) The momentum of ball **P** before collision

  (ii) The momentum of ball **P** after collision

10. (a) State any two important requirements for a complete circuit.

   (b) Distinguish between resistance and resistors.

   (c) Draw a simple circuit to show two bulbs in series connected to a battery of two cells.

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7. Write your **Examinations Number** at the top right corner of every page.
8. Where necessary the following constants may be used:
    i.   Acceleration due to gravity, g = 10 m/s^2.
    ii. $\pi = 3.14$.

QUESTION NUMBER	FOR EXAMINERS' USE ONLY	
	SCORE	EXAMINERS' INITIALS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

SECTION A (15 Marks)
Answer **all** questions.

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

(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.

(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   C. 71.06 g

B. 27.43 g   D. 43.63 g

(iv) Why are machine engines filled with lubricant oil?

A. To reduce frictions between moving parts.

B. To increase viscosity between moving parts.

C. To balance force acting between moving parts.

D. To return the twisted solids to their former state.

(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 sea water is same as of the ship.

C. The sea water is denser than fresh water.

D. Sea water and fresh water have the same density.

(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 high speed compared to those of air.

(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.

(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   C. Regular deflection

B. Internal reflection   D. Regular reflection

(ix)   An object has a mass of 5 kg. What is the kinetic energy when it is moving at a speed of 10 m/s?
A. 50 J   C. 150 J
B. 250 J   D. 100 J

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

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 in the table provided.

List A	List B
(i) The ratio of the distance moved by effort to the distance moved by the load.	A. A simple pulley
	B. Combination pulley
	C. Efficiency
(ii) The ratio of the load raised steadily by a machine when an effort or force is applied.	D. Lever
	E. Mechanical advantage
	F. Single fixed pulley
(iii) A fixed wheel with a rope passing round a groove in the wheel's circumference.	G. The block and tackle pulley system
(iv) The ratio of the work output to the work input times 100%.	H. Velocity ratio
(v) Consists of a rigid bar that moves about a fixed point.	

SECTION B (70 Marks)
Answer **all** questions.

3. (a) Differentiate ferromagnetic materials from paramagnetic materials by giving their typical examples and uses.   **(4 marks)**
    (b) Advice a laboratory technician three appropriate ways of storing magnets so that they can last longer.   **(6 marks)**

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?   **(4 marks)**
    (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?   **(3 marks)**
        (ii) Your aunt is preparing water for newborn baby to bath. 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 bath, what will be the equilibrium temperature in Kelvin after mixing?   **(3 marks)**

5. (a) Consider a book placed on the table, what are the forces acting on it?   **(2 marks)**
    (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?   **(2 marks)**
    (ii) A boy in a stationary boat with a mass of 55 kg jumps onto a trolley of mass 90kg. If the initial speed of a boy is 5 m/s, at what initial speed will the trolley move?   **(6 marks)**

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?   **(4 marks)**
    (b) Suppose a bird is on the 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:
    (i) What will be height of the bird from the ground?   **(3 marks)**
    (ii) Calculate the time taken by the bird to hit the ground?   **(3 marks)**

7. (a) (i) If you want to lift a heavy load vertically to the roof, which simple machine will be used?   **(1 mark)**
    (ii) How is the mechanical advantage and velocity ratio of an incline plane related to the angle of inclination?   **(3 marks)**
    (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 car whose mass is 350 kg. If the efficiency of the screw-jack is 45 %, calculate the amount of the force applied at the end of the handle when lifting the car.   **(6 marks)**

8. (a) Explain the following terms as applied in forces in equilibrium.
    (i)   Centre of mass.   **(2 marks)**
    (ii)   Moment of force.   **(2 marks)**

    (b) A light beam AB rests on supports 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.
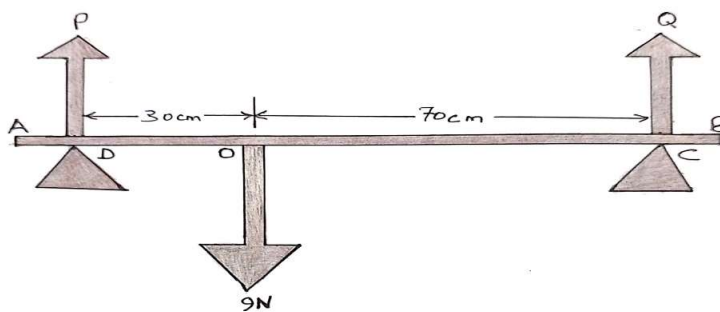   **(6 marks)**

Figure 1

9. (a) Suppose your school has a plan to develop a min power plant project from either water or wind sources and the school management is seeking for a scientific advice from you. What will you advise them on this matter? Use two points.   **(5 marks)**

(b) People are warned by Geophysicists not to build houses near geothermal power plants. Give two reasons for this warning.   **(5 marks)**

SECTION C (15 Marks)
Answer question **ten (10)**

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.   **(5 marks)**
    (b) Draw a simple electrical circuit which will be suitable for that experiment.
                                                                                    (**5marks**)
    (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?
                                                                                    (5marks)

UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
FORM TWO NATIONAL ASSESSMENT
031   **PHYSICS**

TIME: 2:30 Hours   **Year: 2023**

Instructions
1. This paper consists of sections A, B and C with a total of **ten (10)** questions.
2. Answer **all** questions in the space provided.
3. All writing must be in **blue** or **black** ink **except** drawings which must be in pencil.
4. Communication devices, calculators and any unauthorized materials are **not** allowed in the assessment room.
5. Write your **Assessment Number** at the top right corner of every page.
6. Where necessary the following constants may be used:
   (iii)   Acceleration due to gravity, $g = 10$ m/s^2.
   (iv) $\pi = 3.14$.

QUESTION NUMBER	FOR ASSESSOR'S USE ONLY	
	SCORE	ASSESSOR'S INITIALS
1		
2		
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10		
TOTAL		
CHECKER'S INITIALS		

SECTION A (15 Marks)
Answer **all** questions in this section.
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)   A student has an urgent message to send to his/her parents far from school. Which means can be the best?
          A. Landline and mobile phone
          B. Microphone and telephone
          C. Megaphone and mobile phone
          D. Megaphone and microphone

(ii)   What is the usefulness of laboratory rules when carrying out experiments in the Physics laboratory?
- A. Making students enjoy science
- B. Helping students conduct experiment freely
- C. Ensuring safety in the laboratory
- D. Enhancing communication with other technicians

(iii)   Why does a piece of steel sink in water but a steel ship floats?
- A. The density of the steel ship is less than the density of water
- B. Steel is denser than the steel ship
- C. Steel ship has the same density to that of steel
- D. To average density of the steel ship is less than the density of water

(iv)   Which of the following is a set of effects of forces exerted when you are riding a bicycle?
- A. Compressional, viscosity and stretching
- B. Torsional, attraction and couple
- C. Frictional, couple and pulling
- D. Attraction, friction and restoring

(v)   A hydrometer is an instrument for measuring the density or relative density of a liquid. What are you supposed to do in order to increase its sensitivity?
- A. Increasing the size of the large bulb
- B. Making the stem narrower
- C. Reducing the lead shots in the weighted bulb
- D. Increasing the length of the stem

(vi)   How can you make a rough measure of the size of a molecule?
- A. By measuring the height to which water rises in a narrow capillarity tube
- B. By finding the speed with which Brownian vapour spreads in air
- C. By observing Brownian motion off smoke particles
- D. By measuring the area of the cycle in which a small drop spreads in water

(vii)   A boy wants to lift a bucket full of water using a handle of metal. Which form of a handle should he use to lift the bucket comfortably?
- A. Thick handle
- B. Thin handle
- C. Long handle
- D. Sharp handle

(viii)   Which of the following is a set of natural sources of light?
- A. Sun, Star and Fluorescence light
- B. Sun, Star and Lightning
- C. Star, Candle and Bioluminescence fly
- D. Star, Lightning and Wood fire

(ix)   Which statement is true about a ball falling freely from a height of 10 m?
- A. Its potential energy increases but kinetic energy decreases

B. Its potential energy is equal to the kinetic energy

C. Its potential energy is zero and kinetic energy is maximum

D. Its potential energy decreases and kinetic energy increases

(x)   Which method is preferred to use if a student wishes to charge an uncharged body by using a positively charged body in order to make it acquire positive charge?
A. Friction   C. Induction
B. Contact   D. Heating

2. Match the uses of instruments in **List A** with a correct name of the instrument in **List B** by writing a letter of the correct response below the item number in the table provided.

List A	List B
(i) An instrument used to measure density of the liquid. (ii) An instrument used to determine the volume of irregular substance. (iii) An instrument use to transfer specific volume of liquid from one container to another. (iv) An instrument used to determine the volume of displaced water. (v) An instrument used to determine the density of insoluble granules.	A. Density bottle B. Hydrometer C. Eureka can D. Pipette E. Measuring cylinder F. Burette G. Test tube

SECTION B (70 Marks)
Answer **all** questions in this section.

3. (a) Describe three ways in which magnets can be destroyed.   **(6 marks)**
    (b) Using vivid examples, identify four applications of magnets in our daily life.
                                                                        (4marks)

4. (a) What is the function of the constriction in a clinical thermometer?   **(2.5 marks)**
    (b) Explain the principle on which a liquid-in-glass thermometer works.   **(2.5 marks)**
    (c) At what temperature do Fahrenheit and Celsius scale give the same reading?
                                                                        (5marks)

5. (a) (i) Suppose you find a man along the road pushing a motor cycle and it accelerated, but the same man pushed a car and failed to move it. Why the man failed to push the car? Briefly explain.   **(2.5 marks)**
        (ii) An object in a state of rest or moving with uniform motion has no forces acting on it. Argue against this statement.   **(2.5 marks)**
    (b) A car with a mass of 350 kg moving from Kondoa to Babati at a speed of 120 km/hr overtakes a bus with a mass of 1000 kg moving with a speed of 40 km/hr. Determine their momentum.   **(2.5 marks)**
    (c) A boy of mass 50 kg was pushed by a constant force of 20 N for 3 seconds. Determine the acceleration acquired by the body.   **(2.5 marks)**

6. John started moving the car from rest and the car accelerated uniformly at the rate of $4m/s^2$ for 5 s and maintained a constant velocity for 20 s. Afterwards he applied the brakes and the retarded uniformly to rest in 3 s. Calculate the total distance covered by the car. **(10 marks)**

7. (a) Why is an inclined plane regarded as a simple machine? **(3 marks)**
   (b) The wheel and axle with an efficiency of 85 % is used to raise a load of 6000N. if the radius of the wheel is 50 cm while that of the axle is 15 cm, calculate:
   (i) The velocity ratio of the wheel and axle. **(3 marks)**
   (ii) The mechanical advantage of the wheel and axle. **(4 marks)**

8. (a) Why does a body rotate when a certain force is applied on it? **(3 marks)**
   (b) Figure 1 shows a uniform metre rule of weight 2 N which is pivoted at 40 cm mark. If a force of 4 N acts at the end of the metre rule, calculate the value of force X required to keep the rule in equilibrium. **(7 marks)**
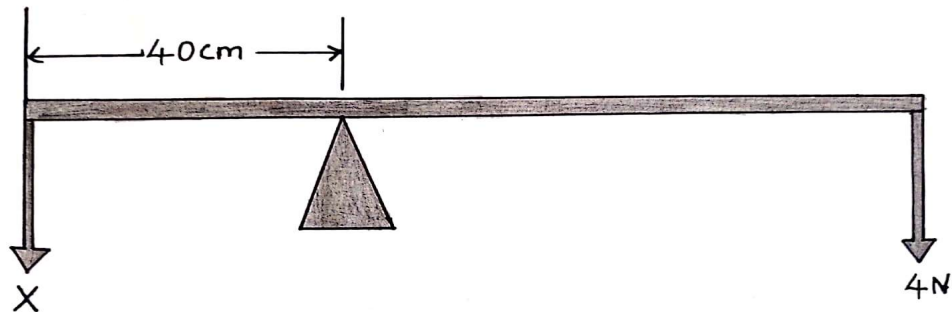
Figure 1

9. (a) Compare natural gas and geothermal energy sources by considering the following:
   (i)   Environmental safety **(2 marks)**
   (ii)   Sustainability **(2 marks)**

   (b) Using two points, state why solar cars are better than petrol cars. **(3 marks)**
   (c) Give three disadvantages of hydroelectric power. **(3 marks)**

SECTION C (15 Marks)
Answer question **ten (10)**

10. (a) Explain how ammeter and a voltmeter are connected in a circuit. **(6 marks)**
    (b) In the circuit shown in Figure 2, the battery and ammeter have negligible internal resistance. Determine the ammeter reading. **(9 marks)**
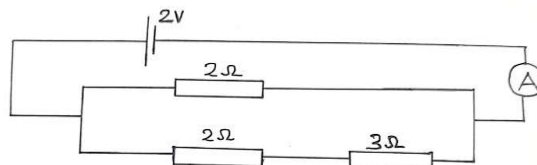
Figure 2

FORM TWO NATIONAL ASSESSMENT: YEAR 2019
PHYSICS - ANSWERS

1.

i.	ii.	iii	iv.	v.	vi.	vii.	viii	ix.	x.	xi	xii.	xiii.	xiv.	xv.	xvi.	xvii	xviii.	xix.	xx.
A	C	D	A	B	D	D	D	B	B	D	B	A	B	A	B	C	C	B	D

2.

i.	ii.	iii.	iv.	v.
C	A	E	B	F

3. (i). Fundamental physical quantity
   (ii). Inclined plane
   (iii). Inertia of rest
   (iv). Incandescent object
   (v). Elastic materials

4. (a) (i) Work is the product of force and the distance covered in the direction of force.
        It is SI unit is Joule (J)
      (ii) Energy is the ability to do work.
      (iii) Power is the rate at which work is done. The SI unit of work is watts.

   (b)   Solution
       Data given
   Mass = 200kg
   Height = 6m
   Time = 10 seconds
   Power = ?

$$From;$$

$$Power = \frac{Workdone}{Time}$$

$$= \frac{F \times d}{t}$$

$$= \frac{ma \times d}{t}$$

$$= \frac{200 \times 10 \times 6}{10}$$

$$= \frac{12000}{10} = 1200 \; watts$$

$$\therefore The \; power \; of \, the \; pump \; is \; 1200 \; watts$$

(c)   Solution

Data given

Mass = 1000 kg

Speed = 15 m/s

Kinetic energy (K.E) =?

But;

$$K.E = \frac{1}{2}mv^2$$

$$= \frac{1}{2} \times 1000 \times (15\,m/s)^2$$

$$= 500kg \times 225\frac{m^2}{s^2}$$

$$= 112500kg.\frac{m^2}{s^2}$$

$$\therefore The\ kinetic\ energy\ possessed\ is\ 112500\ Joules$$

5. (a) (i) When a ball is thrown straight up into the air as the way it goes up, it velocity is decreasing hence when the velocity of the ball becomes zero, since it is moving opposite direction of the gravitational force then the force of gravity becomes active and pull the ball back in its centre of gravity thus the ball fall back.

(ii)   Solution

Data given

Velocity, V = 60 km/h

Time, S = 10 seconds

Acceleration (a) =?

$$60\,^{km}/_h\ into\ ^m/_s$$

$$\frac{60km \times 1000}{1h \times 3600} = \frac{100}{6}\,m/_s$$

$$From;\ a = \frac{v - u}{t} = \frac{(0 - \frac{100}{6})\,m/_s}{10\ s}$$

$$a = \frac{-100}{6} \times \frac{1}{10} = \frac{-10}{6}$$

$$a = -1.667\,^m/_{s^2}$$

$$\therefore Acceleration\ is -1.667\,^m/_{s^2}$$

(b) (i) Distance is the interval from one fixed point to another without specific direction WHILE Displacement is the length from one fixed point to another in a specific direction.

(ii) A passenger in a car, when the car starts sudden moving in front, the person moves back. A passenger in a car when suddenly stop a passenger fall forward.

(c)   Solution

Data given

Acceleration, a = 7m/s^2

Force, F = 3N

Mass, M =?

From; $F = ma$

$$m = \frac{F}{a}$$

$$m = \frac{3N}{7 \, m/s}$$

$$= 0.4285 \approx 0.429 \, kg$$

$$\therefore The \ mass \ of \ the \ body \ is \ 0.429kg$$

6. (a) Pascal's principle of pressure states that "*When any external force applied to a surface of an enclosed liquid pressure will be transmitted equally throughout a liquid*".

(b) (i) Height/depth,

(ii) Density of the liquid and

(iii) Acceleration due to gravity.

(c)   Solution

     Data given

Pressure = 0.2 N/m^2

Force = 2 N

Area =?

From;

$$Pressure = \frac{Force(F)}{Area(A)}$$

$$0.2 \, N/m^2 = \frac{2N}{Area}$$

$$Area = \frac{2N}{0.2 \, N/m^2} = 10m^2$$

$$\underline{Therefore \ the \ area \ of \ an \ object \ is \ 10m^2}$$

7. (a) (i) It travel in straight line.

   (ii) It travels with high speed about $3 \times 10^8 \, m/s$

(b) Diagram of reflection of light.
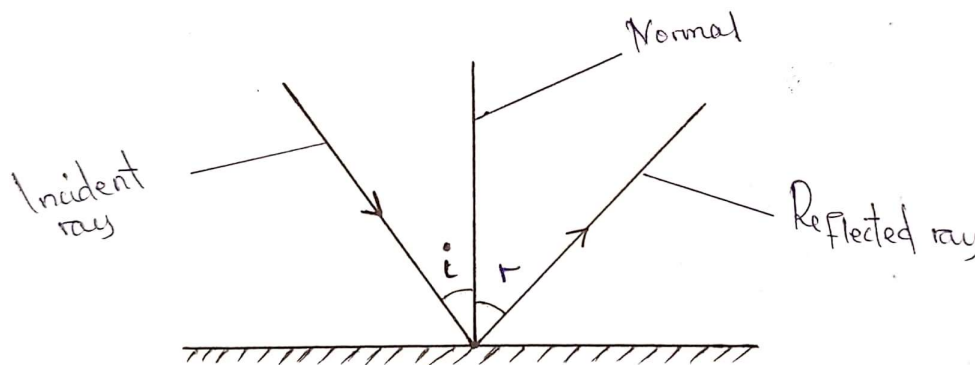
First law of reflection states that "*The incident ray, reflected ray and the normal line all rise from the same plane*".

Second law of reflection states that "*The angle of incidence is equal to the angle of reflection*".

(c) (i) At an angle of 60°.

Solution

$$n = \frac{360^0}{\theta} - 1$$
$$n = \frac{360^0}{60^o} - 1$$
$$n = 6 - 1$$
$$n = 5$$
$$\therefore \underline{The\ number\ of\ images\ is\ 5}$$

(ii) Parallel mirror to each other
-In parallel mirrors to each other number of images formed are infinite or undefined.

8. (a) The principle of moment states that "*For a system to be in a rotational balance, the sum of clockwise moment about any point is equal to the sum of anticlockwise moment about the same point*".

(b) Stable equilibrium.
Is the type of equilibrium in which an object tends to return to its original position after a small displacement.

Unstable equilibrium.
Is the type of equilibrium in which an object tends to move far away after a small displacement.
It moves far away from the original position.

(c)   Solution
Consider the figure below
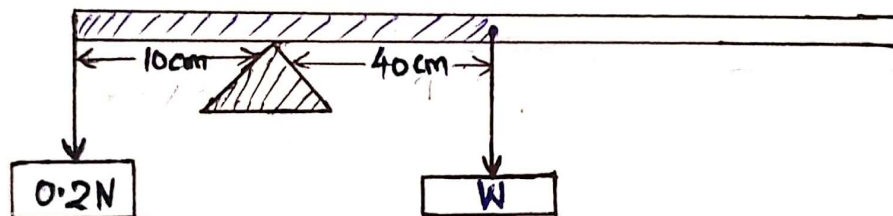
Required to find the mass of a metre rule.
From the principle of moment.

$$Sum\ of\ clockwise\ moment\ =\ Sum\ of\ anticlockwise\ moment.$$
$$W \times 40cm = 0.2N \times 10cm$$
$$\frac{40W}{40} = \frac{2}{40}$$
$$W = 0.05N$$

But,

$$F = mg$$
$$0.05N = m \times 10\ ^N/_{kg}$$
$$m = \frac{0.05N}{10\ ^N/_{kg}} = 0.005kg$$
$$\therefore The\ mass\ of\ metre\ rule\ is\ 0.005kg$$

9. (a) (i) Manometer it is used to measure gas pressure.
     (ii) Hare's apparatus (inverted U-tube) it is used to measure the density of miscible liquids.
     (iii) U-tube it is used to measure the density of immiscible liquids.
     (iv) Barometer it is used to measure atmospheric pressure.

(b) This implies to the concept of pressure that the larger the surface area in contact the smaller the pressure and vice-versa. Elephant's foot has a larger surface area compared to human being's hence the pressure between its foot and the ground is low enabling it to walk comfortably.

(c) Tap C will flow water at a higher distance than A and B. This is because pressure increases with depth and pressure at C is higher than A and B since its deeper. Therefore, pressure depends on depth.

Diagram
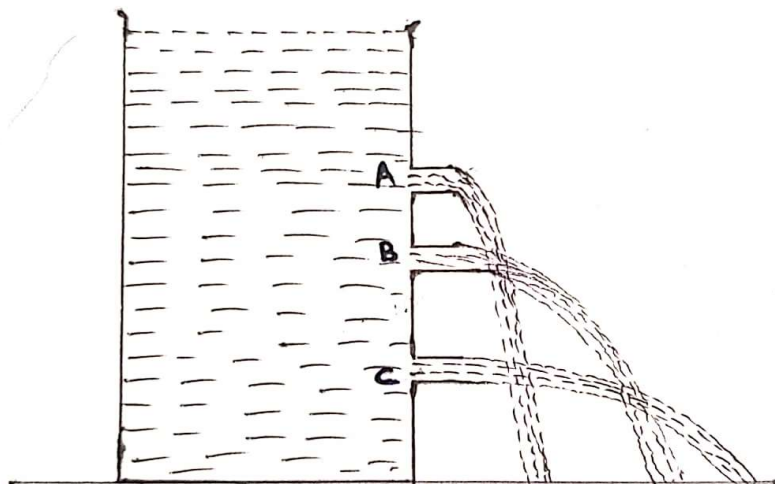
10. (a) (i) Running different devices such as TVs.
   (ii) Lighting light bulbs.
   (iii) Magnetizing magnetic materials and demagnetizing magnets.

(b) When bulbs are connected in a parallel arrangement the potential difference across the terminals of their wires remains the same but current changes. Hence, even if one light bulb stops functioning due to little or no current flowing, other light bulbs won't stop functioning.

(c) Diagram
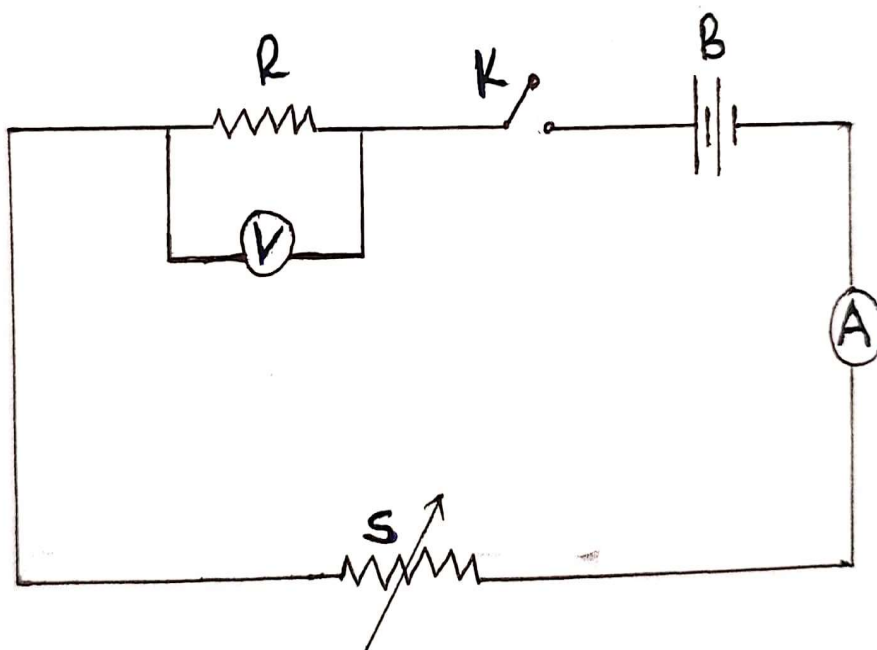
FORM TWO NATIONAL ASSESSMENT: YEAR 2020
PHYSICS - ANSWERS
SECTION A

1.

i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv	xv	xvi	xvii	xviii	xix	xx
B	A	D	C	B	B	A	A	D	D	B	D	C	A	C	C	C	C	B	D

2.

i.	ii.	iii.	iv.	v.
F	D	G	A	B

3.

    i.   Physical quantity
    ii.   Friction
    iii. $10kg\,{}^{m}\!/_{s}$
    iv.   Umbra
    v.   Concave meniscus

SECTION B

4. (a) Second equation

$$s = ut + \frac{1}{2}at^2$$

Third equation

$$v^2 = u^2 + 2as$$

Where by;

$$s = distance\ covered$$
$$u = initial\ velocity$$
$$v = final\ velocity$$
$$a = acceleration$$
$$t = time$$

(b) (i) Velocity is the rate of change of displacement. Velocity is a vector quantity having both magnitude and direction.
The SI-unit of velocity is metre per second (m/s).

(ii) Retardation is the rate of decrease in velocity of a moving body in a given time. It is also known as deceleration of a body.

(c)   Given that,
Initial velocity (u) = 50 m/s
Final velocity (v) = 0 m/s

(i)   Time taken
      From; First Newton's equation of motion.

$$v = u - gt$$
$$0 = u - gt$$

$$\frac{gt}{g} = \frac{u}{g}$$
$$t = 2\left(\frac{u}{g}\right)$$
$$t = 2\left(\frac{50}{10}\right) = 10 \ seconds$$

$\therefore The \ time \ that \ stone \ will \ take \ to \ return \ to \ the \ thrower \ is \ 10 \ seconds.$

(ii)   The maximum height reached
From,

$$h = ut - \frac{1}{2}gt^2$$

$$Time \ taken \ to \ reach \ maximum, t = \frac{u}{g}, t = \frac{50}{10}s = 5 \ seconds$$

$$h = (50 \times 5) - \frac{1}{2} \times 10 \times 5^2$$
$$= 250 - 125 = 125m$$

$\therefore The \ maximum \ height \ reached \ is \ 125 \ m$

5. (a) Elastic potential energy
(b) There is no work done because the books aren't moving in the direction of the force applied (displacement).

(c)   Solution
 Given that;
Mass (m) = 0.2 kg
Height (h) = 20 m
Gravitational force (g) = 10 N/kg
Lost energy (E) = 30J
Height at rebound (H) =?

$$From, \quad P.E = mgh$$
$$= 0.2kg \times 20m \times 10 \ ^N/_{kg}$$
$$P.E = 40J$$
$$40J - 30J = 10 \ Joules$$
$$Now, \quad PE = mgh$$
$$10 = 0.2 \times 10 \times h$$
$$h = \frac{10}{2} = 5 \ m$$

$\therefore The \ height \ at \ rebound \ is \ 5 \ m$

6. (a) It is easier to cut a bar of soap using a thin piece of wire than a thick one because, the thin piece of wire has a small surface area which enables it to exert more pressure on the soap, making it easier to cut.

(b) (i) Siphon
   (ii) Bicycle pump
   (iii)Lift pump
   (iv)Force pump

(c) Given that,

Mass of the car = 8000 kg
Area of one tyre = 50 cm^2
Pressure =?

Recall;

$$Pressure = \frac{Force(F)}{Area(A)}$$
$$Since\ it\ is\ a\ four\ wheel\ drive, total\ area\ =\ 4 \times 50cm^2 = 200cm^2$$
But,
$$1m^2 = 10,000\ cm^2$$
$$? = 200\ cm^2$$
$$= \frac{1m^2 \times 200\ cm^2}{10,000\ cm^2} = 0.02\ m^2$$
$$Pressure = \frac{Force}{Area}$$
But,
$$Force = mass \times acceleration$$
$$= 8000kg \times 10\ ^m/_{s^2}$$
$$= 80,000N$$
$$Pressure = \frac{80,000N}{0.02\ m^2}$$
$$= 4,000,000\ ^N/_{m^2}$$
$$= 4,000,000\ Pa$$
$$\therefore The\ pressure\ exerted\ on\ the\ ground\ is\ 4,000,000\ Pa$$

7. (a) Centre of gravity is a point where all the weight of a certain body are concentrated WHILE Centre of mass is a point where all the mass of a certain body is concentrated.

(b) In order to keep the body's centre of gravity to be low so as the person can be stable while climbing the mountain.

(c) Given that,
Moment of mass (m) = 320 Nm

Force (F) = 120 N

Distance (d) =?

From,

$$moment\ of\ force = force\ (F) \times distance(d)$$
$$320Nm = 120N \times d$$
$$d = \frac{320\ Nm}{120\ N}$$
$$d = 2.67m$$
$$\therefore The\ length\ of\ the\ spanner\ is\ 2.67\ m$$

8. (a) Newton's second law of motion states that "*The rate of change of momentum of an object is directly proportional to the applied force and takes place in the direction of force*".

(b) (i) Rocket propulsion: Rockets remove some gas to the ground which exerts a force on the ground, the ground then exerts a force equal to the one from the rocket and thus enables it to be launched.

(ii)Jumping castles: In jumping/bouncing castles, one exerts a force on the bouncing castle then exerts a force equal to the persons force, onto the person which enables the person to bounce back.

(c)   Solution

Mass of ball, A (M_A) = 100 g = 0.1 kg

Velocity of A (U_A) = 5 m/s

Mass of ball B (M_B) = 500 g = 0.5 kg

Velocity of B (U_B) = -1 m/s

From, The principle of conservation of linear momentum.
$$Total\ momentum\ before\ collision = Total\ momentum\ after\ collision$$
$$Momentum = m \times v$$
So,
$$(M_A \times u_A) + (M_B \times u_B) = (M_A + M_B)v$$
That is;
$$(0.1kg \times 5\,{}^m/_s) + (0.5kg \times -1\,{}^m/_s) = (0.5kg + 0.1kg)v$$
$$0.5kg\,{}^m/_s + -0.5kg\,{}^m/_s = v \times 0.6\ kg$$
$$0\ kg\,{}^m/_s = v \times 0.6kg$$
$$v = \frac{0kg\,{}^m/_s}{0.6\ kg} = 0\,{}^m/_s$$
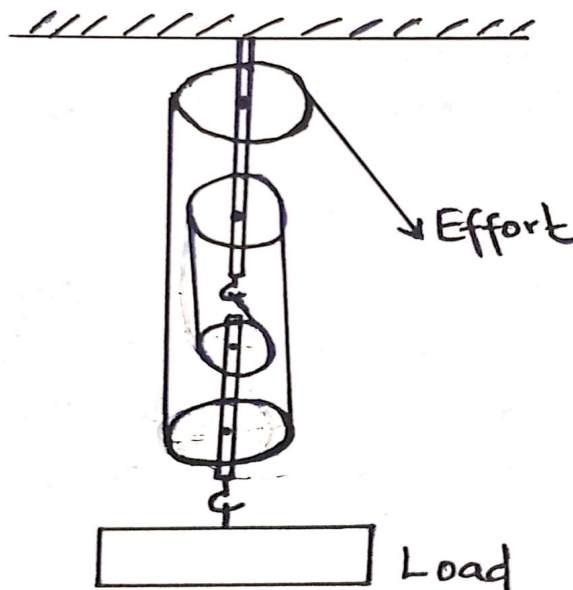$$velocity = 0\,{}^m/_s$$
$$\therefore The\ common\ velocity\ (v)\ is\ 0\,{}^m/_s$$

(ii)The type of collision is inelastic collision

SECTION C

9. (a) The inclined plane has a slanted length which makes a higher effort distance, the longer the effort distance in a plane (inclined plane) the easier it is to move a load from one point to another.

(b) Diagram

(c) (i) Mechanical advantage of a pulley.
Given that;

Velocity ratio (V.R) = Number of pulleys = 8
Effort (E) = 200 N
Efficiency (Eff) = 80%
Mechanical advantage (M.A) =?

From,

$$Efficiency = \frac{M.A}{V.R} \times 100\%$$
$$80\% = \frac{M.A}{8} \times 100\%$$
$$M.A = \frac{80\% \times 8}{100\%} = 6.4$$

$\therefore$ *The mechanical advantage of the pulley system is* 6.4

(ii) The maximum load that can be raised by the effort.
 Given that,
Effort (E) = 200 N
Load =?
Mechanical advantage (M.A) = 6.4

From,

$$M.A = \frac{load}{effort}$$

$$6.4 = \frac{load}{200N}$$

$$Load = 6.4 \times 200N$$

$$= 1280 \, N$$

$$\therefore The \ maximum \ load \ that \ can \ be \ raised \ by \ the \ effort \ is \ 1280 \, N$$

10. (a) Diagram
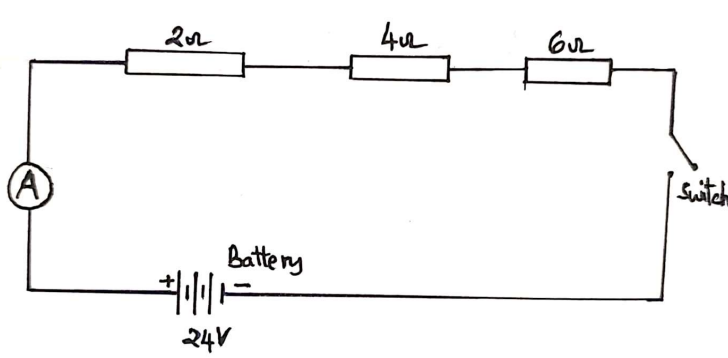
(b)   Solution

$$Total \ resistance \ = \ 2\Omega \ + \ 4\Omega \ + \ 6\Omega$$

$$= 12\Omega$$

$$from, I = \frac{V}{R}$$

$$I = \frac{24V}{12\Omega} = 2A$$

$$\therefore The \ current \ flowing \ in \ the \ circuit \ is \ 2A$$

(c) Given that,

$$I = 2A, \quad R_1 = 2\Omega, \quad R_2 = 4\Omega, \quad R_3 = 6\Omega, \ V =?$$

(i)   Potential difference at R_1

        From,

$$V = IR$$

$$= 2A \times 2\Omega$$

$$= 4V$$

$$\therefore Potential \ difference \ at \ R_1 \ is \ 4V$$

(ii)   Potential difference at R_2

        From,

$$V = IR$$

$$= 2A \times 4\Omega$$

$$= 8V$$

$$\therefore Potential \ difference \ at \ R_2 \ is \ 8V$$

(iii)   Potential difference at R_3

from,

$$V = IR$$
$$= 2A \times 6\Omega$$
$$= 12V$$
$$\therefore Potential\ difference\ at\ R_3\ is\ 12V$$

FORM TWO NATIONAL ASSESSMENT: YEAR 2021
PHYSICS - ANSWERS
SECTION A

1.

i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv	xv	xvi	xvii	xviii	xix	xx
C	B	C	D	D	A	C	A	D	B	D	A	B	A	C	D	D	C	C	B

2.

i.	ii.	iii.	iv.	v.
C	G	E	A	F

3.
  i.   Fundamental physical quantity
  ii.   Velocity ratio is 5
  iii. $10 \, ^m/_{s^2}$
  iv.   Gold leaf electroscope
  v.   Diffusion

SECTION B

4. (a) (i) Joule is the amount of work required to move a body of a force of one newton in a distance of one metre in the direction of the force.
(ii) Energy is the ability to do work.
(iii) Watt is the amount of power required to do work of one joule in one second.

(b) The principle of conservation of energy states that "*Energy cannot be created or destroyed but can be transformed from one form to another*".

(c)   Solution
    Given that,
Mass (m) = 10,000kg
Speed (v) = 25 m/s
Kinetic energy (K.E) =?

From,

$$K.E = \frac{1}{2}mv^2$$
$$= \frac{1}{2} \times 10,000kg \times (25 \, ^m/_s)^2$$
$$= 5,000kg + 625 \, ^{m^2}/_{s^2}$$
$$= 3,125,000 \, Joules$$
$$\therefore Kinetic \; energy = 3,125,000 \, J$$

5. (a) When the body is moving or pulled along the ground with constant velocity, there is no external force acting on it therefore its acceleration is also zero since its acceleration is zero.

From the formula; $F = ma$, but $a = 0$, $F = m \times 0$ in which $F = 0$.

(b) The principle of conservation of linear momentum states that "*If there is no external force acting on a colliding system total momentum before collision is equal to total momentum after collision*".

(c)   Solution

$$Average\ force\ applied = \frac{\Delta P}{\Delta T}$$
$$= \frac{(V_f - V_i)m}{T}$$
$$= \frac{(80\ ^m/_s - 20\ ^m/_s)}{0.5s} \times 0.15kg$$
$$= 18N$$
$$\therefore Average\ force\ applied\ is\ 18N$$

6. (a) (i) Efficiency of a pulley is always less than 100% because of some energy is wasted due to friction

(ii) Due to energy loss during lifting of moving part of machines while doing work.

(b) (i) First class lever

(ii) Second class lever

(iii) Third class lever

Load movement direction

Load   Effort   Fulcrum
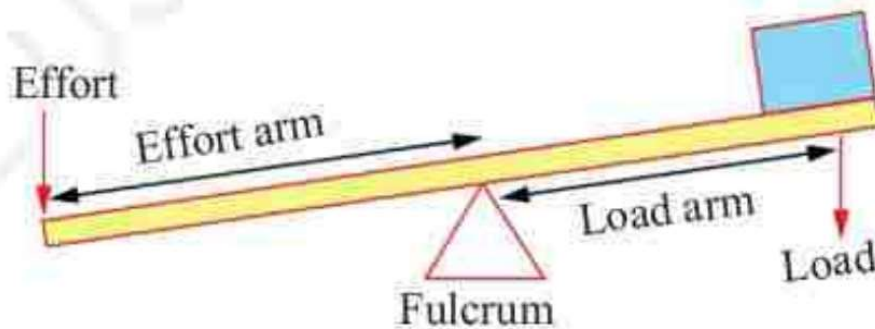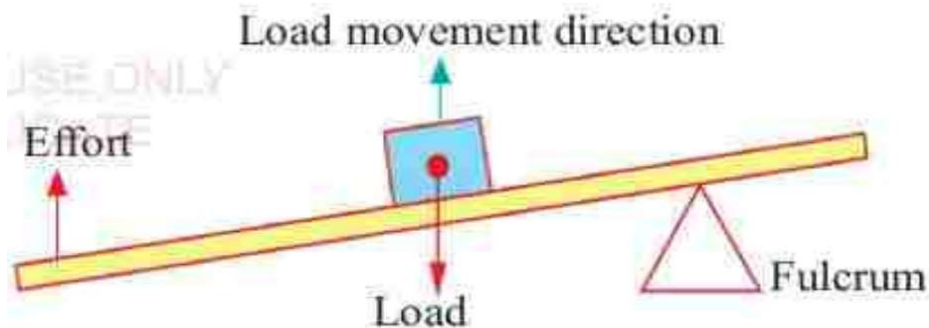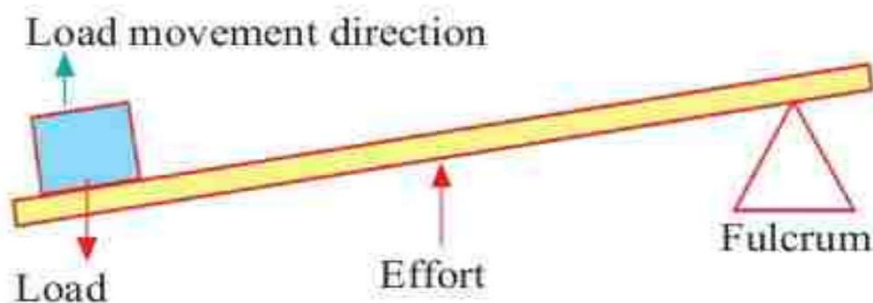
7. (a) Static equilibrium is the state of balance that a body has when in rest such that not moving WHILE Dynamic equilibrium is the state of balance that a body has when in motion, such that when it is moving.

(b) Mechanics use spanner of long stem because it increases the distance between the force and the line of action of force hence increasing the moment of a force. This makes it easier for the mechanic to tight or loosen a nut on a bolt.

(c)   Solution
     Given that,
Moment of force = 12000 NM
Magnitude of force = 6000 N
Perpendicular distance =?

From,
$$Moment\ of\ force = force\ \times perpendicular\ distance$$

$$Perpendicular\ distance = \frac{Moment\ of\ force}{Force}$$
$$= \frac{12000\ Nm}{6000N}$$

$$= 2\ m$$
$\therefore$ *The perpendicular distance between the point and the line of action of the force is* $2\ m$.

8. (a) Buildings are constructed with wide foundations so as to provide a maximum surface area which will in turn exert a minimum pressure on the ground thus prevent destruction of the building. That is why buildings are constructed with wide foundations.

(b) (i) Crashing can experiment.
    (ii) Glass tumbler experiment.

(c) (i)   Solution
      Given that,
Mass of woman = 64 kg
Area (A) = 2 cm^2
Pressure (p) =?

From,

$$Pressure = \frac{Force(F)}{Area(A)}$$

But,

$$Force = mass \times gravity$$
$$= 64kg \times 10 \, ^N/_{kg}$$
$$Force = 640N$$

$$1m^2 = 10,000 \, cm^2$$
$$? = 2 \, cm^2$$
$$= \frac{1m^2 \times 2 \, cm^2}{10,000 \, cm^2} = 0.0002 \, m^2$$

Now,

$$Pressure = \frac{Force}{Area}$$
$$= \frac{640N}{0.0002m^2}$$

$$= 3200000 \, ^N/_{m^2}$$

$$\therefore The \ pressure \ exerted \ by \ the \ woman \ on \ the \ ground \ is \ 3,200,000 \, ^N/_{m^2}$$

(ii) Her heel sink into the ground because her heel possesses a small surface area which will exert a maximum pressure on the ground and that is why it will sink in the ground.

SECTION C

9. (a) First equation:

$$v = u + at$$

Second equation:

$$s = ut + \frac{1}{2}at^2$$

Third equation:

$$v^2 = u^2 + 2as$$

Meaning of the symbols used in the equation;

$$v = final \ velocity$$
$$u = initial \ velocity$$
$$a = acceleration$$
$$t = time$$

$$s = displacement$$

(b) (i) Given that,

Football P:

$$m_p = 0.5kg$$
$$v = 12\,^m/_s$$

From,

$$momentum(p) = mass(m) \times velocity(v)$$
$$= 0.5kg \times 12\,^m/_s$$
$$= 6\,kg\,^m/_s$$
$$\therefore The\ momentum\ of\ ball\ P\ before\ collision\ is\ 6\,kg\,^m/_s$$

(ii) Given,

Mass of ball P = 0.5 kg
Velocity, v = 10 m/s

Solution.

$$Momentum = mass\ \times velocity$$
$$= mv$$
$$= 0.5kg \times 10\,^m/_s$$
$$= 5kg\,^m/_s$$
$$\therefore The\ momentum\ of\ ball\ P\ after\ collision\ is\ 5\,kg\,^m/_s$$

10. (a) A source of electric charge capable of producing electricity for example battery and a conductor through which electric charges are transferred from one point to another for example wire.

(b) Resistance is the opposition of flow of electric charges WHILE resistors are instrument designed to offer resistance or oppose the flow of electric charges.

(c) Diagram
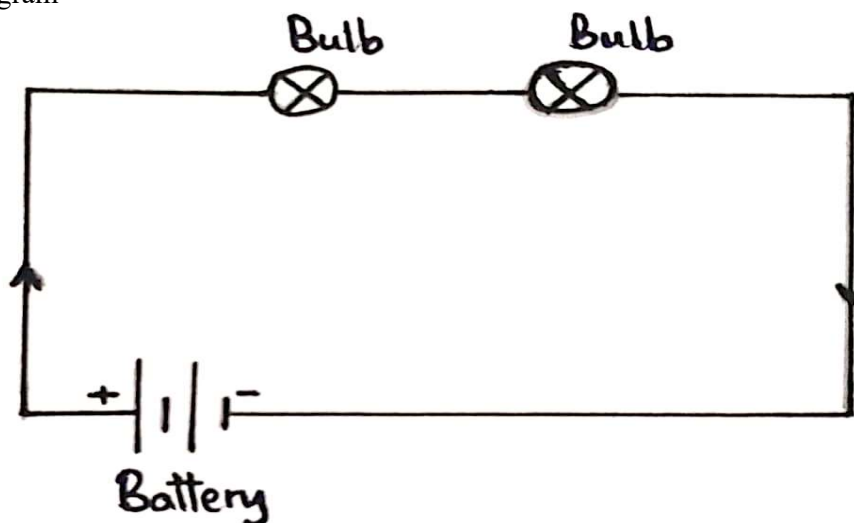
FORM TWO NATIONAL ASSESSMENT: YEAR 2022
PHYSICS - ANSWERS
SECTION A (15 Marks)

1.

i.	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.
B	A	B	A	C	C	C	C	B	C

2.

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

SECTION B (70 Marks)

3. (a)

Ferromagnetic materials	Paramagnetic materials
i. Are materials used to synthesize permanent magnet. ii. Examples are iron, cobalt and nickel.	i. Are materials used to synthesize temporary magnet. ii. Examples are copper and chromium.

(b) The appropriate ways of storing magnets so that can last longer. (**Any 3 points**).
   i. Store magnets in pairs with unlike poles facing each other and piece of magnetic keeper of its ends.
   ii. Avoid keeping magnet near ferrous objects. Example steel shelves.
   iii. Don't put magnets in strong magnetic or electric field.
   iv. Do not put at an over heat place.
   v. Do not subject magnet from any severe stress like vibrations or mechanical impacts.

4. (a) Matter is made up of tiny particles which are in constant motion. As temperature increases the movement/motion of particles also increases in matter and vice versa when the temperature is reduced.
   (b) (i) Given that;
$$Temperature\ (T) = 350K$$
$$From,\quad X°\text{C} = K - 273$$
$$X°\text{C} = 350K - 273 = 77°\text{C}$$
$$The\ temperature\ in\ celsius\ scale\ is\ 77°\text{C}$$

   (ii) Given that;
$$T_1 = 15°\text{C},\qquad T_2 = 45°\text{C}$$
$$Equilibrium\ temperature = \frac{T_1 + T_2}{2}$$
$$T = \frac{15°\text{C} + 45°\text{C}}{2}$$
$$T = \frac{60}{2} = 30°\text{C}$$

Then,
$$K = 273 + 30 = 303K$$
$$The\ equilibrium\ temperature\ after\ mixing\ was\ 303K$$

5. (a) (i) Weight (force of gravity) and
   (ii) Normal reaction force.

   (b) (i) Third Newton's law of motion, i.e "*To every action there is equal and opposite reaction*"

   (ii)   Solution
   Given that,
   Mass of body (M_b) = 55 kg
   Initial velocity of body (U_b) = 5 m/s
   Mass of trolley (M_t) = 90 kg
   Initial velocity of trolley (U_t) = 0 m/s
   Then,
   From the law of conservation of linear momentum.
   $$M_b U_b + M_t U_t = (M_b + M_t)V$$

   $$(55kg \times 5\,{}^m/_s) + (90kg \times 0\,{}^m/_s) = (55kg + 90kg)V$$

   $$275kg\,{}^m/_s + 0 = 145kg.V$$

   $$\frac{275kg\,{}^m/_s}{145kg} = \frac{145kg.V}{145kg}$$

   $$V = 1.89655\,{}^m/_s \approx 1.9\,{}^m/_s$$
   $$\therefore The\ initial\ speed\ of\ the\ trolley\ was\ 1.897\,{}^m/_s$$

6. (a) Acceleration is not a scalar quantity; it is a vector quantity since it is a rate of change of velocity and not speed.

   (b)   Solution

   Given that,
   Initial speed (U) = 0 m/s
   Final speed (V) = 80 m/s

   (i)   Height above the ground (h) =?
           From the Newton's third equation of motion.
           $$V^2 = U^2 + 2gh$$
           Then,
           $$(80\,{}^m/_s)^2 = (0\,{}^m/_s)^2 + \left(2 \times 10\,{}^m/_{s^2} \times h\right)$$
           $$6400\,{}^{m^2}/_{s^2} = 0\,{}^{m^2}/_{s^2} + 20\,{}^m/_{s^2}\,h$$

$$\frac{20\,{}^{m}/_{s^2}\,h}{20\,{}^{m}/_{s^2}} = \frac{6400\,{}^{m^2}/_{s^2}}{20\,{}^{m}/_{s^2}}$$

$$h = 320\,m$$

$$\therefore The\ height\ of\ the\ bird\ from\ the\ ground\ was\ 320\,m$$

(ii)   Time taken by the bird to hit the ground.
        From the 1ˢᵗ equation of motion.

$$V = U + gt$$

$$80\,{}^{m}/_{s} = 0\,{}^{m}/_{s} + \left(10\,{}^{m}/_{s^2} \times t\right)$$

$$\frac{10\,{}^{m}/_{s^2}\,t}{10\,{}^{m}/_{s^2}} = \frac{80\,{}^{m}/_{s}}{10\,{}^{m}/_{s^2}}$$

$$t = 8\,seconds$$

$$\therefore Time\ taken\ was\ 8\,seconds$$

(b) (ii) Alternatively; The second equation of motion.

$$s = ut + \frac{1}{2}gt^2$$

From above,

$$320 = (0 \times t) + \left(\frac{1}{2} \times 10\,{}^{m}/_{s^2} \times t^2\right)$$

$$320 = 5t^2$$

$$\frac{5t^2}{5} = \frac{320}{5}$$

$$t^2 = 64$$

$$t = 8\,seconds$$

$$\therefore The\ time\ taken\ was\ 8\,seconds$$

7. (a) (i) -Inclined plane
           -Screw jack
           -Pulley system

     (ii) The mechanical advantage and velocity ratio depends much on the angle of inclination the easier it to move the load (The smaller the mechanical advantage and velocity ratio) and vice-versa.

    (b)   Solution

     Given that,
    The length of the screw jack handle = 40 cm
    Pitch (p) = 0.5 cm
    Mass of a car (m) = 350 kg
    Efficiency (e) = 45%
    Amount of force applied at the end of the handle =?
    From,

$$V.R = \frac{2\pi R}{Pitch}$$

$$V.R = \frac{2 \times 3.14 \times 40cm}{0.5cm} = 502.4$$

Also,

$$Efficiency = \frac{M.A}{V.R} \times 100\%$$

$$M.A = \frac{Efficiency \times V.R}{100\%}$$

$$= \frac{45\% \times 502.4}{100\%}$$

$$M.A = 226.08$$

But,

$$M.A = \frac{Load}{Effort}$$

$$Load = mass \times gravity$$

$$= 350kg \times 10\,^N/_{kg}$$

$$Load = 3500N$$

Then,

$$Effort = \frac{Load}{M.A}, \qquad Effort = \frac{3500N}{226.08} = 15.48N$$

$$\therefore The\ amount\ of\ force\ applied\ at\ the\ end\ of\ the\ handle\ was\ 15.48N$$

8. (a) (i) Centre of mass it is the mass at which all mass forming a particle appears to be concentrated.

(ii) Moment of force is the product of force and its perpendicular distance of its line of action from the point.

(b)   *Solution*

From,

$$The\ sum\ of\ downward\ forces = Sum\ of\ upward\ forces$$
$$9N = P + Q$$

Also,

$$Sum\ of\ clockwise\ moment = Sum\ of\ anticlockwise\ moment$$

Now,

$$Take\ a\ moment\ about\ point\ (support)\ D.$$
$$9N \times 30cm = 100cm \times Q$$
$$270cm.N = 100cm.Q$$
$$\frac{100cm.Q}{100cm} = \frac{270cm.N}{100cm}$$

$$Q = 2.7N$$

Substitute the value of Q into equation (i)

$$9N = P + Q$$
$$9N = P + 2.7N$$
$$P = 9N - 2.7N$$
$$P = 6.3N$$
$$\therefore The\ reaction\ P\ was\ 6.3N\ and\ Q\ was\ 2.7N$$

Alternatively;

$$9N \times 70cm = P \times 100cm$$
$$P = \frac{9N \times 70cm}{100cm}$$
$$P = 6.3N$$

From the equation;

$$9N = P + Q$$
$$Q = 9N - 6.3N$$
$$Q = 2.7N$$
$$\therefore P\ was\ 6.3N\ and\ Q\ was\ 2.7N$$

9. (a) Water energy sources because;
    i.   Water is virtually available from various sources.
    ii.   It is environmentally friendly.
    iii. It is more reliable than other sources.
    iv.   Water energy increases power very quickly.
   v.   Electricity can be general constant since there is constant flow of water.

   Alternatively, it is wind energy.
    i.   Windmills are efficient, if there is constant wind speed.
    ii.   Can produce much power if there is constant speed and good direction of wind.
   (b) People are warned not to build near geothermal power plant because;
    i.   This energy is hotter and can burn houses and other properties.
    ii.   This energy is associated with earthquake and volcanic activities which are dangerous for settlements. Example can cause house to collapse.

SECTION C (15 Marks)

10. (a) Five (5) electrical components are;
    i.   Variable resistor/rheostat
    ii.   Cell/battery
    iii. Connecting wires
    iv.   Voltmeter
    v.   Ammeter
    vi.   Switch

(b) Diagram of simple electric circuit.
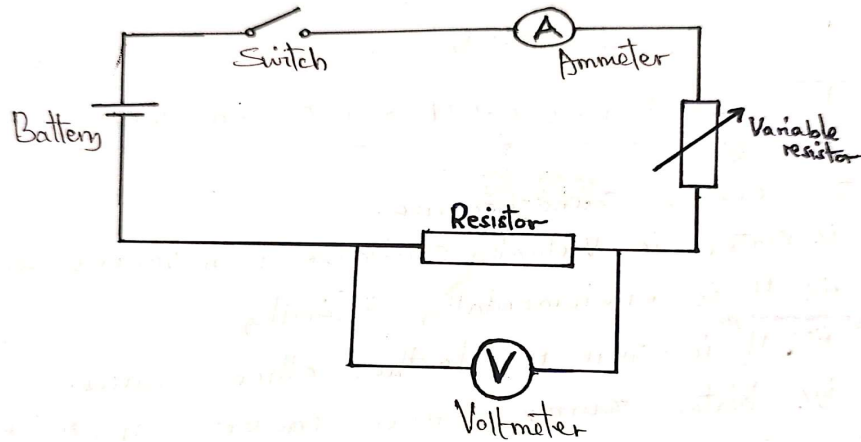
(c) The ammeter should be connected in series with voltmeter and source of current (cell or battery) while voltmeter should be connected parallel with the constant resistor.

FORM TWO NATIONAL ASSESSMENT: YEAR 2023
PHYSICS - ANSWERS
SECTION A (15 Marks)

1.

i.	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.
A	C	D	C	B	D	A	B	D	B

2.

i.	ii.	iii.	iv.	v.
B	C	D	E	A

SECTION B (70 Marks)

3. (a) Ways in which magnet can be destroyed (demagnetization)
   (i)   By dropping a magnet on the floor or a hard surface in a number of times.
   (ii)   By hammering the magnet repeatedly.
   (iii)   By heating the magnet to a very high temperature.
   (iv)   By passing alternating current around the magnet.

   (b) Applications of magnets in our daily life are;
   (i) TVs, sound speakers and radios: The small coil of wire and a magnet inside a speaker transforms the electronic signal to sound vibrations.
   (ii) Electric generators: Magnets are used inside a generator to transform mechanical energy into electrical energy.
   (iii) Credit, debit and ATM cards to protect data.
   (iv) Computers: Magnetic elements on a hard disk help to represent computer data, which is later 'read' by computer to extract information.
   (v) Transformers: Transformers has a soft iron magnetic core inside to transform mechanical energy to electrical energy.

4. (a) Function of the constriction in a clinical thermometer is to break the column of mercury so that it cannot return to the bulb, thus remaining stationary in the tube even when temperature falls.
   (b) The principle in which the liquid in glass works; The liquid in the glass consists of reservoir of liquid which expands or contracts causing the height of the liquid in the capillary tube to rise or fall in response to the temperature to be measured.
   (c) Fahrenheit and Celsius scale give the same reading at $-40°C \ and -40°F$.

5. (a) (i) This because the force (push) depends much on the mass of an object. The man failed to push the car because the car has greater mass compare to the motorcycle, hence it needs a greater force to push a car which cannot be attained by a single man.

   (ii) This statement is not true since the object on a state of rest has its force acting on it due to its weight and the reaction force.
   Also the moving object in a uniform motion has the force due to its acceleration and the force of friction which acts antagonist to each other.

(b) Given that
$$M_1 = 350kg$$
$$V_1 = 120 \, km/hr = (120 \times 1000/3600) \, m/s = 33.33 \, m/s$$
$$M_2 = 1000kg$$
$$V_2 = 40 \, km/hr = (40 \times 1000/3600) \, m/s = 11.111 \, m/s$$

From;
$$Momentum(P) = mass \times velocity$$
$$P = mv$$

Now;
$$P_1 = m_1 v_1 \text{ and } P_2 = m_2 v_2$$

So,
$$P_1 = 350kg \times 33.33 \, m/s = 11665.5kg \, m/s$$
$$P_2 = 1000kg \times 11.111 \, m/s = 11111kg \, m/s$$
$$\therefore The \ momentum \ were \ 11,665.5kg \, m/s \ and \ 11,111kg \, m/s \ respectively.$$

(c) Given that;
Mass = 50kg
Force = 20N
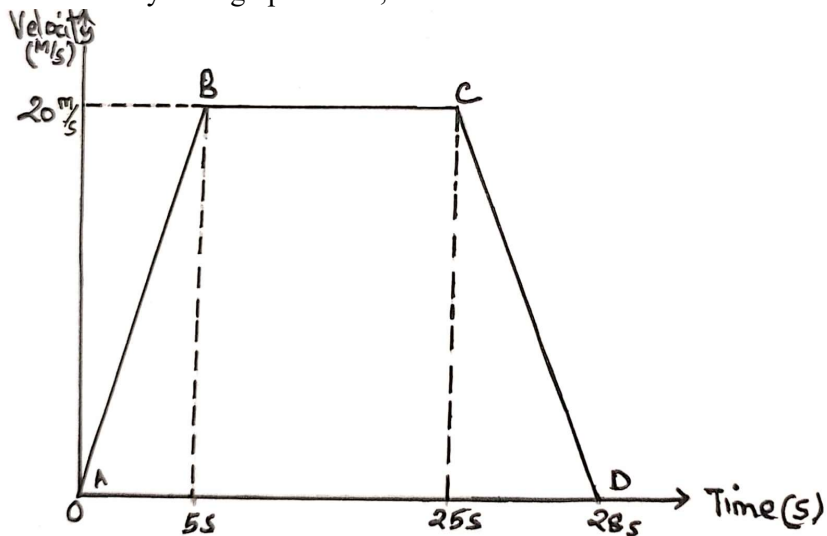Time = 3s
Required, acceleration (a)
From;
$$F = ma$$
$$a = \frac{F}{m}$$
$$a = \frac{20N}{50kg}$$
$$a = 0.4 \, N/kg$$
$$\therefore The \ acceleration \ of \ the \ body \ was \ 0.4 \, m/s^2$$

6. Consider the velocity time graph below;

From;

$$The\ total\ distance\ =\ Total\ area\ under\ the\ graph$$

$$Area\ of\ trapezium\ =\frac{1}{2}(a+b)h$$

$$=\frac{1}{2}(BC+AD)h$$

$$=\frac{1}{2}(20+28)20$$

$$=48\times10$$

$$=480m$$

$$\therefore The\ total\ distance\ covered\ by\ a\ car\ was\ 480m$$

7. (a) An inclined plane is regarded as a simple machine because it requires an application of single force to do works as it made up of smooth flat rigid surface slanted at angle to horizontal.

(b) (i) Given that;
Efficiency, e, = 85%
Load, L, = 6000N
R = 50cm
r = 15cm
from;

$$V.R=\frac{R}{r}=\frac{50cm}{15cm}=3.333$$

$$\therefore The\ velocity\ ratio\ of\ wheel\ and\ axle\ is\ 3.333$$

(ii) Mechanical advantage
From;

$$Efficiency\ (e)=\frac{M.A}{V.R}\times100\%$$

$$M.A=\frac{e\times V.R}{100\%}$$

$$M.A=\frac{85\%\times3.333}{100\%}=2.833$$

$$\therefore The\ mechanical\ advantage\ (M.A)\ of\ wheel\ and\ axle\ is\ 2.833$$

8. (a) A body rotate when a force is applied on it because of having the moment when it is pivoted along the fixed point (fulcrum) during the application of force.
(b)   Solution
Diagram
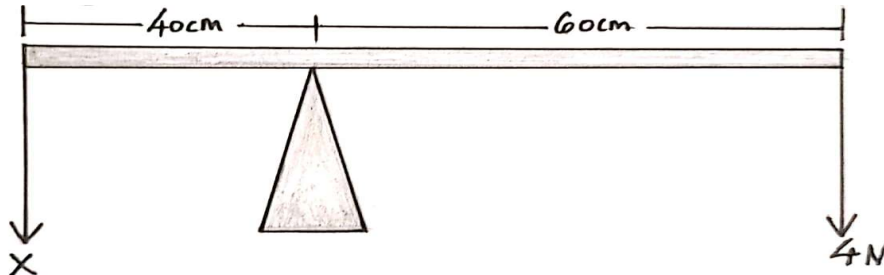
From; The principle of moment.
$$Sum\ of\ clockwise\ moment = Sum\ of\ anticlockwise\ moment.$$
$$4N \times 60cm = X \times 40cm$$
$$X = \frac{240Ncm}{40cm} = 6N$$
$$\therefore The\ value\ of\ force\ X\ was\ 6N\ to\ keep\ the\ rule\ in\ equilibrium.$$

9. (a) (i) Environmental safety
   Natural gas pollute environment by emitting carbon dioxide WHILE Geothermal
   energy can cause heating or burning to the environment and other properties.

   (ii) Sustainability
   Geothermal energy is renewable since its source is natural heat generated and
   stored deep within the Earth's core WHILE Natural gas is cleaner burning of fossil
   fuel so it cannot be renewable hence, Geothermal energy is sustainable.

   (b) The solar cars are better than petrol cars because;
   (i) Solar cars are environmental friend since do not emit harmful gases.
   (ii) Solar cars reduced noise pollution.
   (iii) It cost less in daily uses since do not use fuel, fuel cost goes down which saves
   a lot of money.

   (c) Disadvantages of hydroelectric power.
   (i) Hydroelectric power production will depend on the amount of rainfall in the
   area. During drought can drop considerably.
   (ii) It takes a lot of time to construct and it is costful to construct the dam and other
   resources to install.
   (iii) It causes environmental destruction; If H.E.P is man made, the construction of
   dams has a habitat, flood previously dry areas, may require the appropriation of
   land, leading to the relocation of local communities, change in water quality.

SECTION C (15 Marks)
10. (a) Ammeter is connected in series as it measures current flowing into the components,
    where a voltmeter is connected parallel as it measures the voltage across to ends of the
    conductor.

    (b) Given that;
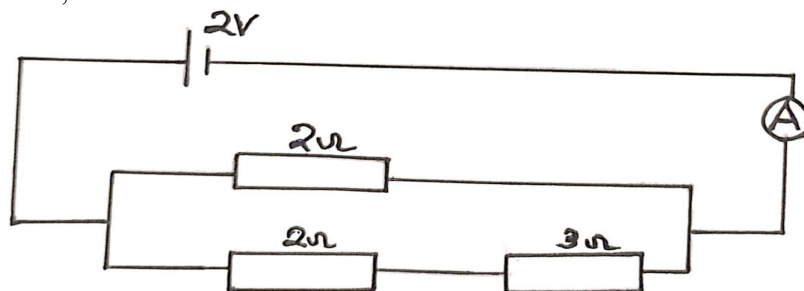
Potential difference (V) = 2V

Resistor 2Ω is in parallel with resistors 2Ω and 3Ω which are connected in series.

The equivalent resistance of 2Ω and 3Ω is given as;

$$= 2\Omega + 3\Omega = 5\Omega$$

Now, 5Ω and 2Ω become in parallel to each other.

For parallel connection; the equivalent resistance is obtained as;

$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_T = \frac{2 \times 5}{2 + 5} = \frac{10}{7} = 1.43\Omega$$

From, Ohm's law

$$I = \frac{V}{R}$$

$$I = \frac{2V}{1.43\Omega} = 1.4A$$

$$\therefore The\ ammeter\ reading\ was\ 1.4A$$