Buttershaw Business and Enterprise College

Physics Paper 1 Key recall facts

Energy, Electricity, Particle Model of Matter and Atomic Structure

"If I have seen further it is by standing on the shoulders of Giants," Sir Isaac Newton, 1675.*

Name……

Group……

Teacher……

*Sir Isaac Newton developed the Universal Law of Gravitation, that states that gravity affects everything in the Universe, and the three Laws of Motion.

Introduction for Pupils (and Parents)

This booklet contains important scientific facts, which at first glance may seem a lot for you to learn. They cover the whole syllabus for GCSE Combined Physics Paper 1. If you do just do a few at a time you shouldn't find it too difficult and you will be able to learn the material quickly. What's more, the rewards will be well worth the effort. You need to know these facts before you can learn more complex skills. If you don't know them, you will enjoy science less and will not make as good progress as you could.

'When students are able to recall a fact quickly and automatically, less working memory is used in order to develop the answer'
(LeFevre, DeStefano, Coleman, & Shanahan, 2005)

We use 'working memory' to solve problems, so if we can recall a large number of facts without too much effort, our brain is freed up to work on more difficult problems. Furthermore, we learn about a subject better when we already know something about it – so getting good general knowledge in place early on is like laying strong foundations that can be built upon over a lifetime.

The key is to practice memorising facts in short bursts – little and often! You should see this as a challenge and should be rewarded for success. Long-term practice is essential; so when you move onto a new topic, don't neglect the older ones. The facts in this booklet will be included in the tests you will take in school during Years 9, 10 & 11. Of course, you will also be tested on more complicated subject matter using past paper questions, but completing these questions will become easier too - once these facts can be recalled with ease.

Suggested Activities

The most common thing that children do to revise is they simply read something repeatedly - hoping it will 'stick'. This method is better than nothing, but it has been found to be one of the least effective in securing long-term knowledge. You might like to try some of the techniques on the following page, or maybe you will think of some of your own. But remember that saying facts out loud on a regular basis really helps move them into long-term memory. So however you practise, try to do so with speech!

1. Verbal Testing

Working with somebody at home, ask them to read out the questions from a topic and you recall the answer. If you can't, simply listen to the answer and move on. Don't expect to recall ten facts in the first session – and don't push too hard when you're tired. Regular short practice will get you there in the end. Practice the facts regularly and you will get better and gain confidence.

2. Key Recall Cards

These are brilliant for teaching facts. Just take some small pieces of card – around playing card size will do – and write the questions on one side and the answers on the other. You can ask someone at home to show you the question while they check the answer, or else you can test yourselves. It's good to introduce competition too, so you might want to try timing yourselves once you get good!

3. Cross-Peer Tutoring

This is something we have researched and used to good effect in BBEC Science. It can be used with either of the techniques above. You should pair up with another pupil, so that one plays the role of a teacher and the other their student. After a while swap roles. This works best if you already have a similar level of ability – and its effectiveness can be very surprising when you see it in action!

4. Self-Assessment

For quiet revision you can cover the right-hand column with a blank piece of paper, read the questions to yourselves and try to recall the answer. In the short term this is less effective than the other methods – but the advantage is that you can practice as often as you like. Once you become confident ask someone at home to test you – tick off the questions each time you get them right. If you date each page when you start learning the facts and the date you have memorized them all you will be able to track your progress – even better, write the date every time you revisit the page. That way you will see which topics you have revised the most when you come to your final revision just before your exams.

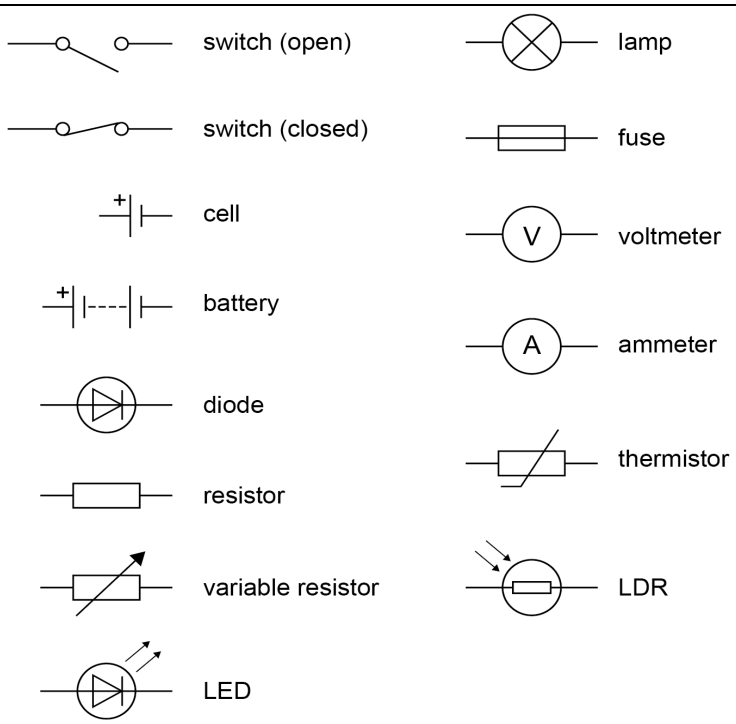
Energy Recall Facts

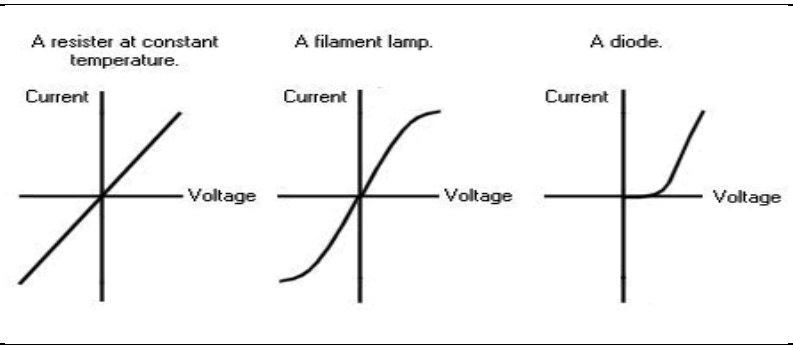
1. Name the different types of energy/energy stores.	• Chemical • Heat or Thermal • Kinetic (movement) • Gravitational Potential (anything above the ground) • Elastic Potential • Nuclear • Magnetic • Electrostatic
2. Define the term 'system'	A system is an object or group of objects
3. What causes an energy transfer?	A change in the system
4. What are the 4 pathways of energy transfer?	Mechanical – work is done against a force e.g., friction, air resistance, gravity Electrical – charges in a circuit Radiation – light and sound Heating
5. Describe the changes in the energy stores when water is brought to a boil in a kettle	Chemical energy store of fuel decreases. Thermal energy store of water/surroundings increases.
6. Describe the changes in the energy stores when a moving car slows down (decelerates)	Kinetic energy store of car decreases. Thermal energy store of brakes/tyres/surroundings increases.
7. Describe the changes in the energy stores, when a falling ball hits the ground	Kinetic energy store of ball decreases. EPE store of ball increases. Thermal energy store of ball/surroundings increases.
8. Describe the changes in the energy stores of a battery powered car.	Chemical energy store of battery decreases. Kinetic energy store of car increases. Thermal energy store of car/surroundings increases.
9. Describe the changes in the energy stores when a person throws a ball in the air	Chemical energy store of person decreases. KE and GPE energy store of ball increases. Thermal energy store of surroundings increases.
10. Define the term 'law of conservation of energy'	Law of conservation of energy is the idea that energy cannot be created or destroyed, but transferred usefully, stored or dissipated.
11. What is dissipation?	Work is done against friction or resistance in a circuit to release thermal energy to surroundings.
12. How is GPE affected by height?	As the height of an object increases, the GPE store of the object increases.
13. How is kinetic energy affected by speed?	As the speed of an object increases, the kinetic energy store of the object increases.

14. Define the term 'specific heat capacity'	Specific heat capacity is the amount of energy needed to heat up 1kg of a substance by 1^oC
15. Oil heats up quicker than water for the same amount of heat energy. Does oil have a lower, or higher, specific heat capacity than water	Lower as it requires less energy to heat up
16. What is power?	Power is the rate at which energy is transferred or the rate at which work is done. It can also be defined as the amount of energy transferred per second.
17. What is work done?	Force x distance moved. When work is done, energy is transferred. This means Work done (J) = power (W) x time (s).
18. Define the term 'thermal conductivity'	The ability of a material to allow the flow of heat through it. The higher the thermal conductivity, the higher the rate of energy transfer by conduction
19. How do you reduce unwanted energy transfer in a house?	Thicker walls Walls made up of materials that have low thermal conductivity values, such as brick Loft insulation Carpets Double glazing windows
20. What is a renewable resource?	Renewable resource is one that can be replenished as it is being used, and is not likely to run out.
21. What is a finite resource?	Non-renewable resource that cannot be replenished at the same rate as it is being used, so will run out.
22. What are the 3 fossil fuels?	Coal, oil and natural gas
23. Why does the UK use a mixture of renewable/non-renewable energy resources?	Some renewables resources are unreliable, but there is increasing pressure to reduce use of fossil fuels that are non-renewable and contribute to global warming and climate change.
24. What are the advantages and disadvantages of using fossil fuels?	**Advantages** • Reliable • Easily available **Disadvantages** • Non-renewable • Produces CO_2 • Causes global warming
25. What are the advantages and disadvantages of nuclear fuel?	**Advantages** • Small amounts produce lots of energy. • Does not produce CO_2. **Disadvantages** • Non-renewable • Radioactive • Increases chances of cancer

26. What are the advantages and disadvantages of biofuel?	**Advantages** • Renewable • Carbon neutral – Plants take in CO_2 when they grow (photosynthesise) **Disadvantages** • Lots of land needed to grow plants. • This land could be used to grow crops for food.
27. What are the advantages and disadvantages of wind energy?	**Advantages** • Renewable • Free once installed. • Does not produce CO_2. **Disadvantages** • Noise and visual pollution • Unreliable – depends on the weather.
28. What are the advantages and disadvantages of solar energy?	**Advantages** • Renewable • Free once installed. • Does not produce CO_2. **Disadvantages** • Unreliable – depends on the weather. • To meet demands, requires a lot of area in terms of solar cells.
29. What are the advantages and disadvantages of geothermal energy?	**Advantages** • Renewable • Reliable all year long • Does not produce CO_2. **Disadvantages** • Location dependent – need to be near hot rocks. • High start-up costs.
30. What are the advantages and disadvantages of hydroelectric power?	**Advantages** • Renewable • Reliable source of energy • Does not produce CO_2. **Disadvantages** • Location dependent – need a huge water supply. • High start-up costs. • Destroys wildlife nearby and floods land.

Electricity Recall Facts

1. Draw and label the following circuit symbols: a) Switch (open) b) Switch (closed) c) Cell d) Battery e) Diode f) Resistor g) Variable resistor h) LED i) Lamp j) Fuse k) Voltmeter l) Ammeter m) Thermistor n) LDR	
2. What is current? What are the units of current?	It is the rate of flow of electric charge. Measured in amps
3. Why are metals good conductors?	Because they have free moving electrons
4. What is the source of potential difference in a circuit?	Cell or battery
5. What is potential difference?	It is another word for voltage. The difference in work done (energy transferred) by, or on a charge, between 2 points in a circuit
6. What is the relationship between potential difference and current at a fixed resistance?	As the potential difference is increased, current increases. They are directly proportional.
7. How is an ammeter connected in a circuit?	In series (within the loop)
8. How is a voltmeter connected in a circuit?	Parallel to the component being measured
9. What is resistance? What are the units of resistance?	Opposing the flow of charge (current). Measured in ohms.
10. What is the relationship between resistance and current at a fixed potential difference?	As resistance is increased, current decreases. They are inversely proportional.
11. What is the job of a variable resistor?	Alter the resistance of the circuit, and therefore current and potential difference across different components

12. State Ohm's Law	Potential difference is directly proportional to the current for a fixed resistor or resistor at constant temperature
13. Sketch the I-V graph of a fixed resistor, filament lamp and diode	
14. Describe the difference between a linear and non-linear graph	Linear graph – straight line Non-linear graph – not a straight or curves
15. Which of the I-V graph(s) are linear?	Fixed resistor or resistor at constant temperature
16. Which of the I-V graph(s) are non-linear?	Filament lamp (bulb) and diode
17. Explain the shape of the fixed resistor line	Resistance is constant, so straight line, and follows Ohm's Law
18. Explain the shape of the filament lamp graph	As potential difference and current increases, bulb gets hotter, and this increases resistance
19. Explain the shape of the diode graph	Very high resistance in reverse direction, so no current Very low resistance in forward direction, so rapid increase in current
20. Describe how the resistance of a thermistor changes with temperature	As the temperature across a thermistor increases, the resistance decreases so the current increases.
21. What are the uses of a thermistor?	Thermostat Sensors to regulate cold and heat
22. Describe how the resistance of a LDR changes with light intensity	As the light intensity falling on a LDR increases, the resistance decreases, so current increases.
23. State some use of a LDR	Light intensity meters and sensors for street lamps.
24. What are the rules of series circuits in terms of the… a) Current b) Potential difference c) Total resistance	a) Current is the same through each component. b) Potential difference of the battery is shared between the components. c) Total resistance is all components added together.
25. What are the rules of parallel circuits in terms of the… a) Current b) Potential difference c) Total resistance	a) Total current in circuit is split between loops. b) Potential difference of each loop is the same as the battery. c) Total resistance is smaller than the value of the smallest resistor.

26. What happens when resistors are combined in parallel?	The total resistance of the circuit decreases, as the electrons (current) has more pathways/loops to flow through.
27. Describe the difference between alternating and direct potential different	A direct potential difference only has one direction (polarity). An alternating current changes the direction (polarity) of current.
28. What is the voltage and frequency of the UK mains electricity?	230V and 50Hz
29. What is the function, colour and position of the: a) Earth wire b) Live wire c) Neutral wire	a) Earth is a safety wire in a metal appliance that has a potential difference of 0V. It is yellow/green striped and goes to the top b) Live wire carries a potential difference of 230V. It is brown and goes right. c) Neutral wire completes the circuit at 0V. It is blue and goes left.
30. Why is the earth wire connected to the metal casing?	It carries the current to the Earth if the metal appliance becomes live. It would be the path of least resistance.
31. What is the National Grid?	Series of pylons, cables and transformers that transfers electrical power from power station to consumers.
32. What is the importance of the step-up transformer?	Increases the potential difference which decreases the current. This reduces the energy loss via heating of wires and so increases efficiency.
33. What is the function of the pylons?	Support and hold the cables
34. What is the function of the cables?	Made up of low resistance wires, to reduce loss via heating.
35. What is the importance of the step-down transformer?	Decreases the potential difference to 230V, so it is safer for consumers.

Particle Model of Matter Recall Facts

1. How does the arrangement of particles affect density?	The more tightly packed particles are, the denser the substance.
2. Describe the arrangement and motion of particles in solids.	• Fixed positions/regular arrangement. • Closely packed together, so highest density. • Vibrate in fixed positions. • Strong forces of attraction between particles.
3. Describe the arrangement and motion of particles in liquids.	• Particles still touching but no regular arrangement. • Less dense than solids. • Particles can move randomly at slow speeds, so liquids can flow. • Weaker forces of attraction between particles.
4. Describe the arrangement and motion of particles in gases.	• Particles are far apart, so lowest density. • Particles can move very fast (random speeds) in random directions. • Have very low densities compared to solids and liquids. • No forces of attraction between particles
5. Name the changes of state	Melting – solid → liquid Freezing – liquid → solid Boiling – liquid → gas Condensation – gas → liquid Sublimation – solid → gas
6. Why is the change of state known as a physical change?	There is no change in the chemical. Ice, water and steam are all H_2O.
7. In a change of state, mass is conserved. What does this mean?	If 1kg of water is boiled, there would be 1kg of steam formed. The mass does not change.
8. What is internal energy?	Internal energy = potential energy + kinetic energy The total energy of all the particles in the system
9. What determines a particle's: a) Kinetic energy b) Potential energy	Kinetic energy due to movement of particles Potential energy due to the position of the particles
10. In what 2 ways does heating change the energy of the particles?	• Increases the temperature/kinetic energy of the particles. • Produces a change of state (increases potential energy)
11. Describe the relationship between temperature and kinetic energy	Temperature is directly proportional to the kinetic energy of the particles

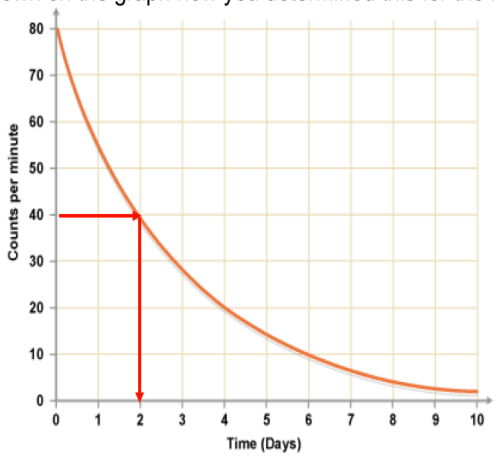
12. Heating curve - Why does the temperature not rise when a substance is at melting point?	Energy is being used to break bonds or overcome the forces of attraction between molecules, so temperature does not rise. • Note: There is no change in kinetic energy but there is an increase in the potential energy.
13. Cooling curve – Why does the temperature not decrease when a gas changes to a liquid?	Energy is released to the surroundings. No change in kinetic energy, but decrease in potential energy and internal energy
14. Define the term 'specific heat capacity'	The amount of energy needed to change the temperature of 1kg of a substance by 1^{o}C
15. Define the term 'specific latent heat'.	The energy needed to change the state of one kilogram of a substance with no change in temperature.
16. Define the term 'specific latent heat of fusion'?	The energy needed to turn 1kg of a solid into a liquid with no change in temperature.
17. What is latent heat of vaporisation?	The energy needed to turn 1kg of a liquid into a gas with no change in temperature.
18. Explain how gas pressure occurs	When particles of a gas collide with the walls of the container, they create a force at right angles. The higher the force, the higher the pressure applied depending on the size of the area.
19. Describe the relationship between temperature and pressure of a gas	As the temperature of the gas particles increases, the pressure also increases. They are directly proportional to each other
20. Explain the relationship between temperature and pressure	• As temperature increases, particles have more kinetic energy and move faster. • This means there are more frequent collisions with the walls of the container. • This creates more force per unit area. • This increases pressure.

Atomic Structure Recall Facts

<table>
<tr><td>1. Name the 3 subatomic particles in the atom and state their location</td><td>• Protons found in the nucleus (centre of atom)
• Neutrons found in the nucleus (centre of atom)
• Electrons found on shells/energy levels around the nucleus</td></tr>
<tr><td>2. What is the relative charge, relative mass and symbol for:
Proton
Neutron
Electron</td><td><table><tr><th>Particle</th><th>Relative charge</th><th>Relative mass</th><th>Symbol</th></tr><tr><td>proton</td><td>+1</td><td>1</td><td>p</td></tr><tr><td>neutron</td><td>0</td><td>1</td><td>n</td></tr><tr><td>electron</td><td>-1</td><td>1/1836
(5.45×10^{-4})</td><td>e^-</td></tr></table></td></tr>
<tr><td>3. What is the radius of an atom?</td><td>0.1nm (10^{-10}m)</td></tr>
<tr><td>4. Size of the nucleus of an atom?</td><td>(10^{-14}m)</td></tr>
<tr><td>5. Why do atoms have no overall charge?</td><td>Equal number of positive protons and negative electrons.</td></tr>
<tr><td>6. How does an atom form an ion?</td><td>Atom has gained or lost electrons to form a full, stable outer shell.</td></tr>
<tr><td>7. How can electron be excited to a higher energy level further from nucleus?</td><td>By absorbing Electromagnetic Radiation</td></tr>
<tr><td>8. What happens when electrons move down to a lower energy level closer to nucleus?</td><td>They emit Electromagnetic Radiation (often in the form of coloured light)</td></tr>
<tr><td>9. Name the Scientists in order of the discoveries made for the history of the atom. What did they discover?</td><td>• Dalton 1803 – Theory that all substances made of atoms and atoms are indivisible (spherical model)
• JJ Thompson 1897 – Plum pudding model after discovering the electron.
• Rutherford 1907 – Alpha scattering experiment that disproved the plum pudding model.
• Neils Bohr 1913 – Idea of electrons in energy levels around nucleus. Bohr model.
• Chadwick 1932 – Discovered the neutron</td></tr>
</table>

10. How did the alpha scattering experiment disprove the plum pudding model?	• Most of the alpha particles went straight through – this meant that most of the atom was empty space. • Some alpha particles deflected by a big angle – this meant large mass/positive charge concentrated in the nucleus. • Only a very few alpha particles deflected by a big angle – this meant nucleus is very small.
11. Compare the plum pudding and the Bohr model	In the plum pudding model, the protons are not subatomic particles but in a ball of positive charge. WHEREAS Nuclear model the protons are in the nucleus. Plum pudding electrons are embedded in the ball of positive charge. WHEREAS Nuclear model the electrons are in shells or energy levels.
12. What is mass number?	Number of protons + number of neutrons
13. What is atomic number?	Number of protons
14. How would you work out the number of protons or electrons of an atom?	Look at the atomic number
15. How would you work out the number of neutrons of an atom?	Mass number – atomic number
16. What is an isotope?	An isotope is an atom of the same element with the same number of protons but different number of neutrons.
17. What is radioactive decay?	Unstable nuclei emit a particle and some gamma radiation
18. How can radioactive decay be detected?	Geiger-Muller (GM) tube Photographic film
19. Why is radioactive decay random?	Cannot predict which nucleus will decay next or when a particular nucleus will decay.
20. Define the term activity and state its units.	Rate at which a source of unstable nuclei decay. It is measured in Becquerels (Bq).
21. Define the term count rate	Number of decays per second measured by a detector.
22. Why is the activity always higher than the count rate?	Radiation is emitted in all directions, so not all reaches detector. Some radiation goes through detector without ionising the detector (gamma).

23. Describe the properties of alpha radiation in terms of: a) Symbol b) What is it composed of c) Charge d) Penetrating ability (range in air) e) Ionisation energy f) Thinnest material stopped by	a) He or α b) 2 protons and 2 neutrons (helium nucleus) c) Positive (+2) d) Very low penetrating ability – few cm in air e) Highly ionising f) Stopped by paper, skin
24. Describe the properties of alpha radiation in terms of: a) Symbol b) What is it composed of c) Charge d) Penetrating ability (range in air) e) Ionisation energy f) Thinnest material stopped by	a) e or β b) Fast moving electron c) Negative d) Moderate penetrating ability – few metres in air e) Weakly ionising f) Stopped by thin piece of aluminium or perspex
25. Describe the properties of alpha radiation in terms of: a) Symbol b) What is it composed of c) Charge d) Penetrating ability (range in air) e) Ionisation energy f) Thinnest material stopped by	a) ɣ b) Electromagnetic wave from nucleus c) No charge d) Very high penetrating ability – possible infinite distance through air e) Very weak ionising ability f) Stopped by thick piece of lead
26. State what happens to the atomic number and mass number during alpha decay	Atomic number decreases by 2. Mass number decreases by 1.
27. State what happens to the atomic number and mass number during beta decay	Atomic number increases by 1. Mass number stays the same.
28. Describe what happens in the nucleus during beta decay	Neutron changes into a proton and an electron. Proton stays in the nucleus whilst electron is emitted as the beta particle
29. Explain what happens during neutron emission	• Neutrons can also be emitted from highly unstable nuclei (nuclear fission) • This is rare. • Reduces mass number by 1.

30. What is half life?	The half-life of a radioactive isotope is…. • the time it takes for the number of radioactive nuclei of the isotope in a sample to halve, ***or*** • the time it takes for the count rate (or activity) from a sample containing the isotope to fall to half its initial level.
31. How can half-life be calculated from a graph?	**Calculations using half-life** Use the graph to determine the half life of the radioisotope. You must shown on the graph how you determined this for the method marks.  Therefore half life = 2 days.
32. If a substance has a short half-life, is it more stable or more unstable?	More unstable – nucleis are decaying very quickly. This would mean that the level of hazard decreases quickly.
33. What is ionising radiation? Describe its effects	Ionising radiation has enough energy to knock electrons off atoms. This changes molecules in cells, such as DNA. Can damage cells, cause mutations and cancer.
34. What is irradiation?	Irradiation is the process of exposing an object to nuclear radiation. The irradiated object does not become radioactive.
35. What is contamination?	Contamination is the when the radioactive atoms are on the object or swallowed/breathed in by the person. Touching radioactive materials without gloves can lead to contamination.
36. How do you prevent radioactive contamination?	Gloves, tongs, and face masks.