Week 1 Revision

Science (Physics)

Year 10

Name: _____

Tutor: _____

Key Science Vocabulary

Accuracy
A measurement result is considered accurate if it is judged to be close to the true value.

Calibration
Marking a scale on a measuring instrument. This involves establishing the relationship between indications of a measuring instrument and standard or reference quantity values, which must be applied. For example, placing a thermometer in melting ice to see whether it reads zero, in order to check if it has been calibrated correctly.

Data
Information, either qualitative or quantitative, that has been collected.

Error
See also uncertainty.

Measurement error
The difference between a measured value and the true value.

Anomalies
These are values in a set of results which are judged not to be part of the variation caused by random uncertainty.

Random error
These cause readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next. Random errors are present when any measurement is made, and cannot be corrected. The effect of random errors can be reduced by making more measurements and calculating a new mean.

Systematic error
These cause readings to differ from the true value by a consistent amount each time a measurement is made. Sources of systematic error can include the environment, methods of observation or instruments used. Systematic errors cannot be dealt with by simple repeats. If a systematic error is suspected, the data collection should be repeated using a different technique or a different set of equipment, and the results compared.

Zero error
Any indication that a measuring system gives a false reading when the true value of a measured quantity is zero, eg the needle on an ammeter failing to return to zero when no current flows. A zero error may result in a systematic uncertainty.

Evidence
Data which has been shown to be valid.

Fair test
A fair test is one in which only the independent variable has been allowed to affect the dependent variable.

Hypothesis
A proposal intended to explain certain facts or observations.

Interval
The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres.

Precision
Precise measurements are ones in which there is very little spread about the mean value. Precision depends only on the extent of random errors – it gives no indication of how close results are to the true value.

Prediction
A prediction is a statement suggesting what will happen in the future, based on observation, experience or a hypothesis.

Range
The maximum and minimum values of the independent or dependent variables; important in ensuring that any pattern is detected. For example a range of distances may be quoted as either: 'From 10 cm to 50 cm' or 'From 50 cm to 10 cm'.

Repeatable
A measurement is repeatable if the original experimenter repeats the investigation using same method and equipment and obtains the same results. Previously known as reliable.

Reproducible
A measurement is reproducible if the investigation is repeated by another person, or by using different equipment or techniques, and the same results are obtained. Previously known as reliable.

Resolution
This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.

Sketch graph
A line graph, not necessarily on a grid, that shows the general shape of the relationship between two variables. It will not have any points plotted and although the axes should be labelled they may not be scaled.

True value
This is the value that would be obtained in an ideal measurement.

Uncertainty
The interval within which the true value can be expected to lie. Whenever a measurement is made, there will always be some uncertainty or doubt about the result obtained. Uncertainty can be expressed in terms of spread of values obtained. For example, a length of 56 cm ±2 cm would mean the true value could be anywhere between 54 cm and 58 cm.

Validity

Suitability of the investigative procedure to answer the question being asked. For example, an investigation to find out if the rate of a chemical reaction depended upon the concentration of one of the reactants would not be a valid procedure if the temperature of the reactants was not controlled.

Valid conclusion

A conclusion supported by valid data, obtained from an appropriate experimental design and based on sound reasoning.

Variables

These are physical, chemical or biological quantities or characteristics.

Categoric

Categoric variables have values that are labels, eg names of plants or types of material.

Continuous

Continuous variables can have values (called a quantity) that can be given a magnitude either by counting (as in the case of the number of shrimp) or by measurement (eg light intensity, flow rate etc). Previously known as discrete variable.

Control

Control variable is one which may, in addition to the independent variable, affect the outcome of the investigation and therefore has to be kept constant or at least monitored.

Dependent

Dependent variable is the variable of which the value is measured for each and every change in the independent variable.

Independent

Independent variable is the variable for which values are changed or selected by the investigator.

Energy

AQA Physics (Combined Science) Unit 6.1: Energy

Required Practical

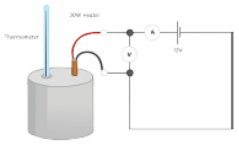
Investigating Specific Heat Capacity

independent variable – material

dependent variable – specific heat capacity

control variables – insulating layer, initial temperature, time taken

$\Delta E = m \times c \times \Delta\theta$



Method:

1. Using the balance, measure and record the mass of the copper block in kg.
2. Wrap the insulation around the block.
3. Put the heater into the large hole in the block and the block onto the heatproof mat.
4. Connect the power pack and ammeter in series and the voltmeter across the power pack.
5. Using the pipette, put a drop of water into the small hole.
6. Put the thermometer into the small hole and measure the temperature.
7. Switch the power pack to 12V and turn it on.
8. Read and record the voltmeter and ammeter readings – during the experiment, they shouldn't change.
9. Turn on the stop clock and record the temperature every minute for 10 minutes.
10. Record the results in the table.
11. Calculate work done and plot a line graph of work done against temperature.

Equations

$E = \frac{1}{2}mv^2$

$E_p = mgh$

$E_e = \frac{1}{2}ke^2$

$\Delta E = m \times c \times \Delta\theta$

$P = \frac{E}{t}$

$P = \frac{W}{t}$

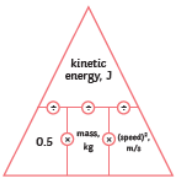
Kinetic and Potential Energy Stores

Movement Energy

kinetic energy = $\frac{1}{2}$ × mass × speed^2

$$E_k = \frac{1}{2}mv^2$$

(J) (kg)(m/s)

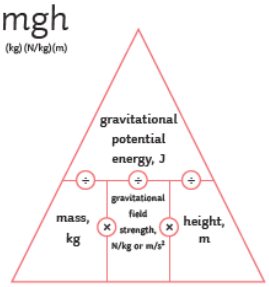


When something is off the ground, it has gravitational potential energy

gravitational potential energy = mass x gravitational field strength x height

$$E_p = mgh$$

(J) (kg) (N/kg)(m)



When an object falls, it loses gravitational potential energy and gains kinetic energy.

Stretching an object will give it elastic potential energy.

elastic potential energy = $\frac{1}{2}$ × spring constant × extension^2

$$E_e = \frac{1}{2}ke^2$$

(J) (N/m)(m)

Transferring Energy by Heating

Heating a material transfers the energy to its thermal energy store - the temperature increases.

E.g. a kettle: energy is transferred to the thermal energy store of the kettle. Energy is then transferred by heating to the waters thermal energy store. The temperature of the water will then increase.

Some materials need more energy to increase their temperature than others.

change in thermal energy = mass × specific heat capacity × temperature change

$$\Delta E = m \times c \times \Delta\theta$$

(J) (kg) (J/kg°C) (°C)

Specific heat capacity is the amount of energy needed to raise the temperature of 1kg of a material by 1°C.

Energy Stores and Systems

Energy Stores	
kinetic	Moving objects have kinetic energy.
thermal	All objects have thermal energy.
chemical	Anything that can release energy during a chemical reaction.
elastic potential	Things that are stretched.
gravitational potential	Anything that is raised.
electrostatic	Charges that attract or repel.
magnetic	Magnets that attract or repel.
nuclear	The nucleus of an atom releases energy.

Energy can be transferred in the following ways:

mechanically – when work is done;

electrically – when moving charge does work;

heating – when energy is transferred from a hotter object to a colder object.

Conservation of Energy

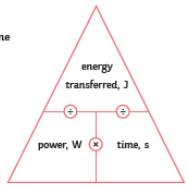
Energy can never be created or destroyed, just transferred from one form to another. Some energy is transferred usefully and some energy gets transferred into the environment. This is mostly wasted energy.

Power

Power is the rate of transfer of energy – the amount of work done in a given time.

power = energy transferred ÷ time

P (W) = E (J) ÷ t (s)



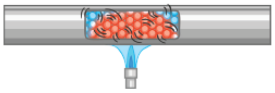
power = work done ÷ time

P (W) = W (J) ÷ t (s)

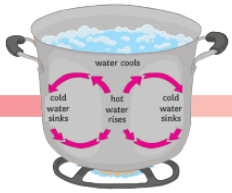
Energy Transfer

Lubrication reduces the amount of friction. When an object moves, there are frictional forces acting. Some energy is lost into the environment. Lubricants, such as oil, can be used to reduce the friction between the surfaces.

Conduction – when a solid is heated, the particles vibrate and collide more, and the energy is transferred.

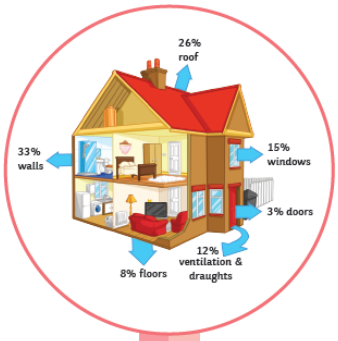


Convection – when a liquid or a gas is heated, the particles move faster. This means the liquid or gas becomes less dense. The denser region will rise above the cooler region. This is a convection current.



Insulation – reduces the amount of heat lost. In your home, you can prevent heat loss in a number of ways:

- thick walls;
- thermal insulation, such as:
- loft insulation (reducing convection);
- cavity walls (reduces conduction and convection);
- double glazing (reduces conduction).

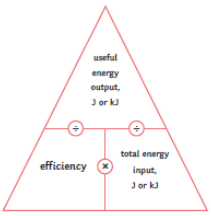


Efficiency

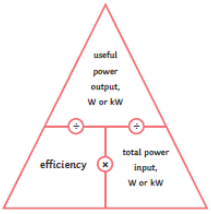
When energy is transferred, some energy is wasted. The less energy that is wasted during the transfer, the more efficient the transfer.

There are two equations to calculate efficiency:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$



$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$



Some energy is always wasted. Nothing is 100% efficient.

Efficiency

Non-renewable – coal, oil, gas - they will all run out, they damage the environment, but provide most of the energy.

Renewable – they will never run out, can be unreliable and do not provide as much energy.

Energy Resource	Advantages	Disadvantages
solar – using sunlight	Renewable, no pollution, in sunny countries it is very reliable.	Lots of energy needed to build, only works during the day, cannot increase power if needed.
geothermal – using the energy of hot rocks	Renewable and reliable as the rocks are always hot. Power stations have a small impact on environment.	May release some greenhouse gases and only found in specific places.
wind – using turbines	Renewable, no pollution, no lasting damage to the environment, minimal running cost.	Not as reliable, do not work when there is no wind, cannot increase supply if needed.
hydroelectric – uses a dam	Renewable, no pollution, can increase supply if needed.	A big impact on the environment. Animals and plants may lose their habitats.
wave power – wave powered turbines	Renewable, no pollution.	Disturbs the seabed and habitats of animals. Unreliable.
tidal barrages – big dams across rivers	Renewable, very reliable, no pollution.	Changes the habitats of wildlife, fish can be killed in the turbines.
biofuels	Renewable, reliable, carbon neutral.	High costs, growing biofuels may cause a problem with regards to space, clearance of natural forests.
non-renewable – fossil fuels	Reliable, enough to meet current demand, can produce more energy when there is more demand.	Running out, release CO_2, leading to global warming, and also release SO_2 which causes acid rain.

Trends in energy resources – most of our electricity is generated by burning fossil fuels and nuclear. The UK is trying to increase the amount of renewable energy resources. The governments are aware that non-renewable energy resources are running out; targets of renewable resources have been set. Electric and hybrid cars are also now on the market.

However, changing the fuels we use and building renewable power plants cost money. Many people are against the building of the plants near them and do not want to pay the extra in their energy bills. Hybrid and electric cars are also quite expensive.

Energy

1) Summarise as much information from the knowledge organiser in the box below. Focus on key words and definitions rather than copying the text word for word.

2) Complete 5 self-quiz questions using the information you have summarised above in the box below.

Question	Answer

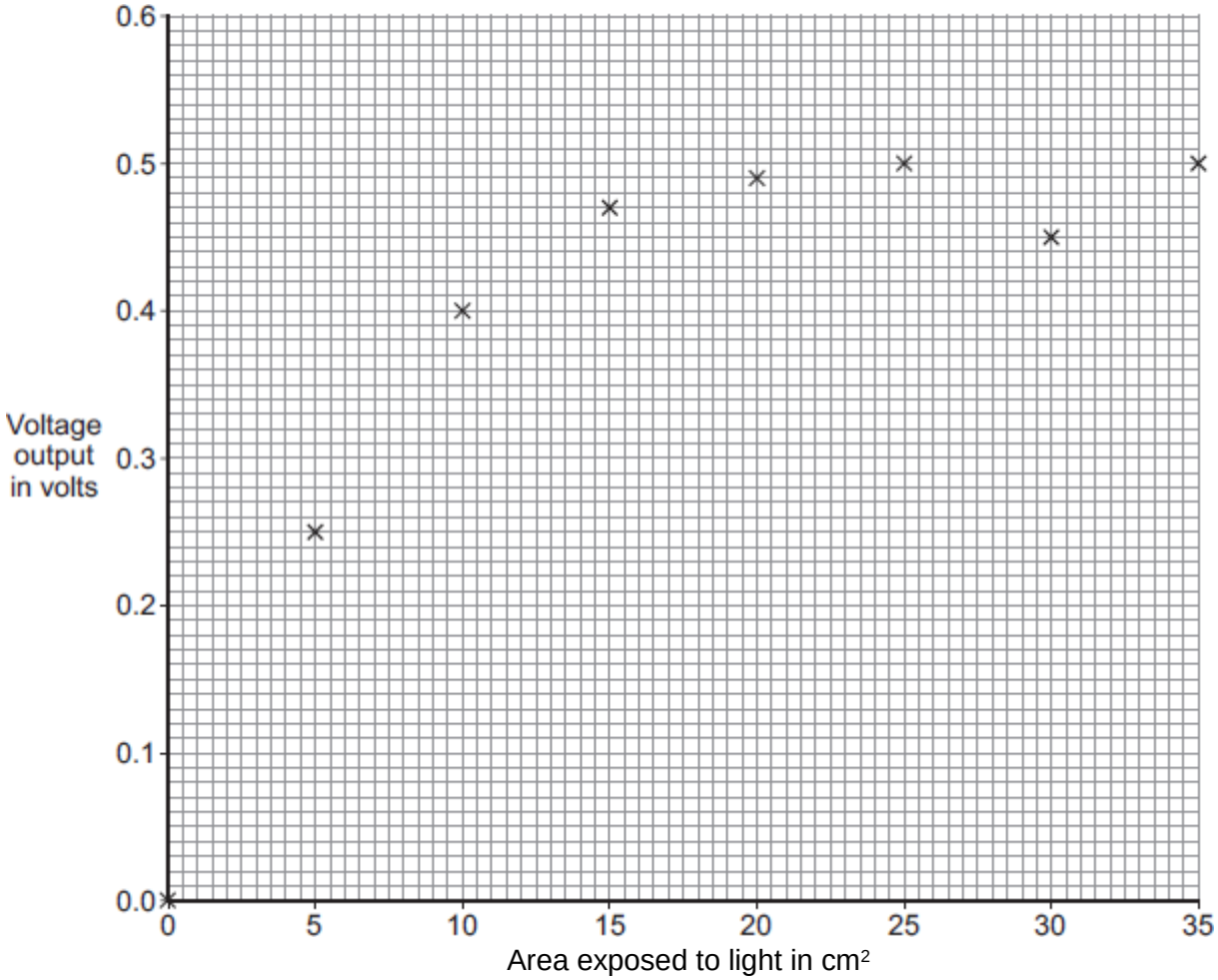
3) Complete both exam questions below and self-mark using the mark scheme

Q1.

A student is investigating how the voltage output of a solar cell depends on the area of the solar cell exposed to light.

He shines a desk light at a solar cell. He varies the area of the solar cell exposed to the light and records the voltage output.

The graph shows the student's results.



(a) One of the results on the graph is anomalous.

(i) Draw a ring around the anomalous result on the graph.

(1)

(ii) Suggest what the student could do about the anomalous result.

_____

_____

(1)

(b) Give **two** conclusions that can be made from these results.

_____

_____

_____

_____

(2)

(c) Most houses use electricity from the National Grid.

Some houses have panels made from many solar cells joined together. These panels produce electricity for the house.

(i) Houses with panels of solar cells remain connected to the National Grid.

Give **two** reasons why.

_____

_____

_____

_____

(2)

(ii) Producing electricity for a house using solar cells is better for the environment than using electricity from coal-fired power stations.

Give **two** reasons why.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q2.

China's economy is growing quickly. To make sure electricity supplies match demand, China is building more coal-fired power stations. These power stations will probably use carbon capture and storage technology.

A lot of people believe that energy resources like falling water should be used instead of energy resources like coal. Hydroelectric power stations generate electricity using the energy of falling water.

A large-scale hydroelectric power station can generate the same amount of electricity as a coal-fired power station.

Photograph supplied by AbleStock.com/Thinkstock

Apart from the emission of carbon dioxide by coal-fired power stations, give **two** advantages and **two** disadvantages of generating electricity using hydroelectric power stations instead of using coal-fired power stations.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Mark schemes

Q1.

(a) (i) point at 30 cm^2 circled

1

(ii) any **one** from:

- repeat it
- discard it
- ignore it

1

(b) any **two** from:

- as area increases, voltage increases
- voltage increases quickly at first then less quickly
- voltage constant after area 21 – 25 cm^2
  allow 0.5(V) is maximum voltage
  allow graph levels off
  allow no light
- if no area exposed, zero voltage
  *for **2** marks accept as area increases, voltage increases quickly at first but at a slower rate afterwards*

2

(c) (i) any **two** from:

- no electricity / light at night
- reduced electricity / light when cloudy
  allow other described weather conditions eg foggy
  allow not sunny (all the time)
- fewer daylight hours in winter
- may not meet demand
  allow cannot produce enough electricity
- National Grid can supply electricity
- can <u>sell</u> electricity (to National Grid)
  allow not working
- if they break / malfunction
  *if no other marks gained allow **1** mark for unreliable*

2

(ii) any **two** from:

it = solar cells

allow converse answers in terms of coal

ignore cheap electricity

(**solar**):

- renewable
- no carbon dioxide / greenhouse gases / global warming

  allow less for no
  if no examples of pollution given
  allow no / less <u>air</u> pollution / atmospheric pollution / harmful gases
- no sulfur dioxide
- no particulates / soot / smoke

  ignore mining
  ignore fossil fuels
  ignore conserves coal reserves

2

[8]

Q2.

unless answers state otherwise advantages and disadvantages relate to hydroelectric

ignore answers that relate to the disadvantages of coal

advantages

any **two** from:

- renewable
- can meet electricity demand quickly

  allow idea of pumped storage to meet demand quickly
  allow short start-up time
- pumped storage to store energy for later use
- no air pollution / named gas eg sulfur dioxide / nitrogen oxides

  allow harmful gases
  ignore no carbon dioxide / greenhouse gases as an advantage
- no acid rain

- no fuel needed / no fuel cost
- does not cause global warming

ignore reference to running cost
ignore can be used as a leisure area

disadvantages

any **two** from:

- relies on rainfall / not as reliable (as coal)
- destruction of wildlife habitats (during construction)

accept displacement of people

- higher set-up cost

ignore unsightly
ignore large area needed

4

[4]