What I need to know	How do I know I know this.

1.1 Kinematics

1	Describe how to measure an average speed.	
2	Carry out calculations involving distance, time and average speed.	
3	Describe how to measure instantaneous speed.	
4	Identify situations where average speed and instantaneous speed are different.	
5	Describe what is meant by vector and scalar quantities.	
6	State the difference between distance and displacement.	

What I need to know	How do I know I know this.

7	State the difference between speed and velocity.	
8	Explain the terms ‘speed’, ‘velocity’ and ‘acceleration’.	
9	State that acceleration is the change in velocity in unit time.	
10	Draw velocity – time graphs involving more than one constant acceleration.	
11	Describe the motions represented by a velocity–time graph.	
12	Calculate displacement and acceleration from velocity–time graphs involving more than one constant acceleration.	

What I need to know	How do I know I know this.

1.2 Dynamics

1	Describe the effects of forces in terms of their ability to change the shape, speed and direction of travel of an object.	
2	Describe the use of a newton balance to measure force.	
3	State that weight is a force and is the Earth's pull on an object.	
4	Distinguish between mass and weight.	
5	State that weight per unit mass is called the gravitational field strength.	

	What I need to know	How do I know I know this.
6	Carry out calculations involving the relationship between weight, mass and gravitational field strength including situations where g is not equal to 10 N/kg.	
7	State that the force of friction can oppose the motion of an object.	
8	Describe and explain situations in which attempts are made to increase or decrease the force of friction.	
9	State that force is a vector quantity.	
10	State that forces which are equal in size but act in opposite directions on an object are called balanced forces and are equivalent to no force at all.	
11	Explain the movement of objects in terms of Newton's First Law.	

	What I need to know	How do I know I know this.

12	Describe the qualitative effects of change of mass or of force on the acceleration of an object.	
13	Define the newton.	
14	Use free body diagrams to analyse the forces on an object.	
15	State what is meant by the resultant of a number of forces.	
16	Use a scale diagram, or otherwise, to find the magnitude and direction of the resultant of two forces acting at right angles to each other.	
17	Carry out calculations using the relationship between acceleration, resultant force and mass, and involving more than one force but in one dimension only.	

What I need to know	How do I know I know this.

18	Explain the equivalence of acceleration due to gravity and gravitational field strength.	
19	Explain the curved path of a projectile in terms of the force of gravity.	
20	Explain how projectile motion can be treated as two independent motions.	
21	Solve numerical problems using the above method for an object projected horizontally. (No knowledge of the equations of motion is expected.)	

What I need to know	How do I know I know this.

1.3 Momentum and energy

1	State Newton's Third Law.	
2	Identify 'Newton pairs' in situations involving several forces.	
3	State that momentum is the product of mass and velocity.	
4	State that momentum is a vector quantity.	
5	State that the law of conservation of linear momentum can be applied to the interaction of two objects moving in one direction, in the absence of net external forces.	
6	Carry out calculations concerned with collisions in which all the objects move in the same direction and with one object initially at rest.	

	What I need to know	How do I know I know this.
7	State that work done is a measure of the energy transferred.	
8	Carry out calculations involving the relationship between work done, force and distance.	
9	Carry out calculations involving the relationship between work done, power and time.	
10	Carry out calculations involving the relationship between change in gravitational potential energy, mass, gravitational field strength and change in height.	
11	Carry out calculations involving the relationship between kinetic energy, mass and velocity. 12 Carry out calculations involving the relationship between efficiency and output power, output energy and input power, input energy.	

What I need to know	How do I know I know this.

1.4 Heat

1	State that the same mass of different materials needs different quantities of heat energy to change their temperature by one degree celsius.	
2	Carry out calculations involving specific heat capacity.	
3	State that heat is gained or lost by a substance when its state is changed.	
4	State that a change of state does not involve a change in temperature.	
5	Carry out calculations involving specific latent heat.	
6	Carry out calculations involving energy, work, power and the principle of conservation of energy.	

What I need to know	How do I know I know this.

2.1 Circuits

1	State that electrons are free to move in a conductor.	
2	Describe electrical current in terms of the movement of charges around a circuit.	
3	Carry out calculations involving the relationship between charge, current and time.	
4	Distinguish between conductors and insulators and give examples of each.	
5	Draw and identify the circuit symbols for an ammeter, voltmeter, battery, resistor, variable resistor, fuse, switch and lamp.	
6	State that the voltage of a supply is a measure of the energy given to the charges in a circuit.	

	What I need to know	How do I know I know this.

7	State that an increase in the resistance of a circuit leads to a decrease in the current in that circuit.	
8	Draw circuit diagrams to show the correct positions of an ammeter and voltmeter in a circuit.	
9	State that in a series circuit the current is the same at all positions.	
10	State that the sum of the potential differences across the components in series is equal to the voltage of the supply.	
11	State that the sum of the currents in parallel branches is equal to the current drawn from the supply	
12	State that the potential difference across components in parallel is the same for each component.	

What I need to know	How do I know I know this.

13	State that V/I for a resistor remains approximately constant for different currents.	
14	Carry out calculations involving the relationship between potential difference, current and resistance.	
15	Carry out calculations involving resistors connected in series and parallel.	
16	State that a potential divider circuit consists of a number of resistors, or a variable resistor, connected across a supply.	
17	Carry out calculations involving potential differences and resistances in a potential divider.	

What I need to know	How do I know I know this.

2.2 Electrical Energy

1	State that when there is an electrical current in a component, there is energy transformation.	
2	State that the electrical energy transformed each second = VI.	
3	Carry out calculations involving the relationships between power, energy, time, current and potential difference.	
4	Explain the equivalence between VI, I^2R and V^2/R.	
5	Carry out calculations involving the relationships between power, current, voltage and resistance.	
6	State that in a lamp electrical energy is transformed into heat and light.	

What I need to know	How do I know I know this.

7	State that the energy transformation in an electrical heater occurs in the resistance wire.	
8	Explain in terms of current the terms d.c. and a.c.	
9	State that the frequency of the mains supply is 50 Hz.	
10	State that the quoted value of an alternating voltage is less than its peak value.	
11	State that a d.c. supply and an a.c. supply of the same quoted value will supply the same power to a given resistor.	

What I need to know	How do I know I know this.

2.3 Electromagnatism

1	State that a magnetic field exists around a current carrying wire.	
2	Identify circumstances in which a voltage will be induced in a conductor.	
3	State the factors that affect the size of the induced voltage, ie field strength, number of turns on a coil, relative movement.	
4	State that transformers are used to change the magnitude of an alternating voltage.	
5	Carry out calculations involving input and output voltages, turns ratio and primary and secondary currents for an ideal transformer.	

What I need to know	How do I know I know this.

2.4 Electronic Components

1	Give examples of output devices and the energy transformations involved.	
2	Draw and identify the symbol for an LED.	
3	State that an LED lights only when connected the correct way round.	
4	Describe by means of a diagram a circuit which will allow an LED to light.	
5	Calculate the value of the series resistor for an LED and explain the need for this resistor.	
6	Give examples of input devices.	

	What I need to know	How do I know I know this.
7	Describe the energy transformations involved in the following devices: microphone, thermocouple, solar cell.	
8	State that, for most common thermistors, the resistance of the thermistor decreases as temperature increases.	
9	State that the resistance of an LDR decreases with increasing light intensity.	
10	Carry out calculations involving potential difference, current and resistance for the thermistor and LDR.	
11	Draw and identify the circuit symbol for an n channel enhancement MOSFET.	

	What I need to know	How do I know I know this.
12	Draw and identify the circuit symbol for an NPN transistor.	
13	State that a transistor can be used as a switch.	
14	Explain the operation of a simple transistor switching circuit.	
15	Identify, from a list, devices in which amplifiers play an important part.	
16	State that the output signal of an audio amplifier has the same frequency as, but a larger amplitude than, the input signal.	
17	Carry out calculations involving input voltage, output voltage and voltage gain of an amplifier.	

What I need to know	How do I know I know this.

3.1 Waves

1	State that a wave transfers energy.	
2	Describe a method of measuring the speed of sound in air, using the relationship between distance, time and speed.	
3	State that radio and television signals are transmitted through air at 300 million m/s and that light is also transmitted at this speed.	
4	Carry out calculations involving the relationship between distance, time and speed in problems on water waves, sound waves, radio waves and light waves.	
5	Use the following terms correctly in context: wave, frequency, wavelength, speed, amplitude, period.	

What I need to know	How do I know I know this.

6	State the difference between a transverse and longitudinal wave and give examples of each.	
7	Carry out calculations involving the relationship between speed, wavelength and frequency for waves.	
8	State in order of wavelength, the members of the electromagnetic spectrum: gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, TV and radio.	

What I need to know	How do I know I know this.

3.2 Reflection

1	State that light can be reflected.	
2	Use correctly in context the terms: angle of incidence, angle of reflection and normal when a ray of light is reflected from a plane mirror.	
3	State the principle of reversibility of a ray path.	
4	Explain the action of curved reflectors on certain received signals.	
5	Explain the action of curved reflectors on certain transmitted signals.	

What I need to know	How do I know I know this.

6	Describe an application of curved reflectors used in telecommunication.	
7	Explain, with the aid of a diagram, what is meant by total internal reflection.	
8	Explain, with the aid of a diagram, what is meant by ‘the critical angle’.	
9	Describe the principle of operation of an optical fibre transmission system.	

What I need to know	How do I know I know this.

3.3 Refraction

1	State what is meant by the refraction of light.	
2	Draw diagrams to show the change in direction as light passes from air to glass and glass to air.	
3	Use correctly in context the terms angle of incidence, angle of refraction and normal.	
4	Describe the shapes of converging and diverging lenses.	
5	Describe the effect of a converging and a diverging lens on parallel rays of light.	

	What I need to know	How do I know I know this.
6	Draw a ray diagram to show how a converging lens forms the image of an object placed at a distance of: a) more than two focal lengths b) between one and two focal lengths c) less than one focal length in front of the lens.	
7	Carry out calculations involving the relationship between power and focal length of a lens.	
8	State the meaning of long and short sight.	
9	Explain the use of lenses to correct long and short sight.	

What I need to know	How do I know I know this.

4.1 Ionising Radiation

1	Describe a simple model of the atom which includes protons, neutrons and electrons.	
2	State what is meant by an alpha particle, beta particle and gamma ray.	
3	State that radiation energy may be absorbed in the medium through which it passes.	
4	State the approximate range through air, and absorption of alpha, beta and gamma radiation.	
5	Explain the term ionisation.	

What I need to know	How do I know I know this.

6	State that alpha particles produce much greater ionisation density than beta particles or gamma rays.	
7	Describe how one of the effects of radiation is used in a detector of radiation.	
8	State that radiation can kill living cells or change the nature of living cells.	
9	Describe one medical use of radiation based on the fact that radiation can destroy cells.	
10	Describe one use of radiation based on the fact that radiation is easy to detect.	

What I need to know	How do I know I know this.

4.2 Dosimetry

1	State that the activity of a radioactive source is the number of decays per second and is measured in becquerels (Bq), where one becquerel is one decay per second.	
2	Carry out calculations involving the relationship between activity, number of decays and time.	
3	State that the absorbed dose is the energy absorbed per unit mass of the absorbing material.	
4	State that the gray (Gy) is the unit of absorbed dose and that one gray is one joule per kilogram.	
5	State that a radiation weighting factor is given to each kind of radiation as a measure of its biological effect.	

	What I need to know	How do I know I know this.
6	State that the equivalent dose is the product of absorbed dose and radiation weighting factor and is measured in sieverts (Sv).	
7	Carry out calculations involving the relationship between equivalent dose, absorbed dose and radiation weighting factors.	
8	State that the risk of biological harm from an exposure to radiation depends on: a) the absorbed dose b) the kind of radiation, e.g. α, β, γ, slow neutron c) the body organs or tissue exposed.	
9	Describe factors affecting the background radiation level.	

What I need to know	How do I know I know this.

4.3 Half life and Safety

1	State that the activity of a radioactive source decreases with time.	
2	State the meaning of the term ‘half-life’.	
3	Describe the principles of a method for measuring the half-life of a radioactive source.	
4	Carry out calculations to find the half-life of a radioactive isotope from appropriate data	
5	Describe the safety procedures necessary when handling radioactive substances.	

	What I need to know	How do I know I know this.

6	State that the dose equivalent is reduced by shielding, by limiting the time of exposure or by increasing the distance from a source.	
7	Identify the radioactive hazard sign and state where it should be displayed.	

What I need to know	How do I know I know this.

4.4 Nuclear Reactors

1	State the advantages and disadvantages of using nuclear power for the generation of electricity.	
2	Describe in simple terms the process of fission.	
3	Explain in simple terms a chain reaction.	
4	Describe the principles of the operation of a nuclear reactor in terms of fuel rods, moderator, control rods, coolant and containment vessel.	
5	Describe the problems associated with the disposal and storage of radioactive waste.	