Ordinary level detailed course content and a simplified approach to answering ordinary level physics
(535/1, 2) -2020 edition by Ivan Zizinga (B.Sc. Education-MUST)

TECHNIQUE: READ, RECITE AND REVIEW (The three R's of revising physics)

This subject piece is specifically prepared to help learners excel in there ordinary physics examinations.

It can be used by all classes and teachers to help them prepare their learners for 535/1 and 535/2.

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"Embrace group discussions, consult your teachers, make use of text books and work out UNEB past papers for at least 15 years" Success to all my 2020 S.4 candidates"

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Physics key words and phrases

The following key words and phrases are commonly used in examination questions. Please read carefully to understand the requirements of each term/phrase to help you score highly.

1. Define: it requires you to "state precisely the meaning of terms or words". A formal statement is required and must be precise. Do not use formula or equations to define E.g.

-Define the term density, define an ampere

-Define moment of a force

-Define the following terms Frequency and wavelength

-Define an echo

-Define hard magnetic materials and soft magnetic materials

-Define temperature and specific heat capacity

-Define the term half life

2. State: a concise answer with no supporting argument. Just like definitions, statement of physical laws must be precise. E.g.

-State the S.I unit of pressure, state Ohm's law

-State the law of conservation of momentum

-state any two ways of demagnetizing a bar magnet

-State the factors which affect the frequency of a vibrating string

-State the laws of reflection

-state two physical properties which change with temperature

-State the conditions under which electrons can be used to generate X-rays

3. What is meant by ……or what do you understand by…… Normally implies that a definition should be given, together with some relevant comment on the context of terms concerned. E.g.

-What is meant by internal resistance of a cell?

-What is meant by momentum?

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-What is meant by the term elasticity?

-What is meant by pressure?

-What is meant by light?

-What is meant by thermionic emission?

4. Explain: Give a detailed account of something. Use basic physics principles to justify or clarify the explanation. A graph or diagram will often be useful. E.g.

-Explain what happens to a ball bearing released in a viscous fluid in a tall cylinder.

-Explain why one feels more pain when pricked with a needle than when pricked with a nail

-With the help of sketch diagrams, explain the effect of size of a gap on diffraction of waves -Explain the difference between a voltmeter and an ammeter in terms of their construction and use

-Explain why a wire heats up when a current is passed through it.

5. Describe: Give a detailed account or representation of something in words, always accompany your explanations with a detailed well labeled diagram

e.g. -Describe an experiment to verify Hooke's law using a spring.

-Describe an experiment to determine the mass of a uniform metre rule using the principle of moments

-Describe an experiment to show that light travels in a straight line

-Describe an experiment to demonstrate resonance in a closed tube

-Describe the electrical method of magnetizing a steel bar

-Describe with the aid of a diagram an experiment to investigate the effect of temperature on volume of a fixed mass of a gas at constant pressure.

-Briefly describe the principle of operation of C.R.O

6. Identify: Recognize or prove something as being a certain. E.g. identify the factors that affect density of a substance.

7. Name: Write down, mention or state. E.g.

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-name the parts labeled in a diagram.

-Name the three main components of a cathode ray oscilloscope (C.R.O)

-Name the three secondary colors and give the primary colors that make up each of the three secondary colors.

8. Determine: Ascertain something after some observation, solve a problem or find out. E.g. Determine the refractive index of a glass block.

9. Discuss: Give points and general description in writing either for or against a statement. E.g. discuss the effect of temperature on density of water.

10. Suggest: Put forward an idea. E.g. suggest what would happen to pressure of a gas if the volume of the gas is reduced.

11. Calculate: Work out a problem mathematically. E.g.

- Calculate the focal length of a converging lens.

-A metal block of mass 3kg at 100^{o}C is placed in 2.5kg of water at 31^{o}C in a copper calorimeter of mass 0.4kg. The water is then stirred until it attains a steady temperature of 43^{o}C. Calculate the specific heat capacity of the metal block.

12. Outline: Give the main points. E.g. outline the steps followed in determining the relative density of a substance.

13. Distinguish between: Make, show or recognize differences. E.g.

-distinguish between density and relative density of a substance.

-Distinguish between a primary and secondary color

-Distinguish between potential difference and internal resistance

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Main competences tested in physics (535)

1. Knowledge**:** here the question tests if a learner can remember basic laws, principles, definitions, concepts, examples etc.
2. Comprehension**:** such questions test if a learner can remember and organize his/her work to make a logical flow of information. E.g.
   (i) Describe an experiment to determine……..
   (ii) Explain the effect of rubbing a glass rod with silk
   (iii) With the aid of a diagram, describe how a cathode ray tube works
3. Application**:** this tests whether a learner can use physics concepts to calculate, analyze or explain an observation. E.g.
   (i) A stone of mass 5kg is released from a height of 16m. Find the speed with which it hits the ground.
   (ii) Explain why a mingling stick is made of wood but not steel.
4. Evaluation: Here the learner should be able to make judgment. E.g. which of the following is not a set of scalar quantities?
5. Competence marks distribution in paper 2 (535/2). Every number in paper two carries 16 marks which are distributed as below.

(i) Knowledge questions-04 marks
(ii) Calculation questions-04 marks
(iii) Application questions-08 marks

Subject specifics

For multiple type questions, try to answer from your mind before you look at the answers.

1. Read each answer thoroughly even if you think you have already spotted the correct one.
2. Note that some answers may be correct. But the question always requires you to choose the most correct answer. Be aware the wrong answers are always plausible.
3. Be active: sketch a diagram; write down a relationship, do anything that helps you think clearly.
4. Be absolutely sure to get the easier questions right, by not rushing them.
5. The questions carry the same marks.
6. In case you want to change your answer (MCQS) in section A, cancel out the value and write your answer outside the box. You are encouraged not to rub your workings in section A question papers. Leave them there.

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Steps to solving questions involving calculations**:**

1. Summarize the information given in the question by using known/standard symbols and convert quantities to S.I units accordingly.
2. Draw a sketch diagram for numbers involving force diagrams.
3. Identify the physics laws and equations which relate to the information you have.
4. Present your work systematically: marks are awarded to:
   (a) Correct formula, ***do not*** abbreviate words like ED for distance moved by the effort, D for density; use physics accepted symbols.
   (b) correct substitution and
   (c) Correct answer with correct unit.
5. Record your answer to the lowest form i.e. to at least three decimal places (3dp) to minimize errors.

For Structured and semi-structured questions**:**

1. Use simple straight forward English.
2. Use clear-labeled diagrams.
3. Where necessary leave space so you can add answers that occur to you later.
4. Explain all your working and put in correct units. Remember wrong units led to loss of marks.
5. Round off your final answers to at least 3 decimal places (do not leave it as a fraction).

Common errors made by candidates**:**

(i) Failure to correctly interpret questions. This is caused by rushing or reading the question once. E.g. State Pascal's principle may be interpreted as "State a Pascal" or "What is a Pascal?" State the principle of moments as "state the principle of conservation of momentum". Etc.

(ii) Stating incomplete laws, principles and definitions; usually omitting conditions. E.g. -----Charles' law states that the volume of a fixed mass of a gas is directly proportional to its absolute temperature. For that case the condition of under constant pressure is not given, therefore no mark is awarded.
-the principle of moments states that when a body is in equilibrium, the sum of clockwise moments about a point is equal to the sum of anticlockwise moments about the same point.
- Define…… in most definitions, learners miss giving key words.

(iii) In description of experiments.

- Unworkable diagrams are drawn which implies that the experiment cannot work.
- Diagrams drawn but not labelled making it hard for examiners to interpret them.

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- Procedure of the experiment not flowing/unworkable. I.e. if one followed the learner's procedure in carrying out the experiment, the expected results would not be obtained.
- E.g. describe an experiment to show the variation of pressure with depth in a liquid.
  Learner's response:
  A can is filled with water. Holes are made on the sides. Water flows out from the bottom hole fastest and furthest from the can compared to the hole at the top. This shows that pressure increases with depth. ***With such a response, No mark is awarded because there is no chorological flow of procedures, Holes cannot be made when water is inside the can.***

  -Omission of diagram when specifically asked for. E.g. with the aid of a diagram, describe……..

  *Requirements when describing experiments**:**

  - *A working diagram*. It should be correctly labeled.
  - *Description*. This gives the procedure followed to obtain the results. Within in the procedure, there MUST be recorded values in terms of unknowns, e.g. the position, p_1 of the pointer is read and recorded.
  - *Observations*. In most cases, observations are embedded within the procedures. Correct observations should be made.
  - *Results*. Treatment of results involves use of obtained values in the experiment to obtain a relationship between the variables. It is not necessary to derive expressions while dealing with experiments.
  - *Conclusion*. Always link the final expression of the results to the question. I.e. the acceleration due to gravity is obtained from the expression, $g = \frac{4\pi^2}{slope,s}$.

(iv). Explanation questions:

Learners fail to give explanations which are based on scientific concepts/principles. Answers are common where students simply state without explaining why?

Example:

(a) Explain why a handle of a door is near its outside edge. (03 marks)

Learner's response: Because the door is heavy and it can easily be opened.

Correct response: The force is applied at the greatest possible distance from the hinges of fulcrum. This gives the greatest moment and the force applied to open the door is minimum.

(b) Use the kinetic theory of matter to explain why temperature of boiling liquid at constant pressure remains constant. (03 marks)

Learner's response: Because the liquid has reached its maximum temperature.

Correct response: When the liquid is boiling, the heat energy supplied provides latent heat to the liquid molecules. These molecules use the energy to break away from attractive forces between them to become gas molecules as they break away from the

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liquid body. The temperature of the molecules as a result remains constant as boiling occurs.

(v) Give two differences or uses and then a learner gives three or four. In this case only the first **two** differences/uses are considered while others are discarded.

(vi) In calculations:

- The method used may not be clear and hard to follow
- Final answer may not have a unit or with a wrong unit.
- Some learners use a formula whereas the question may demand the use of graphical construction as it is usually the case in light.

(vii) Sketching graphs: Axes may not be labeled.

Advise: Should at all times label the axes.

(viii) Distinguish or give differences between… the learner may give differences which don't have similar properties;

Advise: the learner should give matching differences.

(ix) Giving general examples where specific examples are required. E.g. give two medical uses of X-rays

Learner's response: In hospitals. For such a response, the learner is not specific and therefore no mark is awarded.

Advise: Should give the specific medical uses.

(x) In light, learners tend to draw rays without arrows; stating scales without using them, blunt pencils which affects accuracy; confusing symbols for curved mirrors and lenses in ray diagrams.

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Basic units in physics

Before entering the paper, ensure that you have read to detail the following units in physics:

1. Mechanics and properties of matter **(At least 02 questions)**

Unit	**Tick unit covered**	**Key terms/definitions, laws and formulae in mechanics**
Measurements You should be able to: 1. Explain how to use: - the meter rule, the Vernier calipers and the micrometer screw gauge for measuring length. - beam balance, spring balance and electric balance for measuring mass - Stop watches, watches for measuring time. 2. Recognize and state: - the S.I units/other units for the three fundamental quantities. 3. Convert other metric units to S.I unit and vice versa. 4. Express numbers in scientific notation or standard order.		**Definitions:** 1. Derived quantity 2. Fundamental quantity 3. Vector quantity 4. Scalar quantity (give examples of each above and their units) 5. A force (State and define all types of forces e.g. Centripetal force, Up thrust, Magnetic force, friction) 6. Weight 7. Acceleration 8. Acceleration due to gravity 9. Density 10. Relative density 11. Volume 12. Work 13. Power 14. Energy (state and define their S.I units) 15. Work input 16. Work output
5. Use the formula for calculating: Area and Volume.		17. Load

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Density and relative density You should be able to: 1. Define: - Density and state its S.I unit and the other unit. 2. Determine experimentally the densities of: - Regular and Irregular solids, - Liquids and - Gases/Air. 3. Solve numerical problems on density and density of mixtures. 4. Define: - Relative Density (R.D) - Determine experimentally the R.D of; - Solids and Liquids. 5. Solve numerical problems on relative density of solids and liquids.		18. Diffusion 19. Effort 20. Moment 21. Moment of a force 22. Couple 23. Centre of gravity 24. neutral equilibrium 25. stable equilibrium 26. unstable equilibrium 27. terminal velocity 28. stream line flow 29. turbulent flow 30. pressure 31. Pascal 32. Mechanical advantage 33. Velocity ratio 34. Efficiency 35. Pitch of a screw 36. Solid, liquid and a gas 37. Brownian motion 38. Surface tension 39. Capillarity (state factors that affect each of the above)

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Particle nature of matter You should be able to: 1. Define: - Matter. 2. State: (i) - The states of matter. (ii) - The differences between the states of matter. 3. (a) State: - Kinetic Theory of Matter. (b) Describe an experiment (Brownian Motion) to proof the kinetic theory (c) The effect of heat on Brownian motion.		40. Cohesion 41. Adhesion 42. Displacement 43. Speed 44. Uniform speed 45. Velocity 46. Uniform velocity 47. Uniform acceleration 48. Deceleration 49. Projectile 50. Trajectory 51. Uniformly accelerated motion 52. Inertia 53. Momentum 54. Elastic collision
(d) Use the Kinetic Theory to explain change of state. 4. List and define the Properties of Matter. - Molecular forces (Cohesion and Adhesion), - Diffusion -Capillarity, - Surface tension 5. Describe experiments to show: - Diffusion in liquids and gases. - Surface tension. - The effect of detergents on surface tension.		55. Inelastic collision 56. Impulse 57. Elasticity 58. Ductility 59. Brittleness 60. Stiffness 61. Strength 62. Stress 63. Strain 64. Tie 65. Strut

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Forces You should be able to: 1. (a) Define: - Force. (b) State and define: the SI unit of force. 2. List the types of forces. 3. State the effects of force on a body/particle. 4. (a) Define acceleration due to gravity (b) Explain why acceleration due to gravity varies from place to place (c) Describe an experiment to determine acceleration due to gravity, g using a simple pendulum. 5. (a) Define: - Mass and Weight. (b) State: - The difference between mass and weight. (c) Use: - W = mg, to solve numerical problems. 6. Define: - Scalar and vector quantities and give examples for each. 7. Solve numerical problems involving combination vectors (forces).		**Basic laws/principles in mechanics** 1. Law of floatation 2. Laws of friction 3. Newton's laws of motion 4. Kinetic theory of matter 5. Hooke's law 6. Bernoulli's principle 7. Pascal's principle 8. Principle of moments 9. Archimedes' principle 10. Principle of conservation of linear momentum 11. Principle of conservation of energy
The turning effect of forces (Moments, centre of gravity and stability) You should be able to:		**Basic formulae in mechanics** 1. Moment 2. Mechanical energy 3. Force

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1. (a) Define: - Moment. (b) State: - The SI unit of moment. 2. (a) State : - The Principle of moments. - The conditions for a body to be in equilibrium. (b) Define: - Centre of gravity. (c) Describe: - Experiments to determine the centre of gravity of: - Regular body e.g. lamina, - Irregular lamina. 3. (a) State: - Applications of Principle of moments (b) Describe: - Experiments: *To determine the mass of a uniform body. * To determine the mass/weight of an object. 4. (a) Define: - The terms Stability and equilibrium. (b) State: - The types of equilibrium. - Factors which determine the type of equilibrium. (c) Describe: - How to make a body stability		4. Mechanical advantage 5. Velocity ratio (for an inclined plane, wheel and axle, hydraulic lift, gears, a screw, pulley system) 6. pressure in solids 7. pressure in fluids 8. Gas pressure 9. Relative density (for solids and liquids) 10. Density of a floating body 11. Speed 12. Acceleration 13. Equations of motion 14. Momentum 15. Impulse 16. Elastic collision 17. Inelastic collision 18. Potential energy 19. Kinetic energy 20. Force acting on a body falling freely in a viscous fluid

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Work, power and energy You should be able to: 1. (a) Define: -The following terms and state their SI units; - Work and Power (b) Describe an experiment to measure human power (c) Solve numerical problems involving; Work done and Power 2. (a) Define: - the term Energy and state its S.I unit. (b) State: (i) - the Law of Conservation of energy (ii) - the forms and sources of energy		**Key structural diagrams in mechanics** 1. Vernier caliper 2. Micrometer screw gauge 3. A density bottle 4. Hydraulic brake 5. The lift pump 6. The force pump 7. The rubber sucker 8. The siphon 9. An aero foil 10. A spinning ball taking a curve 11. Rocket and jet engine
3. (a) Define: - Potential and Kinetic Energy (b) Describe the Interchange between P.E and K.E. (c) Solve numerical problems involving P.E and K.E 4. (a) State: - The components of Internal-Combustion Engine. (b) Describe:- The mechanism of Four-stroke and Two-stroke Engines (c) State: - The factors that limit the efficiency of Internal-Combustion engines (d) Explain: - How to improve the efficiency of Internal Combustion engines.		

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Machines You should be able to: 1. Define: - Machine, - Mechanical Advantage (M.A), - Velocity Ratio (V.R), - Efficiency. 2. State: - The types of machines - Classes of levers - Practical uses of machines. 3. Carry out calculation on: - M.A, V.R and for the various types of machines. 4. Sketch graphs of: - M.A against load and efficiency against load. 5. Explain why the efficiency of a machine is always less than 100%.		**Key experiments in mechanics** 1. Experiment to: Determine the volume of an irregular object 2. Determine the density of; (i) A regularly shaped solid (ii) An irregularly shaped solid (iii) A floating object (iv) A pin or a ball bearing (v) Air 3. Determine the relative density of; (a) a liquid 4. 5.(b) A solid 6. Measure static friction Measure dynamic/kinetic friction Demonstrate Brownian motion using; (a) Pollen grains (b) Smoke particles in air
Pressure You should be able to: 1. (a) Define: - Pressure and state its S.I unit and other units; (b) State: - The conditions for Pressure in liquids.		7. Show diffusion in liquids 8. Show diffusion in gases 9. Estimate the size of an oil molecule (solve all underlying word problems /calculations) 10. demonstrate surface tension 11. verify Hooke's law (solve all underlying word problems /calculations)

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(c) Describe: - An experiment to show that liquid pressure depends on depth. - How to measure liquid and gas pressure using manometer. (d) State: - The applications of liquid pressure. (e) Describe: - How to measure Relative Density of liquids using manometer. 2. Solve problems involving pressure: - Exerted by solids on a surface and - In liquids. 3. (a) State: (i) - Pascal's Principle (The law) of equal transmission of pressure in liquids. (ii) - Applications of the law of equal transmission of pressure. (b) Describe: - The structures and the mechanisms of: - The Hydraulic Press and - The Hydraulic Brake. (c) Solve problems involving pressure, force and area in the Hydraulic Press. 4. (a) Define: - Atmospheric Pressure. (b) Describe: (i) - Simple experiment to show the effect of atmospheric pressure. (ii) - How to measure atmospheric pressure using Mercury Barometer. (c) State: - The applications of atmospheric pressure. (d) Describe: The structures and the mechanisms of: • The Lift pump and - • The force pump		12. verify the principle of moments (solve all underlying word problems /calculations) 13. locate the position of the centre of gravity of; (i) an irregular object (ii) a regular object 14. measure mechanical advantage and efficiency of pulley system 15. demonstrate existence of atmospheric pressure 16. show that; (a) pressure in liquids does not depend on cross sectional area/ liquid finds its own level (b) pressure at a given depth acts equally in all directions (c) pressure increases with depth (d) pressure depends on density 17. verify Pascal's principle 18. measure liquid pressure 19. measure gas pressure (solve all underlying word problems /calculations) 20. show how a simple mercury barometer is made in the laboratory 21. verify Archimedes principle (Solve all underlying word problems /calculations) 22. verify the law of floatation (solve all underlying word problems /calculations) 23. measure acceleration due to gravity using; (a) a simple pendulum (b) a ticker timer

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Mechanical properties of matter State and define: - The following properties of materials • Strength • Stiffness • Ductility • Brittleness • Elasticity. 2. State: (a) - The factors affecting the strength of a material. (b) - Characteristics of brittle materials. (c) - The factors which determine the amount of deformation of a material. 3. (a) State: - Hooke's law. (b) Describe: - Experiments to verify Hooke's law using - A Nuffield spring and - A copper wire. 4. Define: - Stress and Strain. 5. (a) State: - The factors for stability and safety of structures. (b) Define: - Ties and strut. (c) Identify: - Ties and struts in a structure. 6. (a) Explain: - The effects of compression and tension forces on beams. (b) State:- The uses of beams. 7. (a) Describe:- How concrete is made. (b) State: - The uses of concrete. (c) Describe: - How concrete is reinforced.		**This space is intentionally left empty**

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Motion You should be able to: 1. (a) Define: - Speed, Velocity, Uniform velocity, Acceleration and uniform acceleration. (b) State: - The S.1 units of: Speed, Velocity and Acceleration. - The difference between speed and velocity. (c) State: - The equations of linear motion. Solve problems using the equations of linear motion.		**This space is intentionally left empty**
2. (a) Represent linear motion using: - Displacement-time graph and - Velocity-time graph. (b) Describe from: - Displacement-time graph and - Velocity-time graph. 3. (a) Calculate: - Average speed/velocity and - Acceleration from a sample of tickertape. (b) Describe: - Motion from a sample of a ticker tape. 4. (a) Solve problems involving: - Motion under gravity and - Projectile motion. (b) State: - The forces acting on a body moving in a circle.		

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Force and motion You should be able to: 1. (a) State: - Newton's laws of motion and give examples for laws 1 and 3. (b) Define: - Inertia and state the effects of inertia. 2. Define and the state the SI unit of momentum. 3. (a) State: (i) - The Principle of Conservation of momentum. (ii) - The types of collision (b) Describe: - Experiments to verify the principle (law) of conservation of momentum. (c) State: - Applications of the principle of the principle of conservation. (d) Explain: - The mechanism of: (i) The rocket propulsion (ii) The jet engine 4. Solve problems involving the principle of conservation of momentum.		**This space is intentionally left empty**

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Floatation and Archimedes principle		
You should be able to: 1. State: - Archimedes' Principle. 2. Describe an experiment to verify the principle. 3. State: - Applications of Archimedes' Principle. 4. Solve problems involving Archimedes' Principle. 5. State: - The law of Flotation. 6. Describe an experiment to verify the law of Flotation. 7. State: - Applications of the law of Flotation. 8. Solve problems involving the law of Flotation. 9. Define: - Terminal Velocity 10. (a) Describe: - What happens to a body released to fall in a liquid in a tall measuring cylinder until it hits the bottom. (b) Sketch a velocity- time graph for a body falling in a fluid.		**This space is intentionally left empty**
Fluid flow You should be able to: (a) (i) State Bernoulli's principle (b) Explain the operation of an aero foil (c) Describe how a carburetor works		

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2. Heat **(At least 01 question)**

Unit	**Tick unit covered**	**A must definitions, laws and experiments in heat**
Heat energy You should be able to: (a) (i) Define and state the unit of heat energy (ii) Sources of heat energy (iii) Uses of heat energy (b) Definition of temperature and units (c) Thermometry		**Be able to define the following terms;** 1. Heat 2. Temperature 3. Thermometer 4. Thermometric property 5. Fixed point 6. (read about how to calibrate a thermometer) 7. Fundamental interval 8. Conduction 9. Convection
You should be able to: 1. (a) -Define thermometric properties and give examples. -State: (i) Any two thermometric liquids. (ii) The properties of a good thermometric liquid. (iii) Advantages of mercury over alcohol as used a thermometer. (b) Types of thermometers Fixed points of thermometers Temperature scales and calibration of thermometers (c) Define: The lower and upper fixed points. (c) Solve problems involving (i) Conversion of temperature from one scale to another. (ii) Calculation of temperature for unmarked thermometer.		10. Radiation 11. Sea breeze Land 12. breeze 13. thermal expansion 14. Absolute temperature 15. triple point of water 16. Heat capacity 17. Specific heat capacity 18. Latent heat 19. Specific latent heat 20. Latent heat of vaporization 21. Specific latent heat of fusion 22. Specific latent heat of vaporization 23. Evaporation 24. Boiling, melting and melting point 25. A vapor 26. freezing and freezing point 27. Saturated vapor 28. Saturated vapor pressure 29. Dew point

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Heat transfer You should be able to: (a) Explain (i) Heat transfer by conduction • Applications as in good and bad conductors (ii) Heat transfer by convection • Applications in land and sea breezes • Applications in domestic water heaters (iii) Heat transfer by radiation • Good and bad radiators of heat • Laws of radiation • Applications of radiation in a thermos flask • Applications of radiation in car radiators • Applications of radiation in solar heaters		Determine which metal is the best conductor from a set of them. Show that water is a bad conductor of heat. Show the heat conducting powers of a two or more liquids. Show that glass absorbs heat radiations. Determine the specific heat capacity of a liquid or solid by the mixtures method or the electrical method. Determine the saturated vapor pressure of a small quantity of a liquid. Verify any of the three gas laws. • Be able to state; (i) the 3 units of temperature (ii) the kinetic theory of matter (iii) the 3 factors affecting heat transfer by conduction (iv) the relationship between specific heat capacity and heat capacity (v) the 3 gas laws

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Quantity of heat (heat capacity and latent heat) 1. Heat capacity (a) Specific heat capacity (i) Determination of specific heat capacity of solids and liquids (ii) Numerical treatment $Q = mC\theta$ 2. Latent heat (a) Specific latent heat Latent heat of fusion, $Q = mL_f$ (i) Expt to determine latent heat of fusion of ice (ii) Latent heat of fusion and kinetic theory (b) Specific latent heat of vaporization, $Q = mL_v$ (i) Expt to determine latent heat of vaporization of steam (ii) Latent heat of vaporization and kinetic theory (iii) Numerical treatment of latent heat.		• Be able to; convert one unit of temperature to another. determine the lower and upper fixed point use an uncelebrated thermometer to measure temperature distinguish between forced and free convection. Explain why; (a) Some rods can become red hot and other cannot. (b) Black shoes are always polished. (c) In desert areas white clothes, white houses or white objects are common. (d) a silvery teapot keeps tea hot for a longer period of time. ice is slippery regelation is possible in ice (e) Why evaporation is always accompanied by cooling.
Boiling and Evaporation (a) (i) Definition of boiling (ii) Factors which affect boiling point (b)(i) Definition of evaporation (ii) Factors which affect evaporation (iii) Evaporation and kinetic theory (c) Differences between boiling and evaporation (d) (i) Saturated vapor and saturated vapor pressure (ii) Expt to measure saturated vapor pressure (iii) Kinetic theory explanation of saturated vapor pressure (e) Action of the refrigerator (f) Action of the pressure cooker		Determine the initial or final temperature of a mixture of two or more substances by calculation given the necessary constants. Sketch the heating and cooling curves for a pure and impure substance and explain the shape of the curves. distinguish between real and ideal gases **Be able to give;** 5 advantages of mercury over alcohol as a thermometric liquid 4 advantages of alcohol over mercury as a thermometric liquid 4 disadvantages of water as a thermometric liquid 3 factors affecting the expansivity of a substance

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Expansion of solids and liquids You should be able to: 1. (a) Define: Expansion and Contraction of a material.		4 advantages and 3 disadvantages of thermal expansion 3 factors affecting heat transfer by radiation 5 properties of radiant heat 3 factors affecting evaporation and 2 affecting boiling
(b) Describe: The ball & ring/The bar & the gauge experiments to demonstrate expansion and contraction in solids. (c) State (i) The applications of expansion in solids and liquids (ii) The problems caused by expansion and their solutions. 2. (a) Define: - Linear expansivity (b) Solve problems involving linear expansivity. 3. (a) Describe: Experiments to show expansion in Liquids and Gases. (b) Explain the anomalous behaviour of water and give its importance to aquatic animals.		the difference between a vapor and a gas or a volatile and non-volatile liquid 3 applications of boiling at reduced pressure the kinetic theory explanations for each of the three gas laws • Be able to describe; (a) How the sensitivity of a glass thermometer can be increased. (b) How a clinical, resistance and thermoelectric thermometers operate. (c) How a double-glazed window or door prevents heat transfer. (d) How land and sea breezes are formed. (e) What is meant by the term global warming? (f) How a vacuum flask, car radiator and domestic hot water system works.
Gas laws 1. Boyle's law; PV = constant (i) Experiment to investigate Boyle's law (ii) Numerical treatment 2. Charles' law; V = (constant) x T (i) Experiment to investigate Charles' law (ii) Charles's law and kinetic theory (iii) Numerical treatment 3. Pressure law; P (constant) x T (i) Experiment to investigate the pressure law (ii) Pressure law and kinetic theory (iii) Numerical treatment 4.The equation of state; PV = (constant) x T		(g) How one can make ice by evaporation of ether. (h) How construct and calibrate a mercury or alcohol thermometer. (i) The effect of temperature on saturated vapor pressure. (j) How a refrigerator or hygrometer operates (k) briefly how a petrol or diesel engine operates. (l) an experiment to; show that a liquid, a solid or a gas expands when heated. (m) What is meant by anomalous expansion of water? (n) Determine whether a wire gauze is a conductor or an insulator.

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3. Light **(at least 01 question)**

Unit	Tick unit covered	Basic definitions, laws, explanations, experiments in light
Rays and beam You should be able to: 1. Define: (a) A ray and a beam. (b) State and draw the types of beams.		**Be able to define the following terms;** 1. Light 2. light ray 3. Beam of light 4. Shadow 5. Umbra 6. Penumbra 7. Pole of a mirror
Rectilinear propagation of light 1. (a) State (i) The rectilinear propagation of light. (ii) The types of shadow. (b) Describe an experiment for the formation of the types of shadows. (c) State: The types of eclipses. (d) Describe with a help of diagrams the formation of the types of eclipses. 2. (a) Describe (i) The structure of the Pin-hole camera. (ii) The formation of image in a pinhole camera. (b) State: (i) The properties of the image formed in a pin-hole camera. (ii) The effects of the object distance and the size of the pin hole, on the image formed in a pin-hole camera. 3. (a) Define magnification. (b) Solve problems using the formula of magnification.		8. Principle axis of a mirror or lens 9. centre of curvature of a mirror or lens 10. Focal length of a mirror or lens 11. radius of curvature of a mirror or lens 12. principal focus of a mirror 13. Conjugate foci 14. Real and virtual images 15. Refraction 16. Absolute and relative refractive index 17. Total internal reflection 18. Critical angle 19. Optical centre of a lens 20. Dispersion 21. Accommodation **Be able to explain briefly what is meant by;** 1. Transparent material 2. Opaque object 3. Translucent object Annular eclipse 4. Parallax 5. Magnification or linear magnification 6. Power of a lens 7. Color 8. Light filters

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Reflection of light on plane surfaces (a) Reflection in plane mirrors: (i) Laws of reflection (ii) Formation of images by plane mirrors (iii) Properties of images formed by plane mirrors (iv) Applications of plane mirrors		• **Be able to give;** - 2 types of reflection - 2 types of shadows - 3 types of beams - 2 types of eclipse - 4 properties of images formed by plane mirrors - 2 types of reflectors, curved mirrors and lenses 4 applications of total internal reflection2 types of colors
Reflection of light on curved surfaces		
(a) Types of curved mirrors; (i) concave and (ii) convex -Characteristics of images formed by concave and convex mirrors -Magnification: numerical examples - Scale drawing and location of images formed by concave and convex mirrors (iii) The mirror formula (iv) Experiment to determine the focal length of a concave mirror (v) Applications of curved mirrors		• **Be able to describe;** a) An experiment to verify the law of reflection b) An experiment to determine the focal length of a concave mirror and convex lens c) An experiment to verify the laws of refraction. d) How a (i) magnifying glass, (ii) Compound microscope, (iii) projector and (iv) Lens camera works. e) Briefly the differences between the primary, secondary and complementary colors

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Refraction of light (a) (i) Refraction on plane boundaries (ii) Definition and simple illustrations (iii) Laws of refraction (b) (i) Experimental treatment of Snell's law (ii) Numerical treatment (c) Applications of refraction in: (i) Real and apparent depth (ii) Total internal reflection (iii) Mirages (iv) prisms (d) Refraction through lenses. (i) Types of lenses (ii) Terminologies (iii) Construction of ray diagrams (iv) Properties of images formed (v) The lens formula (optional) (vi) The power of a lens (vii) Expt to determine the focal length of a convex lens		• **Be able to state;** o the laws of reflection o The formula for the number of images formed by two mirrors inclined at an angle θ to each other. o the rules for drawing ray diagrams for lenses and for mirrors o the principle of reversibility of light o 4 uses of curved mirrors o the law of refraction o the relation between critical angle and absolute or relative refractive index • **Be able to;** 1. construct an accurate ray diagram to show how an image is formed in a mirror or a lens 2. draw a diagram to show that a convex mirror has a wider field of view
Color and Dispersion of light (a) The spectrum (ii) Expt to produce a pure spectrum (b) (i) Primary and secondary colours (ii) Color filters; (iii) mixing of colored lights (c) The formation of the rainbow (d) Recombination of colours		3. Explain why light bends towards the normal and at times away from the normal when moving from one median to another. 4. how the mirage is formed 5. the magnitude of the field of view of the fish's eye 6. how multiple images are formed in a thick plane mirror

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Optical instruments (a) Functions and main parts of the projector (b) Functions and main parts of the camera (c) (i)Functions and main parts of the human eye (ii) Eye defects and their correction (d) Comparison of the eye and the camera		7. why objects are colored 8. obtain refractive index of a transparent material from real and apparent depth of the material 9. answer questions about a triangular prism 10. determine the color of an object in colored light

4. Waves **(At least 01 question)**

Unit	**Tick unit covered**	**Key terms/definitions, laws and formulae in waves**
(a) **Types of waves** -progressive and stationary waves -Types of progressive waves; -transverse and longitudinal waves Characteristics of progressive waves (b) Terminologies (i) wave length (ii) amplitude (iii) wave velocity (iv) crest (v) Trough etc. -The wave equation: $V = f\lambda$.		**Key definitions in waves** 1. a wave 2. electromagnetic wave 3. mechanical wave 4. progressive wave 5. transverse wave 6. longitudinal wave 7. crest 8. trough 9. amplitude 10. wave length 11. compression
Reflection of waves Reflection of waves on -Straight barriers -Concave barriers -Convex barriers		12. rare faction 13. frequency 14. hertz 15. cycle 16. period
Refraction of waves (i) The ripple tank -Effect of refraction on velocity and wavelength		17. interference 18. constructive interference 19. destructive interference 20. sound

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Diffraction and interference -Illustration using the ripple tank -Explanation of interference effect -Newton's diffracting grating -Effect of size on slit and wavelength **Sound waves** Production and propagation of sound Characteristics of sound Factors affecting the velocity of sound Waves produced by stings -The musical scale, beats Stationary waves -Waves produced in pipes (i) Closed pipes (ii) Open pipes Acoustics and reverberations Resonance (i) Determination of velocity of sound by resonance method.		21. echo 22. reverberation 23. ultrasonic sound 24. subsonic sound 25. audible range 26. Musical sound 27. Music 28. Noise 29. Pitch of sound 30. Loudness of sound 31. Quality of sound 32. Intensity 33. Fundamental note 34. Fundamental frequency 35. Nodes 36. Antinodes 37. Harmonics 38. Overtone 39. Resonance

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Key laws/principles in waves

Laws of reflection of waves

Key formulae in waves

1. $v = \lambda f$.
2. $Period, T = \frac{t}{n}$.
3. $Frequency, f = \frac{1}{T}$.

Distance, d between successive crests or troughs,

4. $d = (n-1)\lambda$
5. Velocity, V of sound, $v = \frac{2d}{t}$
6. Three factors that affect frequency of stretched String; $f = \frac{1}{l}\sqrt{\frac{T}{\mu}}$.
7. Distance between a node and a node, $l = \frac{\lambda}{2}$
8. Distance between node and antinode, $l = \frac{\lambda}{4}$

Key Experiment to/ explanations to:

1. Show that sound cannot pass through a vacuum
2. why sound travels faster in solids
3. verify the laws of reflection of sound
4. measure velocity of sound using an echo method
5. determine the depth of a sea using a sonar system
6. why echoes are not heard in small rooms

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		7. describe refraction of sound during day and night 8. show interference of sound waves 9. demonstrate resonance using a coupled pendulum and tubes 10. determine velocity of sound in air by resonance method

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5. Electricity **(Electrostatics and Current Electricity) (at least 01 question)**

Unit	**Tick unit covered**	**Key terms/definitions, laws and formulae in electricity**
Electrostatics Be able to define or explain what is meant by the terms; • Electrostatics • surface density • electric field • electric field line • direction of an electric field or field lines Be able to describe; • the difference between insulators and conductors • Briefly how the following devices operate; electromagnets, magnetic relays, lifting magnets, reed switch, electric bell, telephone receivers, loudspeakers. • how to charge; ▯ a body positively or negatively by electrostatics induction. ▯ two bodies both negatively by electrostatic induction ▯ two bodies both positively by electrostatic induction ▯ two bodies oppositely by electrostatics induction ▯ an electroscope positively or negatively by electrostatics induction or by contact		**Definitions:** 1. electric insulator 2. electric conductor 3. electrostatic induction 4. electric flux 5. neutral point 6. electrolyte 7. primary cell 8. secondary cell 9. polarization 10. local action 11. amalgamation 12. zinc amalgam 13. charge 14. coulomb 15. corona discharge 16. current 17. ampere 18. resistance 19. resistivity 20. ohm 21. p.d 22. volt 23. e.m.f 24. internal resistance 25. electrical energy 26. electrical power 27. kilowatt hour 28. filament

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• lightening occurs and how a lightening conductor works • how people can protect themselves from lightening • Faraday's ice pail experiment • Be able to; draw a well labelled diagram of a gold leaf electroscope sketch the electric field lines of ; -isolated positive and negative charges -a charged near a neutral earthed surface -Two or more like or unlike charges near a neutral (or earthed) surface. -a charge in a neutral or charged pail (Faraday's ice pail) -a charged electroscope - two charged parallel plates - two charges near each other state; the first law of electrostatics the 3 methods of charging a body 3 uses of an electroscope 4 applications of electrostatics		**Key structures in electricity** 1. G.L.E 2. Lightening conductor 3. Field patterns 4. Simple cell (its defects) 5. Dry Leclanch'e' cell 6. Lead acid accumulators (read about how its charged) 7. Electric circuits and symbols 8. Filament lamp 9. Fluorescent lamp/tube/discharge lamp **key laws/principles in electricity** 1. law of charges/law of electrostatics 2. ohm's law **key experiments/explanation in electrostatics and current electricity** **(a) explanations** 1. charging by friction 2. charging by contact 3. charging by induction 4. How electricity is transmitted from the power station to final consumer. (b) experiments experiment to: 1. explain how a lightening conductor works 2. faradays' ice pail experiment

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Sources of e.m.f (electric cells) Be able to define or explain what is meant by the terms; -primary cell -secondary cell -electric potential difference -electric current -An ampere -a volt -a coulomb		3. verify ohm's law (solve related word problems/calculations on ohms' law) 4. obtain the internal resistance of a cell using: (a) a voltmeter and standard resistor (b) a voltmeter, ammeter and standard resistor.
-Emf of a cell -an Ohm -resistance of a conductor -Internal resistance of a cell - alternating current Be able to give; • six precautions given to lead acid cells • two advantages of alkaline cells over lead-acid cells • two types of electric circuits • two uses of internal resistance • 2 types of fuses Be able to describe; • briefly how electric power is transferred from the power station to the consumer or industries • the color code of the plug cables used in household wiring • How a dry cell and a lead-acid cell operates. • an experiment verify Ohm's law • an experiment to determine the internal resistance of a cell		**This space is intentionally left empty**

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Be able to; • draw a well labelled diagram of a dry cell or lead-acid cell • obtain an expression for the work, W, done in moving a charge, • Q through a potential difference, V. • obtain the quantity of charge, Q, that has flown in circuit carrying an electric current, I in time, t.		
• Be able to state; ▯ the SI unit of potential, electric current ▯ Ohm's law ▯ the three formula for electric power ▯ 4 factors that affect the resistance of a conductor • Be able to explain; ▯ why voltage is stepped up by transformers before transmission ▯ why alternating current and not direct current is preferred in electric power transmission. ▯ why household wiring circuits are always in parallel and not in series. Circuit components and their symbols		**This space is intentionally left empty**

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Characteristic graphs of ohmic and non ohmic conductors • sketch the IV curves for a; ○ metallic wire ○ semiconductor diode ○ thermionic diode ○ filament bulb ○ And for copper sulphate solution.		
Arrangement of resistors • Derive the expressions for the total resistance of resistors and cells in series and in parallel. • Explain why ammeters are always connected in series and voltmeters in parallel with the devices whose Current or voltage is being determined respectively.		**This space is intentionally left empty**

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6. Magnetism and electromagnetism **(at least 01 question)**

Unit	**Tick unit covered**	**Key terms/definitions, laws and formulae in magnetism**
The magnet -Be able to define or explain what is meant by the terms; magnetic pole magnetic field direction of a magnetic field magnetic axis magnetic neutral point -Be able to give; • two properties of magnetic field lines • three major differences between the magnetic properties of iron and steel -Be able to describe; the domain theory of magnetism **Be able to;** -test for polarity of a bar magnet -differentiate or distinguish between; magnetic and geographic meridian angle -or inclination and angle of declination -magnetic domain and magnetic dipole -soft and hard magnetic material Be able to state; the first law of magnetism		**Key definitions in magnetism** 1. Ferro magnetic materials 2. para magnetic materials 3. diamagnetic materials 4. magnetization 5. hard magnetic materials 6. soft magnetic materials 7. magnetic shielding/screening 8. magnetic saturation 9. induced magnetism 10. demagnetization 11. multiplier 12. shunt 13. magnetic meridian 14. geographic meridian 15. angle of declination 16. angle of inclination **key laws/principles** 1. the law of magnetism 2. domain theory of magnetism 3. right hand grip rule 4. Maxwell's cork screw rule 5. Fleming's left-hand rule 6. Faraday's law 7. Lenz' law
Magnetic effect of an electric current determine; ♦ the direction of the magnetic field produced by an electric current. ♦ whether like currents or unlike currents attract or repel		**Key experiments in magnetism** Experiment to: 1. distinguish between hard and soft magnetic materials 2. Show that attractive forces of a magnet are strongest at its ends

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♦ the direction of the force acting on a current carrying conductor in a magnetic field **Be able to state** the factor affecting the force acting on a current carrying conductor in a magnetic field		3. Show that a freely suspended magnet comes to rest in the north-south direction 4. Verify the law of magnetism 5. Show how a magnetic material is magnetized by: (a) Single touch (b) Double touch (c) Electrical method
describe briefly how the following devices operate; - electromagnets - magnetic relays - lifting magnets - reed switch - electric bell - magnetic separators - telephone receivers - electric motors - loudspeakers - Moving coil galvanometer. - Transformer • how the efficiency of a transformer can be increased The direction of the forces acting on a charged particle moving in a magnetic field. the importance of back emf in a motor how the sensitivity of a moving coil galvanometer can be increased how to convert an ammeter to a voltmeter		(d) induction (e) absolute method 6. determine the polarity of a magnet 7. show that the induced current or e.m.f is as a result of a changing magnetic field 8. show mutual induction

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Electromagnetic induction Be able to define or explain what is meant by the terms; magnetic induction induced magnetism magnetic shielding an electromagnet electromagnetic induction mutual induction		

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Eddy currents Rectification -Be able to give; • The 4Major causes of energy Loss in a transformer • 3 Uses of transformers • 2 Uses of the induction coil • 2 Kinds of rectification -How full wave and half wave Rectification can be achieved. • **Be able to state;** Fleming's left-Hand rule (Motor rule) Fleming's Right-hand rule (Dynamo rule) Maxwell's screw rule Faraday's law and Lenz's law of electromagnetic induction the factors affecting the magnitude of the induced current. • **Be able to explain**; -why an electric current produces heat when flowing in an electric device, using the kinetic theory of matter. -how electromagnetic induction is applied in galvanometer damping. -why voltage is stepped up by transformers before transmission		

7. Modern physics **(at least 01 question)**

Unit	Tick unit covered	Basic definitions, laws, experiments, explanations in modern physics
Atomic structure (a) The atomic structure (i) The nucleus of an atom; protons and neutrons (ii) -Mass number, -atomic number -Isotopes, isobars and isotones		**Be able to define;** atomic number proton number mass number nucleon number thermionic emission photo-electric e ff ect nuclear fission

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(b) Nuclear reactions		nuclear fusion
Nuclear reactions (i) Nuclear fusion -Nuclear fission -Applications of nuclear reactions and products		isotope radioactivity transmutation half-life
Electrons (cathode rays) (a) Nature and production of cathode of cathode rays -Properties of cathode rays The cathode ray oscilloscope Functions of the parts Uses of the C.R.O		•**Be able to give;** 3 examples of isotopes. 2 types of x-rays. 2 characteristics of photoelectric effect. 2 advantages of a cathode ray tube over a moving coil galvanometer.
x-rays (a) -definition -The X-ray tube (i) Production of the X-rays (ii) Properties of X-rays (iii) Health hazards of X-rays (iv) Uses of X-rays		• **Be able to describe;** briefly how an x-ray tube operates an experiment to demonstrate photoelectric effect briefly how a cathode ray tube operates briefly the nature of radioactive radiations

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Radioactivity (a) -Radioactive radiations: alpha, beta and gamma -Properties of radioactive radiations -Effects of radiations on the parent atom -Health hazards of the radiations. (b)Measurement and detection of radioactive radiations -The Geiger Muller tube -The spark counters (c) Half-life of a radioactive substance -Determination of half- life.		how a Geiger Muller tube works how a scintillation counter operates the three major properties used to detect radioactive radiations. • **Be able to state;** - 5 properties of cathode rays - 6 properties of x-rays - the health hazards caused by x-rays - the safety precautions that should be taken to a void the health hazards caused by x-rays. - the agricultural, medical and industrial uses of x-rays. - the 3 types of photocells
The thermionic diode -Action of a diode -Diode characteristic graph -Rectification of A.C		- 4 uses of photocells - 3 properties of each of the 3 radioactive radiations - 2 uses of nuclear fission - 4 medical and - 4 industrial applications of radioactivity - 5 health hazard causes by radioactive radiations - 4 safety precautions that should be ensured to reduce the health hazards caused by radioactive radiations.

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Photo electric effect -definition (i) Expt about photo electric effect (ii) Applications of photo electric effect		• **Be able to;** Explain what is meant by; (i) Thermionic valves (ii) grid and anode current (iii) quality and quantity of x-rays (iv) Identify alpha, α, beta, β and gamma rays and particles from their cloud chamber pictures. (v) Relate peak value and root mean square values of voltage or current. (iv) Identify the radioactive radiations from sketches showing their deviations in electric and magnetic fields. (v)Identify the type radioactive radiations emitted or absorbed from a decay equation. (vi) Determine the half-life of a radioactive sample from some simple given date or from its decay curve.

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