Name: ______________________________

Class: ______________________________

Date: ______________________________

Mr. Rawson • GCSE Physics

P1 Overview – Energy

Listed below is the specification content for P1 Energy, taken from the AQA GCSE Combined Science: Trilogy specification (8464) and grouped under AQA's own sub-topic numbers so you can track your own progress. Everything here is examined on **Physics Paper 1**, and all of it is sat by both tiers except the one statement marked **[HT]** . The back page gathers the equations, the required practical and the maths skills the topic leans on.

Specification • §P1.1 Energy changes in a system • *AQA Trilogy 8464 · Physics Paper 1*

The ways energy is stored before and after such changes.

P1.1.1 Energy stores and systems

- ☐ A system is an object or group of objects. There are changes in the way energy is stored when a system changes.
- ☐ Describe all the changes involved in the way energy is stored when a system changes, for common situations: an object projected upwards; a moving object hitting an obstacle; an object accelerated by a constant force; a vehicle slowing down; bringing water to a boil in an electric kettle.
- ☐ Throughout this section, calculate the changes in energy involved when a system is changed by heating, by work done by forces, and by work done when a current flows.
- ☐ Use calculations to show on a common scale how the overall energy in a system is redistributed when the system is changed.

P1.1.2 Changes in energy

- ☐ Calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level.
- ☐ Kinetic energy, $E_k = \frac{1}{2}mv^2$, with E_k in joules (J), m in kilograms (kg) and v in metres per second (m/s).
- ☐ Elastic potential energy stored in a stretched spring, $E_e = \frac{1}{2}ke^2$, assuming the limit of proportionality has not been exceeded, with E_e in joules (J), k in newtons per metre (N/m) and e in metres (m).
- ☐ Gravitational potential energy gained by an object raised above ground level, $E_p = mgh$, with E_p in joules (J), m in kilograms (kg), g in newtons per kilogram (N/kg, value given) and h in metres (m).

P1.1.3 Energy changes in systems

- ☐ The energy stored in or released from a system as its temperature changes, $\Delta E = mc\Delta\theta$, with ΔE in joules (J), m in kilograms (kg), c in joules per kilogram per degree Celsius (J/kg °C) and $\Delta\theta$ in degrees Celsius (°C).
- ☐ The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.

P1.1.4 Power

- ☐ Power is defined as the rate at which energy is transferred, or the rate at which work is done.
- ☐ $P = E/t$ and $P = W/t$, with P in watts (W), E in joules (J), t in seconds (s) and W in joules (J).
- ☐ An energy transfer of 1 joule per second is equal to a power of 1 watt.
- ☐ Give examples that illustrate the definition of power, for example comparing two electric motors that both lift the same weight through the same height but one does it faster.

Specification • §P1.2 Conservation and dissipation of energy • *AQA Trilogy 8464 · Physics Paper 1*

P1.2.1 Energy transfers in a system

- ☐ Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed.
- ☐ Describe with examples where there are energy transfers in a closed system, and that there is no net change to the total energy.
- ☐ Describe with examples how in all system changes energy is dissipated, so that it is stored in less useful ways. This energy is often described as being wasted.
- ☐ Explain ways of reducing unwanted energy transfers, for example through lubrication and the use of thermal insulation.
- ☐ The higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the material.
- ☐ Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls.
- ☐ You do not need to know the definition of thermal conductivity.

P1.2.2 Efficiency

- ☐ Efficiency = useful output energy transfer / total input energy transfer. Efficiency may also be calculated as useful power output / total power input.
- ☐ Efficiency values may be calculated or used as a decimal or as a percentage.
- ☐ **[HT]** Describe ways to increase the efficiency of an intended energy transfer.

Specification • §P1.3 National and global energy resources • *AQA Trilogy 8464 · Physics Paper 1*

- ☐ The main energy resources available for use on Earth include fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydro-electricity, geothermal, the tides, the Sun and water waves.
- ☐ A renewable energy resource is one that is being, or can be, replenished as it is used.
- ☐ The uses of energy resources include transport, electricity generation and heating.
- ☐ Describe the main energy sources available; distinguish between renewable and non-renewable energy resources; compare the ways different energy resources are used; understand why some energy resources are more reliable than others.
- ☐ Describe the environmental impact arising from the use of different energy resources.
- ☐ Explain patterns and trends in the use of energy resources.
- ☐ Descriptions of how energy resources are used to generate electricity are not required.
- ☐ Consider the environmental issues that may arise from the use of different energy resources, and show that science has the ability to identify environmental issues arising from the use of energy resources but not always the power to deal with those issues, because of political, social, ethical or economic considerations.

Syllabus content reproduced from the AQA GCSE Combined Science: Trilogy specification (8464), version 1.1, section 6.1. Sub-topic numbers follow AQA's own; the statements within them are unnumbered in the specification.

Equations

Seven of these you must **recall**. Two are printed on the equation sheet in the exam, so you need to know what they mean and how to use them, not memorise them.

- ☐ $W = mg$ **[RECALL]**
  weight = mass × gravitational field strength
- ☐ $E_k = \frac{1}{2}mv^2$ **[RECALL]**
  kinetic energy = 0.5 × mass × (speed)^2
- ☐ $E_p = mgh$ **[RECALL]**
  gravitational potential energy = mass × gravitational field strength × height
- ☐ $P = \dfrac{E}{t}$ **[RECALL]**
  power = energy transferred / time
- ☐ $P = \dfrac{W}{t}$ **[RECALL]**
  power = work done / time
- ☐ $\text{efficiency} = \dfrac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ **[RECALL]**
- ☐ $\text{efficiency} = \dfrac{\text{useful power output}}{\text{total power input}}$ **[RECALL]**
- ☐ $E_e = \frac{1}{2}ke^2$ **[EQUATION SHEET]**
  elastic potential energy = 0.5 × spring constant × (extension)^2
- ☐ $\Delta E = mc\Delta\theta$ **[EQUATION SHEET]**
  change in thermal energy = mass × specific heat capacity × temperature change

Required practical

[LAB] **RP14 Specific heat capacity**
An investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store, or work done, to the increase in temperature and subsequent increase in thermal energy stored. Skills: physics AT 1 and AT 5.

Maths skills this topic needs

- ☐ Recall and apply the kinetic energy, gravitational potential energy and power equations (MS 3b, 3c).
- ☐ Use calculations on a common scale to show energy redistribution (MS 1a, 1c, 3b, 3c).
- ☐ Calculate or use efficiency values as a decimal or as a percentage (MS 1a, 1c, 3b, 3c).

Where this topic connects

- ☐ Energy transfer by current, in **P2 Electricity**, work done and energy transfer.
- ☐ Specific heat capacity appears again in **P3 Particle Model of Matter**, section 6.3.2.2.

- ☐ Elastic potential energy, in **P5 Forces**, forces and elasticity, Hooke's Law.
- ☐ Energy resources and environmental impact, cross-curricular with geography and citizenship.