A. OPTICS

1. Define the word**"light"** and any two of its importance.

2. Differentiate the transparent, translucent and opaque materials. Give any two examples for each.

3. (a) Differentiate a light ray from a light beam.

(b) Using ray diagrams, explain the three types of beam of light rays.

4. (a) Using a well labeled diagram, explain how the umbra can be formed only.

(b) Using a well labeled diagram, explain how the umbra and the penumbra can be formed simultaneously.

5. (a) Differentiate luminous from non-luminous sources of light. Give two examples for each

(b) Using a well labeled diagram show how the moon and the sun give the light to the earth.

6. (a) Differentiate the shadow from an eclipse.

(b) Differentiate the solar eclipse from lunar eclipse. Include well labeled diagrams in your answer.

7. (a) What is the reflection of light?

(b) Using a well labeled diagram show how the above phenomenon occurs.

(c) State the two laws of reflection of light.

(d) A ray of light is incident towards a plane mirror at an angle of 30^0 with the mirror surface. What will be the angle of reflection?

(e) Using well labeled diagrams differentiate the two types of reflection of light.

8. (a) What is a plane mirror?

(b) Using a well labeled diagram show how the image of a point object can be formed through a plane mirror.

(c) Mention any three properties of the image formed by a plane mirror.

(d) State any three applications of plane mirrors.

9. (a) Two plane mirrors are kept inclined to each other. Calculate the number of images formed for the following angles of inclination

(i) 120° (ii) 90. (iii) 60° (iv) 30°

(b) Which of the above set up is used in the construction of a kaleidoscope?

10. (a) What is a spherical(curved) mirror?

(b) Differentiate concave mirror from convex mirror. Include ray diagrams in your answer.

(c) Differentiate parabolic mirror from ellipsoidal mirror. Include ray diagrams in your answer.

(d) state two uses of concave mirror and two uses of convex mirrors.

11. An upright pencil is placed 10.0cm from a convex spherical mirror with a focal length of 8.00cm.

(a) Find the position and the magnification of the image.

(b) Using a ray diagram draw the image and state its properties.

12. An object is placed (a) 20cm, (b) 4cm, in front of a concave mirror of focal length 12cm.

    (i) Find the nature and the position of the image formed in each case.

    (ii) Using a ray diagram draw the image formed on each case and state their properties.

13. (a) An object of height h = 4cm is placed a distance p = 15cm in front of a concave mirror of focal length f = 20cm.

  i) What is the height, location, and nature of the image?

  ii) Suppose that the object is moved to a new position a distance p = 25cm in front of the mirror. What now is the height, location, and nature of the image?

(b) A dental technician uses a small mirror that gives a magnification of 4.0 when it is held 0.60cm from a tooth. What is the radius of the curvature of the mirror?

B. ELECTROMAGNETISM

1. (a) What is a magnet?

  (b) Differentiate magnetic materials from nonmagnetic materials.

    Give three examples for each.

2. (a) State the basis law of magnetic poles.

  (b) . Two steel pins were attracted by a magnet. When a south pole was brought in between the two pins, the pins moved further away. Explain why the pins moved apart.

3. What is the main difference between a ceramic magnet and a bar magnet?

4. You have been provided with the following;

(a) a rod labelled S, which is a magnetic material.

(b) a rod labelled N, which is a non-magnetic material.

Explain how you would identify them.

5. (a) Name four types of magnets according to shapes.

  (b) State two properties of a magnet.

  (c) Draw the magnetic field pattern of two bar magnets where two like poles facing each other. Label the neutral point X on your diagram.

6. (a) Define: i) Magnetization   ii) Demagnetization

  (b) State any two methods of magnetization.

  (c) State any two methods of demagnetization.

7. (a) what are magnetic keepers?

  (b) Using a well labelled diagram, show how they work.

8. (a) Use the domain theory of magnetism to explain the magnetic behaviour of Iron.

  (b) State the difference between the magnetic properties of iron and steel.

9. How do magnetic shields work?

10. (a) Name the types of magnets according to the ability of keeping magnetism.

(b) State two applications for each type.

(c) Using a well labelled diagram, explain how an electric bell rings due to magnetic effect of an electric current.

C. ELECTRICITY

1. Define the following terms:

  (a) Electrostatics   (b) Electric charge   (c) Electric circuit

2. (a) Differentiate conductors from insulators. Give two examples for each.

   (b) Differentiate electric field from electric potential.

3. (a) State the Coulomb's law of electrostatics.

   (b) Determine the electrical force of attraction between two balloons with separate charges of $+3.5 \times 10^{-8}$ C and -2.9×10^{-8} C when separated by a distance of 0.65 m.

      Use Coulomb's constant $k=9x10^{-9}Nm^2/C^2$

  (c) Is the electrostatic force calculated on (b) attractive or repulsive? Explain your answer.

4. (a) What is a gold leaf electroscope?

   (b) Mention any three uses of a gold leaf electroscope.

   (c) A gold leaf electroscope is positively charged. Explain how to use this electroscope to test the charges on two rods, where one is negative and the other positive.

5. (a) A polythene rod is rubbed with with the wool.

        (i) Which charge will the polythene acquire?

        (ii) Which charge will the wool acquire?

   (b) The glass is rubbed with a silk cloth.

        (i) Which charge will the glass acquire?

        (ii) Which charge will the silk acquire?

6. (a) Differentiate the method of charging by induction from charging by contact.

   (b) Using well labeled diagrams show how two uncharged conductors may be charged simultaneously.

7. (a) A current of 0.12 A flows in a circuit for 9 minutes. How much charge passes through a given point in the circuit?

(b)Calculate the amount of charge that passes through a point in a circuit in 6hours, if the current in the circuit is 5mA.

8. A current of 6 A is passed through a resistor of 30 Ω m for 1.5 hours. Calculate:

   (a) The potential difference across the terminals of a resistor.

   (b) The electrical power dissipated through the resistor.

   (c) The heat energy absorbed by the resistor.

9.(a) What is the use of ammeter and voltmeter in electric circuit.

  (b) Use a well labeled diagram show how the above instruments are connected in the electric circuit. Give a brief explanation for each connection.

10. (a) Three resistors with 2 ohms , 4 ohms and 6 ohms are connected in parallel, then disconnected and connected again in series. Calculate their total resistance:
  (i) In parallel connection
  (ii) In seres connection
  (b) Mention any three advantages of connecting resistors in parallel.

D. ELECTRONICS

1. Differentiate:
   (a) Electronics and Electricity
   (b) Semiconductor and conductor
2. Mention any three :
  (a) electronic devices.   (b) electronic components
3. (a) What is the use of capacitors in electronic devices.
   (b) Differentiate a diode from a transistor.
 4. (a) State any five types of diodes.
    (b) What is a motherboard for an electronic device.
5. (a) A semi-conductor is formed by ……… bonds.
     i.Covalent ii.Electrovalent.   iii. Co-ordinate.   iv.None of the above
    (b) The most commonly used semi-conductor is ………..
   i. Germanium.   ii.Silicon.   iii.Carbon.   iv.Sulphur
6. (a) Differentiate semi-conductors, conductors and insulators on the basis of band gap.
    (b) Is a hole a fundamental particle in an atom?
    (c) Define a hole in a semi-conductor.
7. (a) Why silicon and germanium are the two widely used semi-conductor materials?
   (b) Explain how watches can be considered as an electronic device.
8. (a) State and differentiate the two types of transistors.
    (b) Using a well labeled diagram show how a transistor works as an amplifier.
    (c) How does a diode work as a rectifier.

9. (a) Explain how diodes are used as rectifiers.
  (b) Using well labeled diagram show how a half-wave rectification can be done.
 (c) Using a well labelled diagram show how a full wave rectification can be done.
10. (a) Differentiate an ordinary diode from a zener diode.
    (b) You are provided with three electric components namely: one ordinary diode, one resistor, one dry cell and connecting wires. Use the symbols of these elements to draw a complete electric circuit such that the ordinary diode is forward biased.
   (c) State and explain the two types of electronic components. Give two examples for each.

E. MECHANICS AND HEAT

1. Explain what is meant by average speed. State the unit of average speed
2. A force of $25N$ acts on a mass of $5kg$ starting from rest. Find the acceleration.
3. What is the difference between mass and weight? State the unit of each quantity.
4. Draw a cone
   a) In a stable equilibrium
   b) In unstable equilibrium
   c) In a neutral equilibrium
5. Calculate the power of a pump which can lift $300kg$ of water through a vertical height of $8m$ in $10\sec$, $g = 10m/s^2$.
6. a) What is meant by the term density of a body?
   b) A body has a volume of $15cm^3$ and mass of $27g$ what is its density? Give the answer in kg/m^3.
7. The diagram shows a balancing uniform rod.
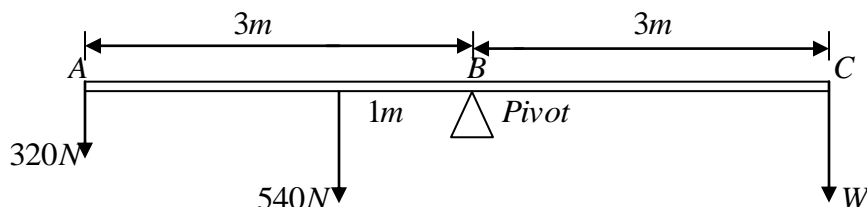
   Calculate force W.
8. a) List energy changes which occur when a torch is switched on
   b) Which are other sources of electricity other than hydroelectric power in Rwanda?
9. a) State Archimedes' principle
   b) a piece of a metal is weighed (i) in air
                              (ii) full submerged in water
                              (iii) full submerged in a salt solution

   The results obtained, but not in correct order, were $6N$, $5N$ and $8N$. Which reading was obtained for b) (i), b) (ii) and b) (iii)?
10. Explain how heat is transferred in water.
11. a) Define the term specific heat capacity of a substance
    b) A piece of Aluminium of mass $600g$ is heated from 25^0C to 100^0C. How much heat is supplied if the specific heat capacity of aluminium is $900J/kgK$? What is the heat capacity of this metal?
12. a) What is meant by i) potential energy?
                        ii) Kinetic energy?
    b) An orange of mass $80g$ falls from its tree $2m$ high above the ground. Calculate the potential energy of the orange before it falls from its tree. Find the kinetic energy of the orange as it hits the ground.
13. a) Which instrument would you use to measure atmospheric pressure?

b) With aid of a diagram show and explain that air of atmosphere exerts force

c) Calculate the pressure exerted by water at $10m$ below the surface of the water in a lake. $g = 10N/kg$ and the density of water $\rho = 1000kg/m^3$

14. A car of mass $15000kg$ travelling at $72km/h$ is brought to rest in $5\sec$. Find

a) The average deceleration

b) The average breaking force

c) The distance moved during the deceleration

15. A student carried out an experiment to determine the density of a liquid. Different masses of the liquid were measured and their respective volumes. The table below shows the results obtained.

Mass/g	Volume/cm^3
4	5
8	10
12	15
16	20
20	25
24	30

a) Plot a graph of mass (Y-axis) against volume (X-axis)

b) Does the graph start from the origin? Explain your answer.

c) Determine the density of the liquid from the graph. Show on the graph how you get your answer.

16. A barge of $40m$ long and $8m$ wide whose sides are vertical is floating in water. If $125000N$ of cargo is added, what depth will it sink? use $g = 10N/kg$ and the density of water $1000kg/m^3$.

17. A block of mass $5000g$ is pulled from rest on horizontal frictional surface by a constant force. if the block moves $8m$ in $2\sec$, find a) the acceleration

b) the force.

18. a ball of mass $800g$ falls from a height of $20m$

a) Calculate its kinetic energy almost striking the ground

b) If it loses 5% of the energy with which it strikes the ground,

i) How high (height) does the ball rise on the bouncing?

ii) With what velocity does the ball bounce?

19. Using diagram of sea breezes and land breezes, give three differences between them

20. a) State five effects of heat

b) What is the normal temperature of human body?

c) State the quantities which have the same unit as heat.

21. $2kg$ of ice at $-10^0 C$ is heated to a steam of $100^0 C$,

a) Draw a temperature-time graph

b) Calculate the amount of heat absorbed.

Use specific heat capacity of ice $2100J / kg^0 C$, specific heat capacity of water: $4200J / kg^0 C$, specific latent heat of fusion: $340000J / kg$ and specific heat capacity of vaporization: $2260000J / kg$.