2027 Physics JAMB Syllabus

JAMB UTME Syllabus: topics and objectives

Aim. This syllabus prepares you for the UTME in Physics. It tests whether you can: (1) sustain your interest in physics; (2) build habits of accuracy, precision and objectivity; (3) interpret physical phenomena, laws, definitions, concepts and theories; and (4) solve physics problems correctly using the relevant theories and concepts.

How to use it. The left column lists what the topic covers. The right column lists what you should be able to do after studying it. Tick each objective off as you master it, and practise past questions on each topic.

1. MEASUREMENTS AND UNITS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Fundamental units: length, mass, time, electric charge, temperature, luminous intensity, amount of substance • Derived units: weight, area, volume, force, speed, etc. • Measuring instruments: vernier calipers, metre rule, micrometer screw gauge, measuring cylinder, stopwatch, beam balance • Derived quantities and their units • Dimensions: meaning and simple examples • Limits of measurement: instrument accuracy, simple error estimation, significant figures, standard form	1. Identify the units of length, area, volume, mass and time 2. Use the common measuring instruments and balances correctly 3. Find lengths, surface areas and volumes of regular and irregular bodies 4. Deduce the units of derived quantities from the fundamental ones 5. Determine dimensions of quantities and use them to test whether an equation is homogeneous 6. Judge instrument accuracy, estimate simple errors and write measurements in standard form

2. SCALARS AND VECTORS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Scalar and vector quantities, with examples • Relative velocity • Resolving a vector into two perpendicular components (including graphical methods) • Position, distance and displacement; frame of reference; coordinates	1. Distinguish scalars from vectors and give examples 2. Find the resultant of two or more vectors and the relative velocity 3. Resolve vectors into perpendicular components and solve vector problems graphically 4. Tell distance from displacement and locate points with a compass, protractor and x-y axes 5. Plot graphs and draw conclusions from them

3. MOTION

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Newton's laws: inertia, mass and force; mass and acceleration; impulse and momentum; force-time graph; conservation of linear momentum • Types of motion: translational, oscillatory, rotational, spin, random; relative motion • Causes of motion; contact forces and force fields • Linear motion: speed, velocity, acceleration; equations of uniformly accelerated motion; motion under gravity; distance-time and velocity-time graphs; instantaneous velocity and acceleration • Projectiles: range, maximum height and time of flight (from the ground and from a height); applications • Motion in a circle: angular velocity and acceleration; centripetal and centrifugal forces	1. Identify the different types of motion and solve problems on straight-line motion 2. State push, pull and field forces (electric, magnetic, gravitational) as causes of motion 3. Tell speed, velocity and acceleration apart and derive the equations of uniformly accelerated motion 4. Solve problems on motion under gravity and read distance-time and velocity-time graphs 5. Derive and use expressions for range, maximum height and time of flight of projectiles 6. Solve impulse and momentum problems and interpret the area under a force-time graph 7. Apply Newton's laws and the law of conservation of linear momentum

• Simple harmonic motion (S.H.M.): definition, examples, period, frequency, amplitude, velocity and acceleration, energy changes; forced vibration and resonance	8. Derive expressions for angular velocity, angular acceleration and centripetal force, and solve circular-motion problems 9. Relate period to frequency and analyse energy changes in S.H.M. 10. Identify types of forced vibration and applications of resonance

4. GRAVITATIONAL FIELD

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Newton's law of universal gravitation • Gravitational potential; conservative and non-conservative fields • Acceleration due to gravity and how g varies over the Earth's surface • Mass versus weight; escape velocity • Parking orbit and weightlessness	1. State and apply the law of universal gravitation 2. Give examples of conservative and non-conservative fields 3. Derive the expression for gravitational potential 4. Explain why g varies over the Earth's surface 5. Distinguish mass from weight and determine escape velocity

5. EQUILIBRIUM OF FORCES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Equilibrium of particles: coplanar forces, triangle and polygon of forces, Lami's theorem • Principle of moments: moment of a force, couple (torque), applications • Equilibrium of rigid bodies under parallel and non-parallel forces; resolving and combining forces; resultant and equilibrant • Centre of gravity and stability: stable, unstable and neutral equilibrium	1. Apply the conditions for equilibrium of coplanar forces 2. Use the triangle and polygon laws and Lami's theorem to solve problems 3. Calculate the moment of a force and of a couple, and describe their applications 4. Resolve forces into perpendicular directions and find the resultant and equilibrant 5. Distinguish stable, unstable and neutral equilibrium

6. FRICTION

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Static and dynamic friction • Coefficient of limiting friction and how to determine it • Advantages and disadvantages of friction; reducing friction • Viscosity and terminal velocity (qualitative); Stokes' law	1. Differentiate static from dynamic friction 2. Determine the coefficient of limiting friction 3. Compare the advantages and disadvantages of friction and suggest ways to reduce it 4. Analyse the factors affecting viscosity and terminal velocity and apply Stokes' law

7. WORK, ENERGY AND POWER

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Work, energy and power: definitions; forms of energy; conservation of energy; energy conversions; area under a force-distance curve • Energy and society: sources, renewable vs non-renewable, uses, development, diversification, environmental impact (global warming, greenhouse effect, spillage), energy crises, conversion, energy devices • Dams and energy production: location of dams and energy production • Nuclear energy	1. Differentiate work, energy and power, compare forms of energy and apply conservation of energy 2. Interpret the area under a force-distance curve and solve numerical problems on work, energy and power 3. List energy sources and tell renewable from non-renewable with examples 4. Explain the importance of energy to society and its impact on the environment 5. Identify energy sources that are friendly or hazardous to the environment and suggest ways of safe energy use

• Solar energy: photoelectric effect, solar collector, solar panel for energy supply	6. State forms of energy conversion; know photovoltaic cells, work function and Planck's constant

8. SIMPLE MACHINES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Definition and types of simple machines • Mechanical advantage, velocity ratio and efficiency	1. Identify the different types of simple machines 2. Solve problems involving mechanical advantage, velocity ratio and efficiency

9. ELASTICITY

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Hooke's law and Young's modulus • Elastic limit, yield point, breaking point • The spring balance as a force-measuring device • Work done per unit volume in springs and elastic strings	1. Interpret force-extension curves 2. Interpret Hooke's law and Young's modulus of a material 3. Use a spring balance to measure force 4. Determine the work done in springs and elastic strings

10. PRESSURE

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Atmospheric pressure: definition, S.I. unit (Pa), measurement, simple mercury barometer, aneroid barometer, manometer, variation with height, barometer as an altimeter • Pressure in liquids: relationship between pressure, depth and density ($P = \rho gh$); Pascal's principle; applications	1. Recognise the S.I. unit of pressure and the instruments that measure it 2. Relate pressure to height and use a barometer as an altimeter 3. Work out the relationship between pressure, depth and density 4. Apply Pascal's principle to solve problems

11. LIQUIDS AT REST

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Density of solids and liquids; relative density • Upthrust on a body in a liquid • Archimedes' principle and law of flotation; applications such as ships and hydrometers	1. Distinguish density from relative density 2. Determine upthrust on a body immersed in a liquid 3. Apply Archimedes' principle and the law of flotation

12. TEMPERATURE AND ITS MEASUREMENT

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Concept of temperature; thermometric properties • Calibration of thermometers • Temperature scales: Celsius and Kelvin (and Fahrenheit) • Types of thermometers; converting between scales	1. Identify thermometric properties used in different thermometers 2. Calibrate thermometers and compare the types 3. Differentiate Celsius, Fahrenheit and Kelvin scales and convert between them

13. QUANTITY OF HEAT

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Heat as a form of energy	1. Differentiate heat capacity from specific heat capacity

• Heat capacity and specific heat capacity of solids and liquids • Determining specific heat capacity: method of mixtures, electrical method, Newton's law of cooling	2. Determine them using simple methods 3. Solve numerical problems

14. CHANGE OF STATE

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Latent heat; specific latent heats of fusion and vaporisation • Melting, evaporation and boiling • Effect of pressure and dissolved substances on boiling and melting points • Applications in appliances	1. Differentiate latent heat from specific latent heats of fusion and vaporisation 2. Differentiate melting, evaporation and boiling 3. Explain the effect of pressure and dissolved substances on boiling and melting points 4. Solve numerical problems

15. THERMAL EXPANSION

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Solids: linear, area and volume expansivities; effects and applications (building gaps, railway lines); relationship between expansivities • Liquids: volume expansivity, real and apparent expansivity, how to determine it • Anomalous expansion of water	1. Determine linear and volume expansivities and relate them 2. Assess effects and applications of thermal expansion 3. Determine real and apparent expansivities of liquids 4. Analyse the anomalous expansion of water

16. GAS LAWS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Boyle's law (isothermal), Charles' law (isobaric), Pressure law (constant volume) • Absolute zero of temperature • General gas equation PV/T = constant; ideal gas equation PV = nRT • Van der Waals gas	1. Interpret the gas laws and use them to solve numerical problems 2. Interpret the Van der Waals equation for one mole of a real gas

17. VAPOURS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Unsaturated and saturated vapours; saturated vapour pressure (S.V.P.) and boiling • Determining S.V.P. by the barometer tube method • Formation of dew, mist, fog, cloud and rain • Dew point, humidity and relative humidity; wet and dry bulb hygrometers	1. Distinguish saturated from unsaturated vapours and relate S.V.P. to boiling point 2. Determine S.V.P. by the barometer tube method 3. Differentiate dew point, humidity and relative humidity 4. Estimate atmospheric humidity with wet and dry bulb hygrometers and solve numerical problems

18. STRUCTURE OF MATTER AND KINETIC THEORY

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Molecular nature of matter: atoms and molecules; Brownian motion, diffusion, surface tension, capillarity, adhesion, cohesion, angle of contact; law of definite proportion	1. Differentiate atoms from molecules 2. Use molecular theory to explain Brownian motion, diffusion, surface tension, capillarity, adhesion, cohesion and angle of contact

• Kinetic theory: assumptions; explaining gas pressure, Boyle's and Charles' laws, melting, boiling, vaporisation, temperature change and evaporation	3. State the assumptions of kinetic theory and use it to explain gas behaviour and changes of state

19. HEAT TRANSFER

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Conduction, convection and radiation • Temperature gradient, thermal conductivity, heat flux • Effect of surface nature on radiation and absorption; conductivities of common materials • Thermos (vacuum) flask; land and sea breeze; combustion engines	1. Differentiate the three modes of heat transfer 2. Solve problems on temperature gradient, thermal conductivity and heat flux 3. Compare conductivities of common materials and the effect of surface nature 4. Explain how a thermos flask works and tell land from sea breeze 5. Analyse the working of internal combustion, jet engines and rockets; compare electric and combustion engines

20. WAVES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Production and propagation: wave motion, vibrating sources, energy transfer, particle motion vs wave motion, $V = f\lambda$, phase difference, wave number, wave vector, progressive wave equation $Y = A \sin[(2\pi/\lambda)(vt \pm x)]$ • Classification: mechanical and electromagnetic; longitudinal and transverse; stationary and progressive; examples from springs, ropes, strings, ripple tank • Properties: reflection, refraction, diffraction, plane polarisation; superposition and interference; beats; Doppler effect (qualitative)	1. Interpret wave motion and identify vibrating sources of waves 2. Relate frequency and wavelength to wave velocity and use the progressive wave equation 3. Determine phase difference, wave number and wave vector 4. Differentiate mechanical from electromagnetic, longitudinal from transverse, stationary from progressive waves 5. Differentiate reflection, refraction, diffraction and polarisation 6. Apply the principle of superposition and explain beats and the Doppler effect 7. Solve numerical problems on waves

21. PROPAGATION OF SOUND WAVES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Need for a material medium • Speed of sound in solids, liquids and air • Reflection of sound: echoes, reverberation, applications, advantages and disadvantages	1. Show that sound needs a material medium 2. Compare the speed of sound in solids, liquids and air, and the effect of temperature and pressure 3. Solve problems on echoes, reverberation and speed of sound 4. Compare advantages and disadvantages of echoes

22. CHARACTERISTICS OF SOUND WAVES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Noise and musical notes; quality, pitch, intensity, loudness; musical instruments • Harmonics and overtones on strings: $f_0 = (1/2L)\sqrt{(T/\mu)}$, with $\mu = m/l$, and in air columns • Acoustic examples of resonance • Frequency of notes from open and closed pipes in relation to length	1. Differentiate noise from musical notes 2. Analyse quality, pitch, intensity and loudness and their use in instruments 3. Identify overtones on strings and in air columns and give acoustic examples of resonance 4. Determine note frequencies from open and closed pipes in relation to their lengths

23. LIGHT ENERGY

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Sources of light: natural and artificial; luminous and non-luminous objects • Propagation: speed, frequency, wavelength; shadows and eclipses; the pin-hole camera	1. Compare natural and artificial sources; differentiate luminous from non-luminous objects 2. Relate speed, frequency and wavelength of light 3. Interpret shadows and eclipses and solve pin-hole camera problems

24. REFLECTION OF LIGHT AT PLANE AND CURVED SURFACES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Laws of reflection and applications • Image formation by plane, concave and convex mirrors; ray diagrams • Mirror formula $1/f = 1/u + 1/v$ • Linear and angular magnification	1. Interpret the laws of reflection 2. Illustrate image formation by plane, concave and convex mirrors 3. Apply the mirror formula and find linear magnification 4. Apply reflection to the periscope, kaleidoscope and sextant

25. REFRACTION OF LIGHT

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Laws of refraction; refraction in terms of the speed of light in media; refractive index • Finding refractive index of glass and liquid with Snell's law; real and apparent depth; lateral displacement • Critical angle and total internal reflection • Glass prism: minimum deviation formula $n = \sin[(A + D)/2] / \sin(A/2)$ • Lenses: types, lens formula $1/f = 1/u + 1/v$, Newton's formula $f^2 = ab$, magnification	1. Interpret the laws of refraction and determine refractive index by Snell's law and by real and apparent depth 2. State conditions for total internal reflection and apply it to mirage, prisms, binoculars and optical fibres 3. Use the lens formula and ray diagrams to solve optical problems and find magnification 4. Calculate the refractive index of a prism by the minimum deviation formula and trace rays through a prism

26. OPTICAL INSTRUMENTS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Principles of microscopes, telescopes, projectors, cameras and the human eye (physiological detail not required) • Power of a lens; angular magnification • Near and far points; sight defects and corrections	1. Apply the principles of optical instruments to solve problems 2. Distinguish the human eye from the camera 3. Calculate the power of a lens and angular magnification 4. Determine near and far points and correct sight defects

27. DISPERSION OF LIGHT AND THE ELECTROMAGNETIC SPECTRUM

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Dispersion of white light by a triangular prism; pure spectrum • Colour mixing by addition and subtraction; colour of objects and filters; the rainbow • Electromagnetic spectrum: sources and uses of the radiations	1. Identify primary colours and obtain secondary colours by mixing 2. Explain the rainbow and why objects have colour; analyse colour with filters 3. Analyse the electromagnetic spectrum by wavelength, source, detection and use 4. Define monochromatic light

28. ELECTROSTATICS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Positive and negative charges; charging by friction, contact and induction • Electroscope • Coulomb's inverse square law; electric field and potential; field intensity and potential difference • Electric discharge and lightning	1. Identify charges and charge a body by friction, contact and induction 2. Use an electroscope and apply Coulomb's law 3. Deduce expressions for field intensity and potential difference 4. Identify field patterns of isolated and interacting charges 5. Explain charge distribution on a conductor and how lightning conductors work

29. CAPACITORS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Types and functions of capacitors; parallel plate capacitors • Capacitance and its link to plate area, separation and medium: C = εA/d • Capacitors in series and parallel • Energy stored in a capacitor	1. Determine the uses of capacitors and analyse parallel plate capacitors 2. Determine capacitance and the factors affecting it 3. Solve problems on capacitor arrangements 4. Determine the energy stored in a capacitor

30. ELECTRIC CELLS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Simple voltaic cell and its defects • Daniell cell, Leclanche cell (wet and dry) • Lead-acid accumulator, nickel-iron (Nife), lithium-ion, mercury-cadmium • Maintenance of cells; arrangement of cells; efficiency of a cell	1. Identify the defects of the simple cell and their corrections 2. Compare different cells, including the solar cell 3. Compare the lead-acid and nickel-iron accumulators 4. Solve problems on series and parallel arrangements of cells

31. CURRENT ELECTRICITY

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• E.m.f., p.d., current, internal resistance, lost volts • Ohm's law, resistivity, conductivity; measuring resistance; meter bridge • Resistors in series and parallel and combinations • Potentiometer: measuring e.m.f., current and internal resistance • Electrical networks	1. Differentiate e.m.f., p.d., current and internal resistance 2. Apply Ohm's law and calculate total resistance of series and parallel arrangements 3. Use the meter bridge and potentiometer; know the potentiometer's advantages 4. Determine resistivity and conductivity 5. Apply Kirchhoff's laws to networks

32. ELECTRICAL ENERGY AND POWER

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Electrical energy and power; commercial unit • Power transmission • Heating effect of current; house wiring; fuses	1. Apply the expressions for electrical energy and power 2. Explain how power travels from station to consumer 3. Identify the heating effect of current and its uses 4. Identify advantages of parallel over series wiring and determine fuse rating

33. MAGNETS AND MAGNETIC FIELDS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Natural and artificial magnets; soft iron vs steel; making magnets and demagnetising • Magnetic field of a permanent magnet and of a current in a straight wire, circular coil and solenoid • Earth's magnetic field: poles, magnetic meridian, dip and declination; flux and flux density; variation over the Earth's surface • Applications: navigation and mineral exploration	1. Give examples of natural and artificial magnets and tell soft iron from steel magnetically 2. Make and demagnetise magnets and keep magnets from losing magnetism 3. Draw the flux patterns of magnets, current-carrying conductors and solenoids (with polarity) 4. Identify the magnetic elements of the Earth and their variation 5. Examine applications of the Earth's magnetic field

34. FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Force between two parallel current-carrying conductors • Force on a moving charge in a magnetic field • D.C. motor; electromagnets; carbon microphone • Moving coil and moving iron instruments; converting galvanometers to ammeters and voltmeters (shunts, multipliers); sensitivity	1. Find the direction of force using Fleming's left-hand rule 2. Interpret attraction and repulsion between parallel conductors 3. Relate force to field strength, velocity and angle of entry of a charge 4. Explain the d.c. motor and electromagnets 5. Compare moving iron and moving coil instruments and convert a galvanometer to an ammeter or voltmeter 6. Identify factors affecting galvanometer sensitivity

35. ELECTROMAGNETIC INDUCTION

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Faraday's laws; Lenz's law and conservation of energy; factors affecting induced e.m.f.; a.c. and d.c. generators; transformers; induction coil • Inductance: meaning, unit, energy stored $E = \frac{1}{2}LI^2$, uses of inductors • Eddy currents: reduction, applications, effects	1. Interpret the laws of electromagnetic induction and the factors affecting induced e.m.f. 2. Show how Lenz's law illustrates conservation of energy 3. Explain a.c. generators, types of transformer and the induction coil 4. Interpret inductance and its unit; compute total inductance in series and parallel 5. Deduce the energy stored in an inductor 6. Describe how eddy-current losses are reduced and how eddy currents are used

36. SIMPLE A.C. CIRCUITS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• A.C. current and voltage; peak and r.m.s. values • A.C. source with a resistor, a capacitor (capacitive reactance) and an inductor (inductive reactance) • R-L-C circuits: vector diagram, phase angle, power factor, impedance, effective voltage • Resonance and resonance frequency $f_0 = 1/(2\pi\sqrt{(LC)})$	1. Differentiate peak from r.m.s. values and find phase difference between current and voltage 2. Interpret R-L-C circuits and vector diagrams 3. Calculate effective voltage, reactance and impedance 4. Recognise the condition for resonance and find the resonant frequency 5. Determine instantaneous power, average power and power factor

37. CONDUCTION OF ELECTRICITY THROUGH LIQUIDS AND GASES

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to

• Liquids: electrolytes and non-electrolytes; electrolysis; Faraday's laws; applications (electroplating, calibrating an ammeter) • Gases: discharge through gases (qualitative); applications	1. Distinguish electrolytes from non-electrolytes and analyse electrolysis 2. Apply Faraday's laws of electrolysis to problems 3. Analyse discharge through gases and its applications

38. ELEMENTARY MODERN PHYSICS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Bohr's and Rutherford's theories; atomic models and their limits; structure of the atom; energy levels and spectra • Thermionic and photoelectric emission; Einstein's equation and stopping potential; applications; simple production of X-rays • Radioactivity: properties and uses of alpha, beta and gamma rays; half-life and decay constant • Fusion and fission; binding energy, mass defect, $\Delta E = \Delta Mc^2$ • Wave-particle duality; electron diffraction; uncertainty principle	1. Identify atomic models and their limitations and describe the structure of the atom 2. Differentiate energy levels and spectra; compare thermionic and photoelectric emission 3. Apply Einstein's equation and calculate stopping potential 4. Interpret X-ray production, properties and applications 5. Analyse radioactivity, stable vs unstable nuclei, isotopes; compare alpha, beta and gamma rays 6. Relate half-life to decay constant; determine binding energy and mass defect 7. Analyse wave-particle duality and solve problems on the uncertainty principle

39. INTRODUCTORY ELECTRONICS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Metals, semiconductors and insulators (elementary band gap) • Intrinsic and extrinsic semiconductors (n-type and p-type) • Diodes in rectification; transistors in amplification	1. Differentiate conductors, semiconductors and insulators 2. Distinguish intrinsic from extrinsic semiconductors and electron from hole carriers 3. Analyse diodes and transistors and relate them to rectification and amplification

40. INTRODUCTION TO FIBRE OPTICS AND LASERS

TOPICS / CONTENTS	OBJECTIVES: candidates should be able to
• Fibre optics: concept, transmission of light through an optical fibre, uses in LAN, medicine and laser beams • Lasers: meaning, types (solid state, gas, liquid, semiconductor), uses (research, communication, medicine, military, holograms), dangers	1. Explain fibre optics and how light travels through an optical fibre 2. Apply fibre optics in LAN and medicine 3. Explain what a laser is, its types and uses, and the dangers of using lasers