Subject: Physics Pre-A-level (Transition Materials)

So, you want to study A-level physics?

...And so you should, Physics is a rewarding and diverse subject that opens many doors. The course you are about to embark on (AQA Physics) reflects this, covering a broad selection of topics from the strangeness of the quantum world to the mechanics that explains how we interact with the world around us.

Within this document there are a number of tasks and suggestions to help you get 'A-level ready' this is not intended to be new information rather a consolidation of the work that you have done previously. Maths is the language of Physics and as a result you will need to hone your skills in this area, again I'm not asking for any new maths skills to be learned but you will find some new applications of your existing skills.

Where I have given you specific tasks to complete, I am also providing you with the answers to these tasks, this is so that you can guide your learning. The aim of these tasks is to start a discussion so, if you are getting everything right (before you look at the answers) then great! If you can't see how to get from the question to the answer then please get in touch with me (jones.b@highsted.kent.sch.uk) or Mr. Mulligan (mulligan.j@highsted.kent.sch.uk) or both of us and we will give you some pointers.

As we move through the course your eyes will be opened to a new way of looking at the Universe. I hope that this opportunity is not wasted and that you leave Sixth Form asking even more questions than when you join it. A lifelong passion for physics will stand you in good stead, irrespective of the direction you travel in life.

I look forward to seeing you in September

Mr Jones (Head of Physics)

First things first...

During the course we will make use of Isaac Physics (https://isaacphysics.org/) so go there and make yourself an account, use your school e-mail address for this. Once registered explore some of the GCSE content and make sure that you have completed the GCSE to a-level material. (https://isaacphysics.org/pages/pre_made_gameboards#gcse_to_alevel)

The motto of the Isaac Physics website is "you work it out" the aim is to get you familiar with the process of breaking a big problem into smaller more manageable steps and then using your knowledge and skills to reach the final answer.

Reading watching and listening

To help you develop your inquisitive side you will need to read around the subject. Since the course is very broad you will need to discover how this is linked to your own interests or career goals (and it will be, everything is Physics). Here are some suggestions for papers, books, podcasts and YouTube channels that might help. And if you find any others let me know and I will add them for next year.

Books:

- Stephen Hawking - A Brief History of Time
- JP McEvoy and Oscar Zarate - Stephen Hawking: A graphic Guide
- Brian Greene - The Elegant universe
- Edwin A. Abbot - Flatland
- Chad Orzel - How to Teach Relativity to Your Dog
- Richard P. Feynman - Six Easy Pieces
- Ben Goldacre - Bad Science
- Peter Atkins - Galileo's finger
- Russell Stannard - The Time & Space of Uncle Albert
- Russell Stannard - Black Holes and Uncle Albert
- Russell Stannard - Uncle Albert and the Quantum Quest
- Lee Smolin - Three Roads to Quantum Gravity
- Richard Feynman - Feynman Lectures in Physics (Vol 1-3) [Can also be found on youtube]
- Bill Bryson - A Short History of Nearly Everything

YouTube suggestions:

Institute of Physics

Feynman Lectures

Veritasium

Smarter Every Day

Lectures by Walter Lewin

Minutephysics

Steve mould

Sixty Symbols

Articles (grouped by topic areas)

Gravitational Waves and General Relativity

Einstein's gravity theory passes toughest test yet: Bizarre binary star system pushes study of relativity to new limits: http://phys.org/news/2013-04-einstein-gravity-theory-toughest-bizarre.html

First Direct Evidence of Cosmic Inflation: https://www.cfa.harvard.edu/news/2014-05

Gravitational Waves from Early Universe Remain Elusive: http://www.jpl.nasa.gov/news/news.php?release=2015-46

Crashing Black Holes http://calteches.library.caltech.edu/4298/1/BlackHoles.pdf

CERN's new Einstein Observatory to explore black holes, Big Bang: http://phys.org/news/2011-05-cerneinstein-observatory-explore-black.html

String Theory

New website dedicated to discussion of string theory: http://phys.org/news/2012-10-website-dedicateddiscussion-theory.html

Scientists find a practical test for string theory: http://phys.org/news/2014-01-scientists-theory.html

What is string theory? http://www.physics.org/article-questions.asp?id=47

String theory: it's not dead yet: http://www.newscientist.com/article/dn11882-string-theory-its-not-deadyet.html#.VQa6AqzLcjU

Finally, a MAGIC test for string theory?: http://www.newscientist.com/article/dn12609-finally-a-magic-testfor-string-theory.html

Quantum Computers

How Quantum Computers Work: http://computer.howstuffworks.com/quantum-computer.htm

The Father of Quantum Computing: http://archive.wired.com/science/discoveries/news/2007/02/72734

The Revolutionary Quantum Computer That May Not Be Quantum at All: http://www.wired.com/2014/05/quantum-computing/

Materials Science

Scientists fabricate defect-free graphene, set record reversible capacity for Co3O4 anode in Li-ion batteries: http://phys.org/news/2014-08-scientists-fabricate-defect-free-graphene-reversible.html

Theoretical physicists design 'holy grail' of materials science: http://phys.org/news/2015-03-theoreticalphysicists-holy-grail-materials.html

Novel crumpling method takes flat graphene from 2D to 3D: http://phys.org/news/2015-02-crumplingmethod-flat-graphene-2d.html

Stanene is '100% efficient', could finally replace copper wires in silicon chips: http://www.extremetech.com/extreme/171551-stanene-is-100-efficient-could-finally-replace-copper-wiresin-silicon-chips

What is Aerogel? Theory, Properties and Applications: http://www.azom.com/article.aspx?ArticleID=6499

Particle Physics

Why particle physics matters: http://www.symmetrymagazine.org/article/october-2013/why-particlephysics-matters

It's a boson! But we need to know if it's the Higgs: http://www.newscientist.com/article/dn22029-its-aboson-but-we-need-to-know-if-its-the-higgs.html?page=1#.VQfooqzLdVw

Particle chameleon caught in the act of changing http://press.web.cern.ch/press-releases/2010/05/particlechameleon-caught-act-changing The search for dark matter at the LHC: http://www.symmetrymagazine.org/article/the-search-for-darkmatter-at-the-lhc Could the Higgs

Nobel Be the End of Particle Physics?: http://www.scientificamerican.com/article/could-thehiggs-nobel-be-the-end-of-particle-physics/

Astrophysics

How do we know dark matter exists?: http://phys.org/news/2015-03-dark.html

The corrugated galaxy: Milky Way may be much larger than previously estimated: http://phys.org/news/2015-03-corrugated-galaxy-milky-larger-previously.html

Solving the riddle of neutron stars: http://www.sciencedaily.com/releases/2015/03/150310074105.htm

Cosmology: First stars were born much later than thought: http://www.sciencedaily.com/releases/2015/02/150205131233.htm

Podcasts

These are all available via BBC sounds

- In our time
- The life scientific
- Frontiers
- The infinite monkey cage
- BBC inside science

HIGHSTED

Useful information and activities

Topics

The A-level course builds on your GCSE knowledge, here is a summary of the topics from the specification and some quickfire questions for each section that link your GCSE knowledge

Particles and radiation

This section introduces students both to the fundamental properties of matter, and to electromagnetic radiation and quantum phenomena. Teachers may wish to begin with this topic to provide a new interest and knowledge dimension beyond GCSE. Through a study of these topics, students become aware of the way ideas develop and evolve in physics. They will appreciate the importance of international collaboration in the development of new experiments and theories in this area of fundamental research.

Substances found in the periodic table are…?
Approximately how many elements are there?
Who came up with the Plumb Pudding model of the atom?
What is the ionising power of alpha radiation?
Define irradiation
What is meant by the ionising power of radiation?
What did James Chadwick discover about the atom?
Describe the Plumb Pudding model of the atom
What is the range of gamma radiation in air?
The radius of an atom is …?

Waves

GCSE studies of wave phenomena are extended through a development of knowledge of the characteristics, properties, and applications of travelling waves and stationary waves. Topics treated include refraction, diffraction, superposition and interference.

Give a use of visible radiation
What is the EM radiation with the lowest frequency?
The maximum displacement of a point on a wave away from its undisturbed position is the…
Name an example of a transverse wave
Which two angles are equal in reflection?
List the EM spectrum from long to short wavelength.
Draw a transverse wave and label the wavelength and amplitude
An object is said to __________ radiation when energy from an EM wave is taken up by the object
The distance from a point on one wave to the equivalent point on the next wave is the …
Why are X-rays good for taking images of bone?

Mechanics and materials

Vectors and their treatment are introduced followed by development of the student's knowledge and understanding of forces, energy and momentum. The section continues with a study of materials considered in terms of their bulk properties and tensile strength. As with earlier topics, this section and also the following section Electricity would provide a good starting point for students who prefer to begin by consolidating work.

If balanced forces act on a stationary object it will …
On a distance time graph a curved line becoming horizontal represents…
What is the unit of mass?
Give two examples of contact forces
What is the unit of weight?
The tendency of objects to continue in their state of rest or of uniform motion is known as …
A typical reaction time is …
On a velocity time graph a horizontal line along the x-axis represents…
When a spring is stretched and its length is permanently altered it is known as ____________ _____________
If balanced forces act on a moving object it will …

Electricity

This section builds on and develops earlier study of these phenomena from GCSE. It provides opportunities for the development of practical skills at an early stage in the course and lays the groundwork for later study of the many electrical applications that are important to society.

Resistance is…?
State the rule for current in a parallel circuit
Potential difference between two points in a circuit is….?
Draw the circuit symbol for a diode
An example of alternating current is…?
What is a parallel circuit?
What does a step-up transformer do?
What is the unit of current?
Draw the circuit symbol for a cell
State the rule for current in a series circuit

Further mechanics and thermal physics

The earlier study of mechanics is further advanced through a consideration of circular motion and simple harmonic motion (the harmonic oscillator). A further section allows the thermal properties of materials, the properties and nature of ideal gases, and the molecular kinetic theory to be studied in depth.

State the units of volume
State the units of density
Draw a particle diagram for a liquid
A change which creates new products and cannot be reversed is _________ change
Changes of state are caused by the amount of _________ a substance has
Draw a particle diagram for a solid
Particles are arranged regularly in a ….?
The amount of energy required to change the state of one kilogram of a substance with no change in temperature is the …?
Latent heat of vaporisation is for changing….?
Latent heat of fusion is for changing…?

Fields and their consequences

The concept of field is one of the great unifying ideas in physics. The ideas of gravitation, electrostatics and magnetic field theory are developed within the topic to emphasise this unification. Many ideas from mechanics and electricity from earlier in the course support this and are further developed. Practical applications considered include: planetary and satellite orbits, capacitance and capacitors, their charge and discharge through resistors, and electromagnetic induction. These topics have considerable impact on modern society.

Flemming's left hand rule shows the relative directions of what things?
Tow opposite poles always _______
What is an induced magnet?
In Flemming's LH rule, the thumb gives the direction of …
The places on a magnet where the magnetic forces are the strongest are called the…
Which rule can be used to determine the direction a motor will rotate?
Which three elements are magnetic?
What is an important property of a solenoid/electromagnet as a magnet?
What is the definition of a magnetic field?
What two words describe the magnetic field within the coil of a solenoid?

Nuclear physics

This section builds on the work of Particles and radiation to link the properties of the nucleus to the production of nuclear power through the characteristics of the nucleus, the properties of unstable nuclei, and the link between energy and mass. Students should become aware of the physics that underpins nuclear energy production and also of the impact that it can have on society.

How does beta decay alter the mass number of the parent nucleus?
How does gamma radiation alter the mass and atomic number of the parent nucleus?
Name the three types of radiation
Define half life
What will absorb (stop) gamma radiation?
Define contamination
All substances are made up of…?
Which particles are located in the atom's nucleus?
Does an irradiated object become radioactive itself?
Emission of radiation from an atom may lead to _____________ moving to a ______________ energy level

Turning points in physics

This option is intended to enable key concepts and developments in physics to be studied in greater depth than in the core content. Students will be able to appreciate, from historical and conceptual viewpoints, the significance of major paradigm shifts for the subject in the perspectives of experimentation and understanding. Many present-day technological industries are the consequence of these key developments and the topics in the option illustrate how unforeseen technologies can develop from new discoveries

This unit builds on all of the work covered and is a great chance to develop your further reading rather than the quickfire questions you should research the work of the following Physicists;

- JJ Thompson
- Frank Dunnington
- Robert Millikan
- Thomas Young
- Christiaan Huygens
- Isaac Newton
- Heinrich Hertz
- Max Planck
- Louis de Broglie
- Ernst Ruska, Gerd Binnig and Heinrich Rohrer
- Albert Michelson and Edward Morley
- Hendrick Lorentz
- William Bertozzi

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Skills and information

Greek letters

Greek letters are used often in science. They can be used as symbols for numbers (such as π = 3.14…), as prefixes for units to make them smaller (eg µm = 0.000 000 001 m) or as symbols for particular quantities (such as λ which is used for wavelength).

The Greek alphabet is shown below.

Α	α	alpha
Β	β	beta
Γ	γ	gamma
Δ	δ	delta
Ε	ε	epsilon
Ζ	ζ	zeta
Η	η	eta
Θ	θ	theta
Ι	ι	iota
Κ	κ	kappa
Λ	λ	lambda
Μ	μ	mu

Ν	ν	nu
Ξ	ξ	ksi
Ο	ο	omicron
Π	π	pi
Ρ	ρ	rho
Σ	ς or σ	sigma
Τ	τ	tau
Υ	υ	upsilon
Φ	φ	phi
Χ	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Task 1: list all of the Greek letters you have encountered in Science and Maths so far and what you have used them to represent.

SI units and prefixes

Every measurement must have a size (e.g. 2.7) and a unit (e.g. metres or ºC). Sometimes, there are different units available for the same type of measurement. For example; ounces, pounds, kilograms and tonnes are all used as units for mass.

To reduce confusion, and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	*m*	kilogram	kg
length	*l* or *x*	metre	m
time	*t*	second	s
electric current	*I*	ampere	A
temperature	*T*	kelvin	K
amount of substance	*N*	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units. For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

Some derived units have their own unit names and abbreviations, often when the combination of SI units becomes complicated.

Some common derived units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation	SI unit
Force	*F*	newton	N	$kg\ m\ s^{-2}$
Energy	*E* or *W*	joule	J	$kg\ m^2\ s^{-2}$
Frequency	*f*	hertz	Hz	s^{-1}

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Task 2: Which SI unit and prefix would you use for the following quantities?

1. The length of a finger
2. The temperature of boiling water
3. The time between two heart beats
4. The width of an atom
5. The mass of iron in a bowl of cereal
6. The current in a simple circuit using a 1.5 V battery and bulb

Sometimes, there are units that are used that are not combinations of SI units and prefixes. These are often multiples of units that are helpful to use.

For example, a light year is a distance of 9.46 × 1012 km.

Task 3: Re-write the following in SI units.

1. 1 minute
2. 1 hour
3. 1 tonne

At A level quantity will be written in standard form, and it is expected that your answers will be too. This means answers should be written as ....x 10^y. E.g. for an answer of 1200kg we would write 1.2 x 10^3kg.

Task 4: Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54 600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many V in 0.511 MeV? Express in standard form.
10. How many m in 11 km? Express in standard form.

Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. Find out how to do this here:

https://www.youtube.com/watch?v=cbKc_qilgzA

Task 5: Rearrange the following:
1. E=m x g x h to find h
2. Q= I x t to find I
3. E = ½ m v^2 to find m
4. E = ½ m v^2 to find v
5. v = u + at to find u
6. v = u + at to find a
7. v^2 = u^2 +2as to find s
8. v^2 = u^2 +2as to find u

Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given.

You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

Task 6: Give the following to 3 significant figures:

1. 3.4527
2. 40.691
3. 0.838991
4. 1.0247
5. 59.972

Task 7: Calculate the following to a suitable number of significant figures:
1. 63.2/78.1
2. 39+78+120
3. (3.4+3.7+3.2)/3
4. 0.0256 x 0.129
5. 592.3/0.1772

Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table. Don't wait until the end, discard anomalies and then write it up in neat.

Tables should have column heading and units in this format quantity/unit e.g. length /mm.

All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDFhttp://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

Below is a table of results from an experiment where a ball was rolled down a ramp of different lengths. A ruler and stop clock were used.

Task 8: Identify the errors the student has made.

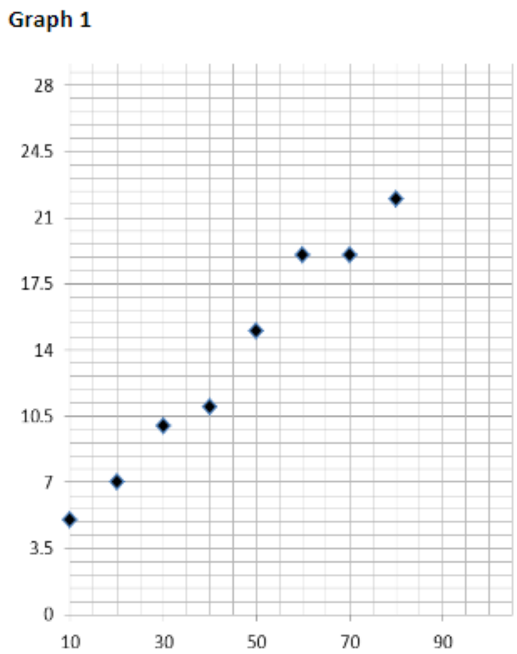
	Time			
Length/cm	**Trial 1**	**Trial 2**	**Trial 3**	**Mean**
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

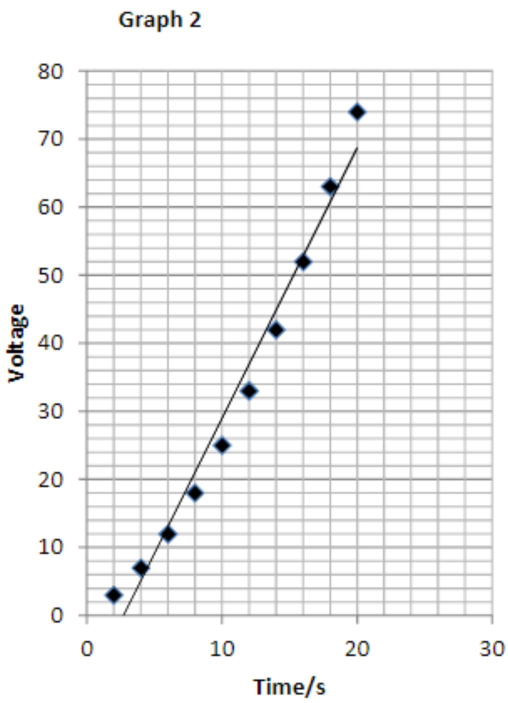
Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Task 9: Identify how the following graphs could be improved





Answers

Particles and radiation

Substances found in the periodic table are…?	elements
Approximately how many elements are there?	100
Who came up with the Plumb Pudding model of the atom?	J J Thompson
What is the ionising power of alpha radiation?	very high
Define irradiation	When an object is exposed to radiation
What is meant by the ionising power of radiation?	how likely it is to ionise atoms which it comes into contact with
What did James Chadwick discover about the atom?	That the nucleus contains neutrons as well as protons
Describe the Plumb Pudding model of the atom	A ball of positive charge with negative electrons embedded in it
What is the range of gamma radiation in air?	unlimited in air
The radius of an atom is …?	0.1 nm (1 x 1010 m)

Waves

Give a use of visible radiation	Fibre optic communications
What is the EM radiation with the lowest frequency?	Radio
The maximum displacement of a point on a wave away from its undisturbed position is the…	Amplitude
Name an example of a transverse wave	light, water, any electromagnetic
Which two angles are equal in reflection?	angle of incidence and angle of reflection
List the EM spectrum from long to short wavelength.	Radio, microwave, infrared, visible, UV, X-rays, gamma
Draw a transverse wave and label the wavelength and amplitude	See GCSE notes
An object is said to __________ radiation when energy from an EM wave is taken up by the object	absorb
The distance from a point on one wave to the equivalent point on the next wave is the …	wavelength
Why are X-rays good for taking images of bone?	absorbed by bone but transmitted through soft tissue

Mechanics and materials

If balanced forces act on a stationary object it will …	remain stationary
On a distance time graph a curved line becoming horizontal represents…	deceleration
What is the unit of mass?	kilograms (kg)
Give two examples of contact forces	e.g. friction, air resistance
What is the unit of weight?	Newtons (N)
The tendency of objects to continue in their state of rest or of uniform motion is known as …	inertia
A typical reaction time is …	0.2-0.9 s
On a velocity time graph a horizontal line along the x-axis represents…	stationary object
When a spring is stretched and its length is permanently altered it is known as ____________ ____________	Inelastic deformation or inelastic behaviour
If balanced forces act on a moving object it will …	continue to travel at a constant speed

Electricity

Resistance is…?	caused by anything which opposes the flow of electric charge
State the rule for current in a parallel circuit	the total current through the whole circuit is the sum of the currents through the separate components
Potential difference between two points in a circuit is….?	the work done when a couloumb of charge passes between the points.
Draw the circuit symbol for a diode	teacher to draw on board…
An example of alternating current is…?	mains electricity
What is a parallel circuit?	A circuit with more than one route for charge to flow
What does a step-up transformer do?	Increases p.d.
What is the unit of current?	Amps (A)
Draw the circuit symbol for a cell	teacher to draw on board…
State the rule for current in a series circuit	the current is the same at every point in the circuit and in every component

Further mechanics and thermal physics

State the units of volume	m3
State the units of density	kg/m3
Draw a particle diagram for a liquid	teacher to draw on board...
A change which creates new products and cannot be reversed is __________ change	chemical
Changes of state are caused by the amount of __________ a substance has	energy
Draw a particle diagram for a solid	teacher to draw on board...
Particles are arranged regularly in a ....?	solid
The amount of energy required to change the state of one kilogram of a substance with no change in temperature is the ...?	specific latent heat
Latent heat of vaporisation is for changing....?	liquid to vapour (gas)
Latent heat of fusion is for changing...?	solid to liquid

Fields and their consequences

Flemming's left hand rule shows the relative directions of what things?	Force, magnetic field and current
Tow opposite poles always ________	attract
What is an induced magnet?	A magnetic material which becomes a magnet when placed in a magnetic field.
In Flemming's LH rule, the thumb gives the direction of ...	Force
The places on a magnet where the magnetic forces are the strongest are called the...	poles
Which rule can be used to determine the direction a motor will rotate?	Flemming's left hand rule.
Which three elements are magnetic?	iron, cobalt and nickel
What is an important property of a solenoid/electromagnet as a magnet?	can be switched on and off with electric current
What is the definition of a magnetic field?	The area around a magnet where a force acts on another magnet or magnetic material
What two words describe the magnetic field within the coil of a solenoid?	strong and uniform

Nuclear Physics

How does beta decay alter the mass number of the parent nucleus?	stays the same
How does gamma radiation alter the mass and atomic number of the parent nucleus?	unchanged (energy is released as the particles in the nucleus reorganise to a lower energy arrangement)
Name the three types of radiation	alpha, beta and gamma
Define half life	The time taken for number of radioactive nuclei in a sample to halve OR time taken for count rate (or activity) from a sample to fall to half its initial value
What will absorb (stop) gamma radiation?	several centimetres of lead
Define contamination	The unwanted presence of materials containing radioactive atoms
All substances are made up of…?	atoms
Which particles are located in the atom's nucleus?	protons, neutrons
Does an irradiated object become radioactive itself?	no
Emission of radiation from an atom may lead to ______________ moving to a _______________ energy level	electrons, lower

Task 2:

1. Cm
2. K
3. S
4. nm
5. µm
6. MA

Task 3:

1. 60 s
2. 3600 s
3. 1000 kg

Task 4:

1. 2400 m
2. 8 100 000 J
3. 326 000 000 000 W
4. 54.6 m

Task 4 continued:

5. 5.240 000 g
6. 1.8 x 10^{-8}m
7. 6.32 x 10^{-7}m
8. 1.002 V
9. 5.11 x 10^{-5}V
10. 1.1 x 10^{4}m

Task 5:

1. h= E/ (m x g)
2. I = Q/t
3. m = (2 x E)/v^2 or E/(0.5 x v^2)
4. v= √((2 x E)/m)
5. u = v – at
6. a = (v-u)/t
7. s = (v^2 – u^2) / 2a
8. u = √(v^2-2as)

Task 6:

1. 3.35
2. 40.7
3. 0.839
4. 1.02
5. 60.0

Task 7:

1. 0.809
2. 237
3. 3.4
4. 0.00330
5. 3343

Task 8:

- Time should have a unit next to it
- Length can be measured to the nearest mm so should be 10.0, 22.0 etc
- Length 65 trial 2 is an anomaly and should have been excluded from the mean
- All mean values should be to 2 decimal places
- Mean of length 61 should be 6.99 (rounding error)

- **Task 9:**

Graph 1:

- Axis need labels
- Point should be x not dots
- Line of best fit is needed
- y axis is a difficult scale
- x axis could have begun at zero so the y-intercept could be found

Graph 2:

- y-axis needs a unit
- curve of best fit needed not a straight line
- Point should be x not dots