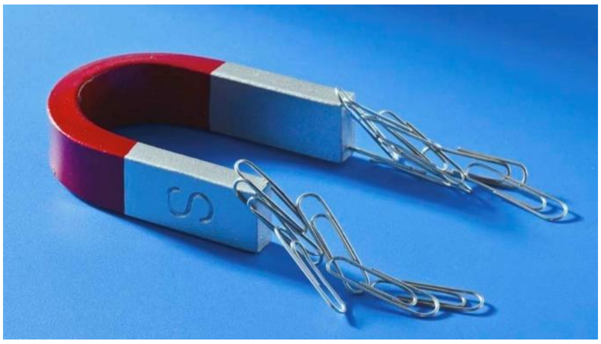
Edexcel GCSE Combined Science

Y11 Winter 1 assessment

Revision guide & Workbook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Select and Apply equations

Students may be asked to select and apply these equations in the exam papers. These equations will be given in a formulae sheet at the end of the exam papers.

Equations required for higher tier only are shown in bold text. Higher tier only equations will not be given in the formulae sheet for the foundation tier papers.

(Final velocity)^2 – initial velocity)^2 =2 x acceleration x distance $v^2 - u^2 = 2 \times a \times x$
Force = change in momentum ÷ time $\mathbf{F = \frac{(mv - mu)}{t}}$
Energy transferred = current x potential difference x time $E = I \times V \times t$
Force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density x current x length $\mathbf{F = B \times I \times l}$
$\frac{\text{Voltage across primary coil}}{\text{Voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$ $\frac{V_p}{V_s} = \frac{N_p}{N_s}$
Change in thermal energy = mass x specific heat capacity x change in temperature $\Delta Q = m \times c \times \Delta\theta$
Thermal energy for a change of state = mass x specific latent heat $Q = m \times L$
Energy transferred in stretching = 0.5 x spring constant x (extension)^2 $E = \frac{1}{2} \times k \times x^2$

Topic 8: Energy and Forces- Revision

There are 8 different stores of energy

Thermal, kinetic, chemical, elastic potential, magnetic, gravitational potential, electrostatic and nuclear. (**T**oday **K**ids **C**an **E**asily **M**emorise **G**CSE **E**nergy **N**ames)

Energy can be transferred between these stores mechanically, electrically, by heating and by radiation.

Energy in systems

When **energy is transferred**, it **changes the system**. A **system** is just the scientific name for an **object**, or a **group of objects**. As **systems change** some **energy is always dissipated** into less useful forms.

Energy transfer by heating

Think about a pan of water being heated by the hob at home. If we consider the pan of water then energy is transferred into the system by heating, the thermal energy store within the pan of water increases.

If the system consists of the pan of water and the stove, then energy is transferred within the system. The chemical energy stores in the fuel are transferred to thermal energy stored in the pan of water.

Electrical energy transfer

Think about your TV, electrical energy is transferred into the system from the mains supply and then light and sound transfer energy away from the system by radiation.

Mechanical energy transfer

Forces can be used to transfer energy. Think about lifting a box onto a shelf, chemical energy (from the food you have eaten) is transferred into the box and stored as kinetic and eventually gravitational potential energy stores. As the box is lifted you must do work against gravity, if you dropped the box then gravity would do work on the box to make it fall. Think about the falling box, no energy is transferred into the system, but the gravitational potential stores are transferred to kinetic energy stores, some energy would be dissipated by heating to the surroundings.

When a **force moves** an object through a distance, and **does work**, some energy is often **dissipated** to the **thermal energy stores** of **the surroundings**. **Lubrication** can **reduce friction** and, therefore, **reduce** the amount of **energy wasted** improving the **efficiency**.

Work done

Whenever a force acts to move an object through a distance work is done on the object as energy is transferred. When **1 newton of force** moves an object through **a distance of 1 metre** (1 Nm) we say that **1 joule (1 J) of work** has been done. **1 joule (J) = 1 newton meter (Nm).**

Work done (J) = force (N) x distance moved in direction of force (m) **E = F x d**

Power

Power is the **rate of energy transfer**; it tells us how much **work is done every second**. The unit of power is the **watt (W)** which is the same as **1 joule per second (J/s)**.

Power (W) = work done (J) ÷ time taken (s) **P = E ÷ t**

Equations from paper 1

You also need to be able to recall and apply these equations from your paper 1 knowledge.

GPE (J) = mass (kg) x gravitational field strength (N/kg) x change in vertical height (m) **GPE = m x g x Δh**
KE (J) = ½ mass (kg) x velocity^2 (m/s) **KE = ½ m x v^2**
Efficiency = $\dfrac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$

Topic 8: Energy and Forces- Knowledge Questions

1 Identify which type of energy is stored in each scenario.

Thermal	A rock on the top of a hill
Kinetic	A car moving very quickly
Chemical	A hot cup of tea
Gravitational potential	A can of petrol

(4)

2 List the four ways that energy can be transferred between energy stores.

____

____ (4)

3 State the equation used to calculate work done from force and distance.

____ (1)

4 Calculate how much work is done when a force of 10 N moves 3 m.

____________ J (2)

5 a. What happens to the amount of thermal energy stored in a pan of water as it gets heated? Circle the correct answer.

Increases	Stays the same	Decreases

(1)

5 b. If the pan is removed from a heat source it will cool down. Where does the thermal energy go?

____

____ (2)

5 c. How could this heat loss be reduced?

____

____ (1)

6 A box is placed on a high shelf; however, it slips and begins falling towards the ground. Describe the energy transfers involved. (How is energy stored at the start and at the end also consider how energy is lost from the box.)

____

____ (3)

7 State the equation used to calculate power from work done and time.

____ (1)

8 A machine transfers 200 J of energy in 4 seconds. Calculate the power.

____________ W (2)

9 a. State the equation used to calculate efficiency.

____

____ (1)

9 b. State the equation used to calculate kinetic energy.

____ (1)

9 c. State the equation used to calculate gravitational potential energy. (1)

____

Topic 9: Forces and their Effects- Revision

Forces are caused by interactions

An object is pushed or a pulled because it is interacting with something. Some forces occur when objects are touching, we called these contact forces, and some forces occur when objects are not touching each other, these are called non-contact forces. Forces are vector values as they have magnitude (size) and direction, unlike scalar values (such as mass) which only have magnitude.

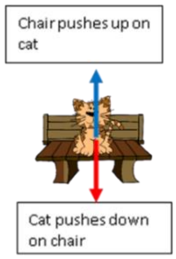
Contact Forces

If the interacting objects are touching, then there will be a contact force. The '**normal contact force**' acts on ALL objects that touch, and **friction** is another example of a contact force. When you sit on the chair, there is an upward force from the chair that stops you falling, this is a 'normal contact force'. N.B. In this context, the term 'normal' refers to the force acting at right angles to the surface. **Upthrust**, such as **buoyancy** or **lift**, is also a contact force.

Non-contact forces

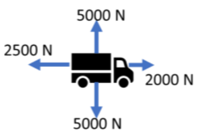
If the interacting objects are not touching then there will be non-contact forces, these will usually be caused by force fields. Examples are gravitational fields, magnetic field and electrostatic fields. A force field is the area around an object where it can affect other objects. For example, the Earth orbits the Sun because the Sun's **gravitational field** provides a centripetal force. The area around a magnet that can attract or repel another magnet is called the **magnetic field** and an object charged with static electricity has an **electrostatic field** around it.

Action-reaction pairs



Or Newton's 3rd law pairs, is the name given to the pair of forces in every interaction. Every action force has an equal and opposite reaction, the pair of forces are the same size but act in opposite directions. Action-reaction pairs are always the same size, act in opposite directions and act on different objects. They are also the same type of force.

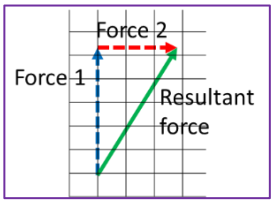
Free-body diagram & Resultant force



Shows all the forces acting on an object, or system, in isolation. It only shows the forces acting on that object. It does not show the forces that the object exerts on other objects. It is very rare that only one force acts on an object, the sum of all the separate forces can be replaced by 1 single force- the resultant force. When forces are parallel, they are simply added or subtracted to find the resultant force.

↓↓HIGHER ONLY ↓↓

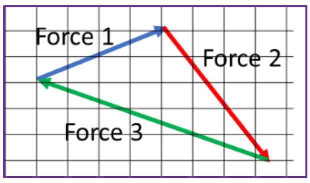
Vector Diagrams



You can draw scale diagrams to measure the size and direction of resultant, missing or component forces. Scale drawings can be made with nothing more than a ruler, a protractor and a pencil.

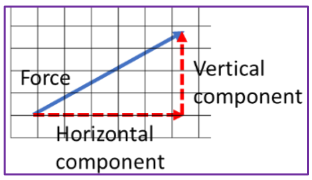
To find the resultant force acting on an object we **draw all the forces from the first to last (tip-to-tail)**. Then **connect the start to the end** and this is the resultant force. We select a sensible scale to represent the size of the force (e.g. 1 cm = 1 N) and use a protractor to measure angles to find the direction of the forces.

If an object is in equilibrium, we know that the forces acting on it must be balanced, or the resultant force equals zero. If we drew a scale diagram to represent a situation in equilibrium, then the tip of the last arrow would meet the tail of the first.



If you are given several forces and told the object is in equilibrium but there is a force missing then all you need to do **is draw the forces you are given**, and **connect the tip of the last force to the tail of the first**- this line is the missing force. Measure it and use the scale to find the size, use a protractor to find the direction.

A force acting **at an angle** can be **broken down** into the **horizontal and vertical components.** These can be easier to work with.



We can split the force into horizontal and vertical components using a simple scale drawing. With a sensible scale use a **ruler and a protractor to draw your force**. Then **add your components to complete a 'triangle'**, measure the length and use your scale to find the size of the component forces.

Topic 9: Forces and their Effects- Knowledge Questions

1 Describe what is needed for forces occur.

____ (1)

2 Describe how scalar values are different to vector values.

____

____ (2)

3 a. The normal contact force is an example of a contact force. Name two other contact forces.

____ (2)

3 b. Describe an example of the normal contact force.

____

____ (3)

4 a. Describe what a force field is.

____

____ (1)

4 b. List three examples of non-contact forces.

____

____ (3)

5 Describe what we know about the size and direction of the two forces in an action-reaction pair.

____

____ (2)

6 Select the description that describes the 2nd force in this action-reaction pair.

A student pushes down on the chair with 400 N of force.

a. The student pushes up on the chair with 400 N of force.	b. The chair pushes down on the student with 50 N of force.	c. The chair pushes up on the student with 400 N of force.	d. The chair pushes up on the student with 50 N of force.

(1)

7 State which forces are shown in a free-body diagram.

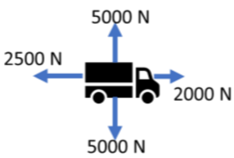
____ (1)

8 Describe what is meant by the term resultant force.

____

____ (1)

9 Calculate the horizontal & vertical resultant forces acting on this lorry.



Vertical resultant force ______________________

Horizontal resultant force ______________________ (2)

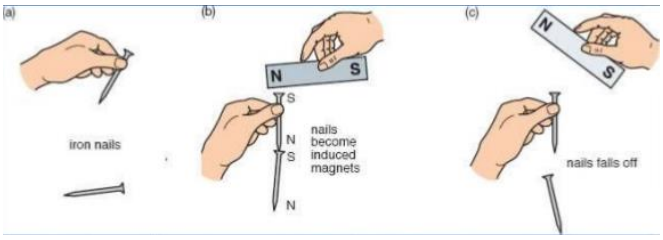
10 If several forces were acting on the same object, how would you draw the force arrows to find the resultant force using a scale diagram?

____ (1)

Topic 12: Magnetic fields - Revision

Magnets

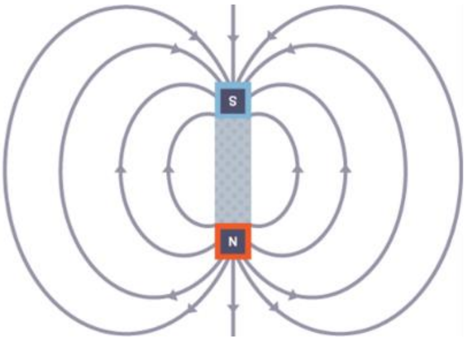
A bar magnet is a **permanent magnet**- it is always magnetic. It will attract magnetic materials (iron, steel, nickel and cobalt) if they are placed inside the **magnetic field**.
The north end of a magnet will attract the south end of another magnet or repel the north end.
When a piece of magnetic material is placed inside a magnetic field, it becomes a magnet. This is an **induced magnet** because it stops being magnetic when removed from the magnetic field.

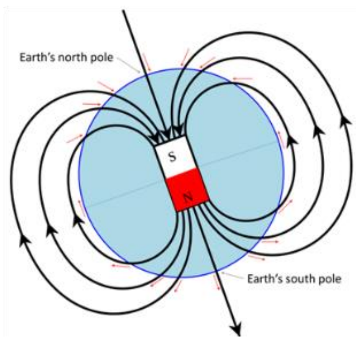


The diagram here shows that the iron nails do not attract (a) once placed inside the magnetic field, however, they acts as magnets (b). When removed from the magnetic field, they no longer attract, and fall (c).

Magnetic fields

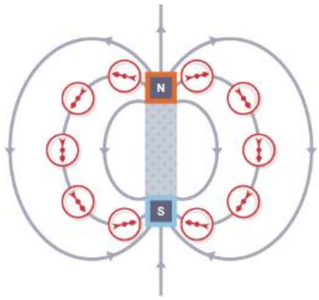
Magnets have many uses including speakers, electric motors, generators and compasses.
Compasses contain small magnets that are free to rotate and line up with any magnetic field they experience. The Earth's magnetic field is similar in shape to that of a bar magnet.
When drawing field lines you should ensure that, none of your lines overlap and the arrows point in the correct direction (from north to south). Notice that what we call the North Pole is actually a magnetic south pole- this is why the north pole of a compass magnet will point north.





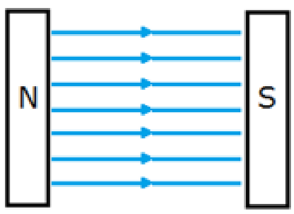
You can also use **plotting compasses** to **investigate** the **magnetic field** surrounding a bar magnet. Remember that the needle of a plotting compass points to the south pole of the magnet.

1. Place the plotting compass near the magnet on a piece of paper.
2. Mark the direction that the compass needle points.
3. Move the plotting compass to many different positions in the magnetic field, marking the needle direction each time.
4. Join the points to show the field lines.



Uniform magnetic fields

Two flat magnets can produce a **uniform magnetic field** when placed close to each other. The field is the same strength and direction at every point.



Topic 12: Magnetic fields- Knowledge Questions

1 Why is a bar magnet known as a permanent magnet?

____ (1)

2 Name four magnetic metals.

____

____ (2)

3 How will the north pole of a magnet affect the north and south poles of a different magnet?

North __________________ South ___________________ (1)

4 An iron nail is placed inside a magnetic field and becomes a magnet. Why is the nail known as an induced magnet?

____ (1)

5 Give four uses of magnets.

____

____ (2)

6 Describe two rules you should follow when you are drawing magnetic field line.

____

____ (2)

7 Why does the north pole of a compass magnet point towards the geographic North Pole?

____

____ (1)

8 Which pole of a magnet does the needle of a plotting compass to?

____ (1)

9 Complete these sentences to describe how to investigate the magnetic field surrounding a bar magnet.

Place the ____________ compass close to the bar magnet.

Mark the ____________ that the needle points.

Move the compass to ____________ positions around the magnet and repeat. Join the ____________ to show the field lines. (4)

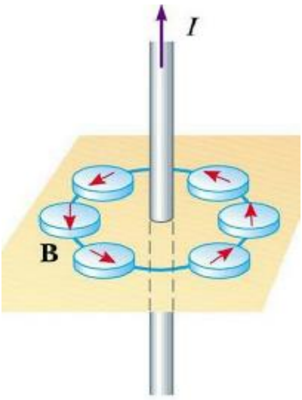
10 Where is a uniform magnetic field produced?

____ (1)

11 Describe the strength and direction of a uniform magnetic field at different points.

____ (1)

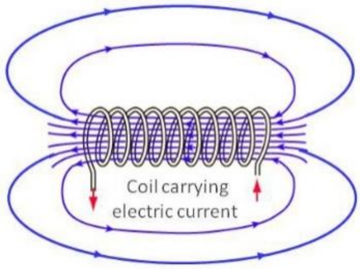
Electromagnets



Whenever current flows through a length of wire- a magnetic field is created. This magnetic field can be investigated with plotting compasses, using a similar method as described above.

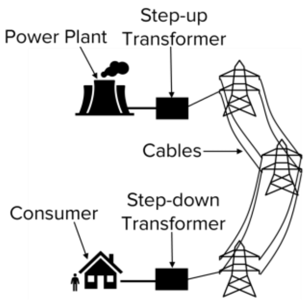
The **higher the current**- the **stronger the magnetic field**. The field get weaker as you move away from the wire.

If the current changes direction then so does the magnetic field.



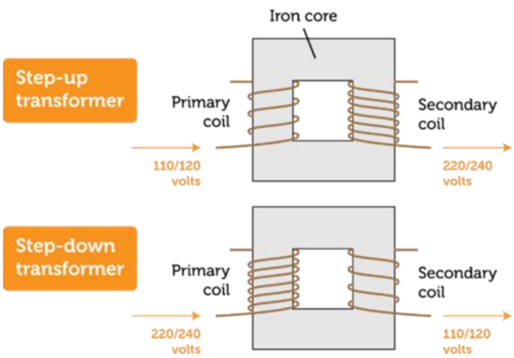
A **solenoid** is a coil of wire with current flowing through it- this is an electromagnet. The magnetic field is strongest inside the solenoid because the fields add together whereas outside of the coil they tend to cancel each other out making the field weaker. An electromagnet is made stronger by placing an iron core through the centre- this acts as a temporary magnet as it is only magnetic whilst the field from the electromagnet is affecting it.

The national grid



Electricity is sent from the power station to homes, schools and factories through a network of wires, and cables called the **national grid**. As the current flows through the wires, they get warm and energy is wasted. Smaller currents mean less energy wasted by heating. Transformers are used to change the size of the potential difference (voltage). If the voltage increases then the current decreases. If the voltage decreases then the current increases.

Transformers



A transformer is made of an iron core with two separate coils of wire wrapped around.

A step-up transformer increases the voltage and decreases the current.

A step-down transformer decreases the voltage and increases the current.

A power station produces electricity at 25 kV, this is **increased**, by a **step-up** transformer, to 400 kV. This decreases the current and means **less energy is wasted** as heat- the efficiency has been improved.

High voltages, however, are dangerous so the **voltage** is then **decreased**, by a **step-down** transformer, before it is delivered, **safely**, to the consumer.

Larger factories use electricity at 33 kV, smaller factories us 11 kV and homes, schools, offices and shops use 230 V.

An alternating current is needed for transformers to work.

- The alternating current produces a changing magnetic field in the primary coil
- The magnetic field is strengthened by the iron core
- The magnetic field produces a changing voltage in the secondary coil
- The changing voltage produces an alternating current in the secondary coil.

Because energy cannot be made or destroyed then, if a transformer is 100 % efficient, then the power supplied by the primary coil must be equal to the power transferred by the secondary coil. The current or voltage in either coil can be calculated using the following equation:

primary voltage x primary current = secondary voltage x secondary current

$$V_p \times I_p = V_s \times I_s$$

Topic 12: Magnetic fields- Knowledge Questions

1 What is created when current flows through a length of wire?

____ (1)

2 How does the size of the current affect the strength of the magnetic field?

____ (1)

3 What happens to the direction of the magnetic field if the direction of the current is changed?

____ (1)

4 a. What is a solenoid?

____

____ (2)

4 b. Why is the magnetic field strongest inside of a solenoid?

____ (1)

5 What do we call the network of wires and cables that delivers electricity from the power station to our homes?

____ (1)

6 Transformers are used to change the size of the voltage. What happens to the size of the current if the voltage is increased?

____ (1)

7 What is a transformer made from?

____

____ (2)

8 How is a step-up transformer different to a step-down transformer?

____

____ (2)

9 a. Why do we want to deliver electricity through power lines with a high voltage and low current?

____

____ (2)

9 b. Why does the voltage have to be lowered again before being used in shops and homes?

____ (1)

9 c. What type of current is needed for transformers to work?

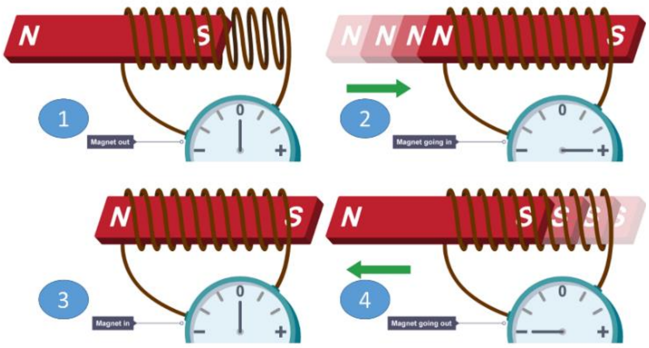
____ (1)

Topic 13: Electromagnetic induction (H) - Revision

Electromagnetic induction

If a wire is placed inside of a changing magnetic field, then a potential difference (voltage) can be induced inside the wire. The induced voltage causes a current to flow. The same effect is seen if the wire moves inside of a magnetic field.

Diagram 1 shows the magnet stationary, outside of the coil, and no voltage induced.
Diagram 2 shows the magnet moving into the coil and a positive voltage induced.
Diagram 3 shows no voltage induced when the magnet is stationary inside the coil.
Diagram 4 shows the magnet moving out of the coil and a negative voltage induced.

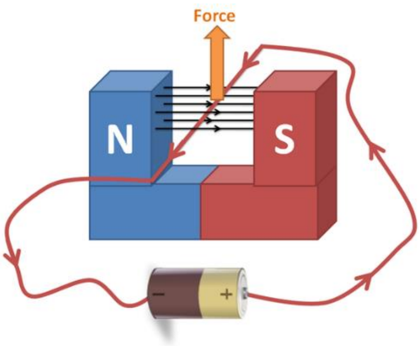


Changing the induced voltage

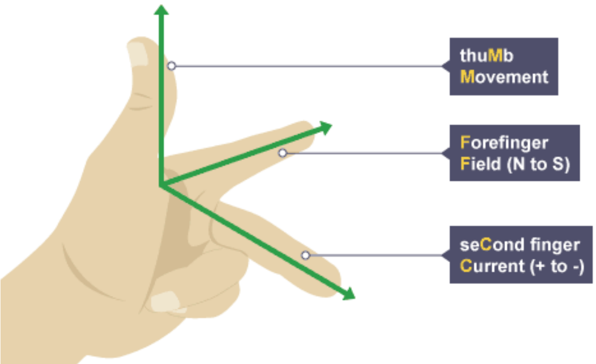
The direction of the induced voltage changes if the direction of movement is changed or if the poles of the magnet were switched.
The size of the induced voltage increases if the number of turns of wire is increased, the magnetic field strength is increased or the speed of movement is increased.
When an induced voltage causes a current to flow, the current induces a magnetic field around the coil. The induced magnetic field always acts against the motion that caused it to be created. For example in diagram 2 the magnet is moving into the coil, the magnetic field would work against this movement- trying to push the magnet back out of the coil.

The motor effect

When a current carrying wire is placed inside a magnetic field, it feels a force acting on it- this is called the **motor effect.**
The motor effect is caused because the current flowing the wire creates a magnetic field, around the wire, and this interacts with the magnetic field between two magnets.
The magnet also feels the same force, but in the opposite direction.



Fleming's left hand rule (FLHR) can be used to find the direction of the force acting on the wire.



Hold your thumb, forefinger and second finger at right angles to each other:

- the forefinger is lined up with magnetic field lines pointing from north to south
- the second finger is lined up with the current pointing from positive to negative
- the thumb shows the direction of the motor effect force on the conductor carrying the current

The size of the force acting on the wire depends on several factors: the strength of the magnetic field, the size of the current flowing through the wire and the length of wire that is inside the magnetic field.

Force (N) = magnetic field strength (T) x current (A) x length (m)
F = B x I x l

The strength of a magnetic field (also known as the flux density) is measured in units of **tesla (T).** One tesla is equivalent to 1 newton per amp metre (1 N/Am).

Topic 13: Electromagnetic induction- Knowledge Questions

1 How can a potential difference be induced inside a wire?

____

____ (2)

2 Give two ways of changing the direction of an induced voltage.

____

____ (2)

3 Give three ways of increasing the size of an induced voltage

____

____ (3)

4 Complete these sentences by adding the missing words.

When an induced voltage causes a ________________ to flow it induces a ________________ field around the coil. This induced field acts against the ________________ that caused it to be created. (3)

5 a. When a current carrying wire is placed inside a magnetic field- it feels a force. What do we call this effect?

____ (1)

5 b. What causes this affect?

____

____ (2)

c. Which rule tells us about the direction of the force?

____ (1)

5 d. What do the following digits represent in this rule?

Thumb: ______________________________________

Forefinger: __________________________________

Second finger: _______________________________ (3)

5 e. Give three factors that affect the size of the force acting on the wire.

____

____ (3)

6 Which equation links force, magnetic field strength, current and length?

____ (1)

7 What unit is used to measure magnetic field strength?

____ (1)

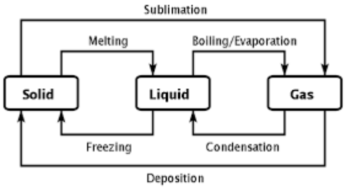
Topic 14a: Particle model - Revision

Kinetic theory model

Kinetic model	Properties	Particle arrangement	Forces of attraction
Solid 	Cannot be compressed Have a fixed shape	Particles are tightly packed, can vibrate but cannot move around	Particle are held together by strong force of attraction
Liquid 	Cannot be compressed Take on the shape of their container	Particles are still tightly packed but can move past each other	Force of attraction is not strong enough to hold particles in a fixed position
Gas 	Easy to compress Expand to fill their container	Particles are far apart and moving around quickly	There is no force of attraction between the particles

Everything is made of tiny particles, these particles are arranged differently or solids liquids and gases. The way the particles are arranged explains the different properties of solids, liquids and gases.

Changes of state are physical changes- this means that no new substances are formed, the particles are just arranged differently and the change can easily be reversed.

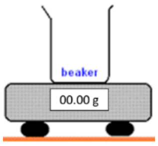


Density

Solids are denser than liquids, which are denser than gases. The density of a substance is the mass of a certain volume. Solids are denser than gases because the particles are more tightly packed- the same amount of particles have a smaller volume in a solid than in a liquid.

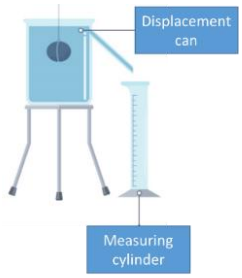
$$\text{Density (kg / m}^3\text{) = mass (kg)} \div \text{volume (m}^3\text{)}$$
$$\rho = m \div V$$

Investigating density

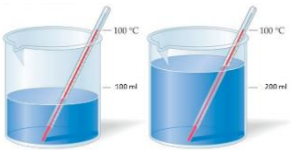


To investigate the density of a liquid place beaker onto a balance, and set the reading to zero, use a measuring cylinder to measure out a set volume of liquid and pour into the beaker- record the mass and volume of the liquid. Use the equation $\rho = m \div V$ to find the density.

To investigate the density of a solid you use a balance to find the mass of the object. To find the volume you submerge the object into a displacement can and collect the water displaced, in a measuring cylinder- this is the volume as the object. Record the mass of the object and the volume of water displaced. Use the equation $\rho = m \div V$ to find the density.



Changing temperature



Temperature and thermal energy are linked but are not the same- 200 ml of boiling water stores twice as much energy as 100 ml of boiling water. When an object is heated, energy is stored in the moving particles- this is thermal energy. When a solid is heated and stores more thermal energy the vibrations of the particles increases. When a liquid or gas is heated the movement of the particles increases. During a change of state, the energy is being used to overcome the forces between the particles and is not stored in the moving particles- therefore the temperature of an object being heated does not increase during a change of state. When an object is cooled (loses energy) and changes state the movement of the particles does not decrease, as energy is release as the force of attraction, between particles, is strengthened so the temperature does not change.

Specific heat capacity

Different materials heat up at different rates, this is because they have different heat capacities. **Specific heat capacity** is the energy required to increase the temperature of 1 kg of a substance by 1°C, represented by the following equation.

$$\text{Energy (J) = specific heat capacity (J /kg°C) x mass (kg) x temperature change (°C)}$$
$$Q = m \times c \times \theta$$

Specific latent heat

Different materials need different amounts of energy to change state, and boiling requires more energy than melting. **Specific latent heat** is the energy required to make 1 kg of a substance change state, represented by the following equation.

$$\text{Energy (J) = specific latent heat (J /kg) x mass (kg)}$$
$$Q = m \times L$$

Topic 14a: particle model- Knowledge Questions

1 Complete these sentences by adding the correct words.

Everything is made of tiny ________________. The way these are arranged explains the different ________________ of solids, ________________ and ________________. (4)

2 Describe the properties of solids, liquids and gases.

Solids: ____

Liquids ____

Gases: ____ (3)

3 Select the correct term to complete these sentences:

a. As a substance changes state from a solid to a liquid to a gas the particles tend to *move* **faster/ slower**.

b. As a substance changes state from a solid to a liquid to a gas the *force of attraction* between the particles gets **stronger / weaker**.

c. As a substance changes state from a solid to a liquid to a gas the *density* of the substance usually **increases / decreases**. (3)

4 Which equation links density, mass and volume?

____ (1)

5 How can you use a balance and a beaker to find the mass of a liquid?

____

____ (2)

6 How can you use a 'displacement can' to find the volume of a solid?

____

____

____ (3)

7 Where is the energy stored when an object is heated?

____ (1)

8 What happens to the temperature of a substance during a change of state?

____ (1)

9 Where does the heat energy go during a change of state?

____ (1)

10 What is specific heat capacity?

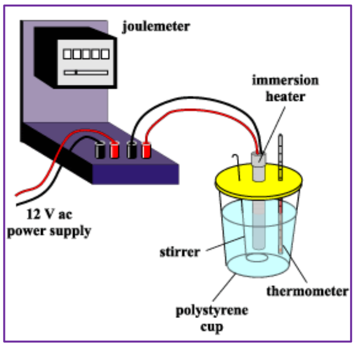
____ (1)

11 What is specific latent heat?

____ (1)

Topic 14b: Particle model - Revision

Investigating specific heat capacity



- Place a beaker on a balance and zero the balance, add some water and record the mass. Use a thermometer to measure and record the temperature of the water.
- Place an immersion heater into the beaker and connect to a joule meter.
- Turn on the heater and leave on for 5 minutes, gently stirring the water occasionally.
- Record the new temperature and the value on the joule meter. The reading on the joule meter tells you the energy change and the temperature change is the difference between the start and end temperature.
- **Specific heat capacity = energy ÷ (mass x temperature change)**.

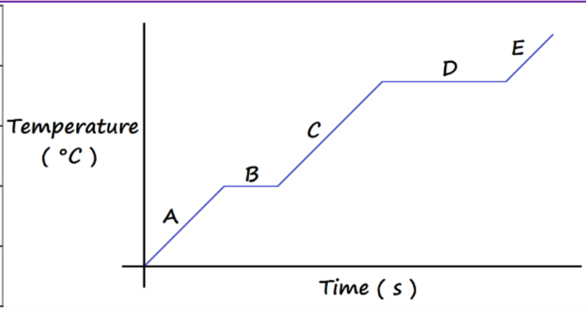
The results of this experiment are improved by using insulation such as lagging wrapped around the beaker, or a lid. This reduces the unwanted energy transfer to the surroundings- more of the energy supplied by the heater stays in the water.

Investigating melting ice

- Place a thermometer into a boiling tube of crushed ice and record the temperature.
- Place the boiling tube into a beaker of hot water and use Bunsen burner to keep the water hot.
- Record the temperature every minute, once the ice has all melted take the temperature for five minutes more.
- Make a note of the time when the ice started to melt and had all melted.

This graph shows how the temperature of a substance changes when heated from a solid state through to a gas. The table describes what is happening at each stage and describes how the energy is used.

A	Solid being heated	Vibration of particles is increasing
B	Melting	Force of attraction between particles being weakened
C	Liquid being heated	Movement of particles is increasing
D	Boiling	Force of attraction between particles being weakened
E	Gas being heated	Movement of particles is increasing

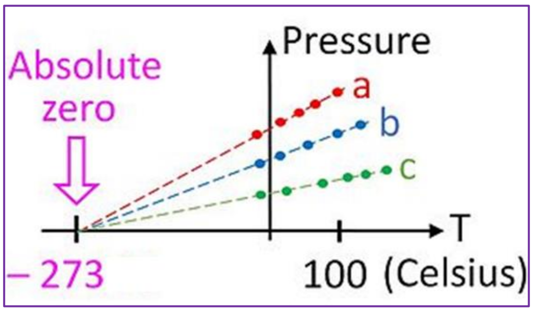


Gas temperature and pressure

The particles in a gas are free to move, the more they are heated the faster they move- the more kinetic energy they have. Gas pressure is caused when the particles collide with the walls of a container, the faster the particles are moving the more often they collide and the more force they collide with- **as the temperature of a gas increases so does the pressure**. The units of pressure are **pascals (Pa**), 1 Pa = 1 N/m^2.

Absolute zero

If we cool a gas the pressure reduces, in a linear manner (a straight line), eventually the gas will condense to become a liquid, however if we could continue reducing the temperature of any gas the **pressure would become zero** at **-273 °C**, this is known as **absolute zero** and the particles would have **no kinetic energy**



The Kelvin scale measures temperature from absolute zero, the average kinetic energy of the parties in a gas is directly proportional to its kelvin temperature. 1 K is equal to 1 °C.

To convert from kelvin to degrees Celsius: subtract 273.

293 K = 293 – 273 = 20 °C

To convert from degrees Celsius to kelvin: add 273.

100 °C = 100 + 273 = 373 K

Topic 14b: Particle model- Knowledge Questions

1 a. Which three values do you need to measure to investigate the specific heat capacity of a material?

____

____ (3)

1 b. Why does adding insulation to the beaker improve the results of the investigation?

____ (1)

2 a. What happens to the movement of particles when a solid is being heated?

____ (1)

2 b. What happens to the force of attraction between particles when a solid is being melted to a liquid?

____ (1)

2 c. What happens to the vibration of particles when a liquid is being heated?

____ (1)

3 Complete these sentences by adding the missing words:

The particles in a gas are free to ________________, the more they are heated the ________________ they move- the more ________________ energy they have. (3)

4 What causes gas pressure?

____ (1)

5 Why do faster moving gas particles cause more pressure?

____

____ (2)

6 What are the units of pressure?

____ (1)

7 a. What temperature is 'absolute zero'?

____ (1)

7 b. What do we know about the pressure and kinetic energy of gas particles if they were cooled to 'absolute zero'?

____ (1)

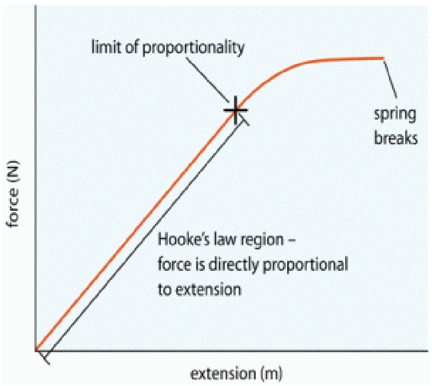
8 Convert the following temperatures to degrees Celsius.

293 Kelvin ________________ °C 353 Kelvin ________________ °C (2)

Topic 15: Forces and matter - Revision

Changing shape

Forces can **change the shape** if an object- they can stretch, bend or compress an object. This requires **two forces**- with one force the object might change velocity but a change in shape always requires at least two forces.
Elastic objects return to their own shape when the forces are removed.
Inelastic objects keep their new shape when the force is removed.



A spring is elastic when smaller forces are applied as it returns to its own shape- however if larger forces are applied they behave inelastically and are permanently deformed (keep their new shape). There is a **linear** relationship between the length of a spring and the force applied- the graph is a **straight line**.
If a graph of force is plotted against extension the straight line passes through the origin- the extension is **directly proportional** to the force. If the extension doubles then so does the force. If you stretch the spring too far, it passes the elastic limit and the relationship becomes non-linear. Rubber bands have **non-linear** relationships between extension and force- the graph is **not a straight line**.

Calculations with springs

The stiffer a spring is, the more force you need to get the same extension as a less stiff spring. The **spring constant** is a value that tells us about the stiffness of a spring- it tells us how much force is needed to create an extension of 1 metre, it has the unit N/m.

Force (N) = spring constant (N/m) x extension (m)

$$F = k \times x$$

A stretched spring stores energy because work has to be done to stretch it (a force moves through a distance- remember: work done = force x distance moved by force). The amount of energy stored in a spring depends on the spring constant (stiffness) and the extension of the spring.

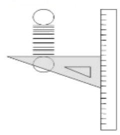
Energy (J) = ½ x spring constant (N/m) x extension² (m²)

$$E = \frac{1}{2} \times k \times x^2$$

Investigating springs

- Measure the length of an unstretched spring- this is the original length.
- Add a known weight (e.g. 1 N) to the spring and record the new length.
- Subtract the original length from the new length- this is the extension, record the extension.
- Keep adding weights to the spring and repeating the measurements until you have added 10 N.
- Plot a graph of force against extension- the gradient of the slope is equal to the spring constant
- Use energy = ½ x spring constant x extension² to calculate the work done to stretch the spring.

You can improve your investigation by using a set square to help take your measurements.



Topic 15: Forces and matter- Knowledge Questions

1 Give three ways in which forces can change the shape of an object. (3)

2 What is the smallest number of forces needed to change an object's shape? (1)

3 Which types of object return to their own shape when forces are removed? (1)

4 Which types of object do not return to their own shape when forces are removed? (1)

5 What type of relationship produces a graph with a straight line that passes through the origin? (1)

6 What happens to the force-extension relationship of a spring when it is stretched beyond the elastic limit? (1)

7 What shape is the force-extension relationship for a rubber band? (1)

8 What does the 'spring constant' tell us about a spring? (1)

9 Which equation links force, spring constant and extension? (1)

10 a. Why does a stretched spring store energy? (1)

10 b. Name the two factors that affect the amount of energy stored in a stretched spring. (2)

11 Describe how you could measure the extension of a spring. (3)

Topic 8: Energy and Forces- Knowledge Answers

1	Thermal Kinetic Chemical Gravitational potential	A rock on the top of a hill A car moving very quickly A hot cup of tea A can of petrol
2	Mechanically, electrically, by heating and by radiation.	
3	Work done = force x distance	
4	10 x 3 = **30 J**	
5a	Increases	
5b	Dissipated by heating (1) to the surroundings (1)	
5c	Use a lid (1) to insulate (1)	
6	Gravitational potential energy (1) is transferred to kinetic energy (1) mechanically (1). Some energy will be dissipated to the surrounding (1)	
7	Power = work done ÷ time	
8	200 ÷ 4 = **50 W**	
9a	Efficiency = useful energy ÷ total energy	
9b	Kinetic energy = ½ mass x vleocity^2	
9c	Potential energy = mass x gravitational field strength x height	

Topic 9: Forces and their Effects- Knowledge Answers

1	An interaction between two objects	
2	Scalar values have only size (1) vector values have size and direction (1)	
3a	Friction (1) upthrust (1) lift (1) buoyancy (1) tension (1)	
3b	Any two objects (1) touching (1) The force acts at right angles to the surface (1)	e.g. person sat on chair (2)
4a	The area around an object where it can affect other objects	
4b	Magnetic (1) electrostatic (1) gravitational (1)	
5	Equal in size (1) opposite direction (1)	
6	c. The chair pushes up on the student with 400 N of force.	
7	All of the forces acting on an object	
8	The sum of all the separate forces replaced by one single force	
9	Vertical resultant force **5000 – 5000 = 0 N** Horizontal resultant force **2500 – 2000 = 500 N (left)**	
10	Draw all the forces from the first to the last (tip-to-tail)	

Topic 12: Magnetic fields- Knowledge Answers

1	It is always magnetic
2	Iron, nickel, steel, cobalt
3	North will be repelled (1) South will be attracted (1)
4	It stops being magnetic when removed from the magnetic field
5	Any four sensible answers: speakers, electric motors, generators, magnets
6	Lines should not overlap (1) Arrows point from north to south (1)
7	Geographic North Pole is a magnetic south pole
8	South pole
9	Place the **<u>plotting</u>** compass close to the bar magnet. Mark the **<u>direction</u>** that the needle points. Move the compass to **<u>different</u>** positions around the magnet and repeat. Join the **<u>points</u>** to show the field lines.
10	Between two flat magnets
11	The same

Topic 12: Magnetic fields- Knowledge Answers

1	A magnetic field
2	Larger the current- stronger the field
3	The direction of the field also changes
4a	A coil of wire (1) with a current flowing through it (1)
4b	The magnetic fields add together
5	The national grid
6	Current decreases
7	An iron core (1) two (separate) coils of wire (1)
8	A step-up transformer increases voltage whilst a step-down decreases voltage (1) A step-up transformer decreases current whilst a step-down increases current (1) A step-up transformer has more turns on the secondary coil whilst a step-down has more turns on the primary ORA (1)
9a	Less energy is wasted as heat (1) more efficient (1)
9b	Lower voltage is safer
9c	Alternating current (a.c.) (1)

Topic 13: Electromagnetic induction- Knowledge Answers

1	The wire should be placed inside a changing (1) magnetic field (1)
2	Change the direction of movement (1) change the poles of the magnet (entering) (1)
3	Stronger magnetic field (1) move the magnet / wire faster (1) increase the number of turns of wire (within the field) (1)
4	When an induced voltage causes a **current** to flow it induces a **magnetic** field around the coil. This induced field acts against the **motion** that caused it to be created.
5a	The motor effect
5b	The flow of current creates a magnetic field (1) which interacts with the magnetic field between the magnets (1)
5c	Fleming's left-hand rule (FLHR)
5d	Thumb- direction of movement / force (1) Forefinger- direction of magnetic field (1) Second finger- direction of current flow (1)
5e	The strength of the magnetic field (1) the size of the current (1) the length of the wire (1)
6	Force = magnetic field strength x current x length
7	Tesla (T)

Topic 14a: particle model- Knowledge Answers

1	Everything is made of tiny **particles**. The way these are arranged explains the different **properties** of solids, **liquids** and **gases**.
2	Solids: cannot be compressed and have a fixed shape (1) Liquids: cannot be compressed and {can flow / take on the shape of their container} (1) Gases: can be compressed and expand to fill their container (1)
3a	**Faster**
3b	**Weaker**
3c	**Decreases**
4	Density = mass ÷ volume
5	Place the beaker on the balance and press zero (1) add the liquid a take the reading (1)
6	Fill the can to spout (1) add the object and collect the water (that is displaced) (1) use a measuring cylinder to find the volume (1)
7	In the moving particles
8	Temperature stays the same
9	Used to overcome forces between the particles
10	The energy needed to increase the temperature of 1 kg of a substance by 1°C
11	The energy needed to make 1 kg of a substance change state

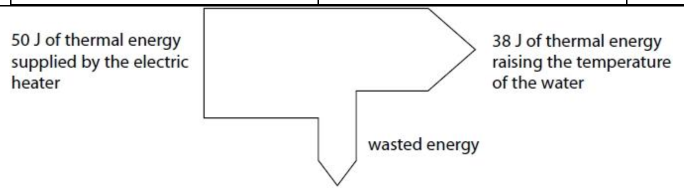
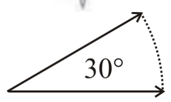
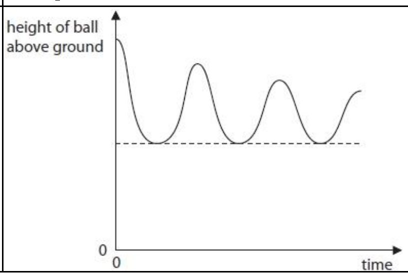
Topic 14b: particle model- Knowledge Answers

1a	Mass (1) energy transferred (1) change in temperature (1)
1b	Reduces the unwanted energy transfer
2a	They vibrate more
2b	The force of attraction gets weaker
2c	Movement increases
3	The particles in a gas are free to **move**, the more they are heated the **faster** they move- the more **kinetic** energy they have.
4	Gas particles colliding with the walls of a container
5	They collide more often (1) and they collide with more force (1)
6	Pascals (Pa) or newton per metre^2 (N/m^2)
7a	-273 °C or 0 K
7b	There would be no pressure or kinetic energy
8	293 K = 20 °C (1) 353 K = 80 °C (1)

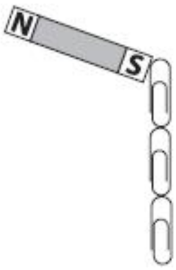
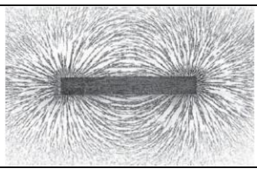
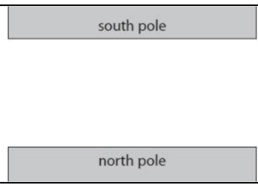
Topic 15: Forces and matter- Knowledge Answers

1	Stretch (1) bend (1) compress (1)
2	Two forces
3	Elastic
4	Inelastic
5	A directly proportional relationship
6	It becomes non-linear (or is no longer directly proportional)
7	Non-linear
8	The stiffness of the spring
9	Force = spring constant x extension
10a	Work is done (to stretch the spring)
10b	The spring constant (1) the extension (1)
11	Use a ruler (1) to measure the original length (1) and the stretched length (1) Extension = stretched length – original length (1)

Topic 8 & 9: Energy and Forces - Exam Questions

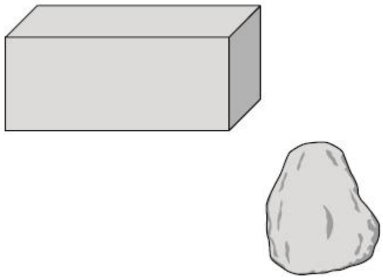
<table>
<tr><td>1a</td><td colspan="2">Which of these is NOT an energy store? (1) Tick the correct box:
<table><tr><td>A. Kinetic</td><td>B. Thermal</td><td>C. Renewable</td><td>D. Chemical</td></tr></table></td></tr>
<tr><td>1b</td><td colspan="2">Which of these is a non-contact force? (1) Tick the correct box:
<table><tr><td>A. Upthrust</td><td>B. Thermal</td><td>C. Friction</td><td>D. Magnetic</td></tr></table></td></tr>
<tr><td>1c</td><td colspan="2">Which of these is NOT a type of energy transfer? (1) Tick the correct box:
<table><tr><td>A. Chemically</td><td>B. Mechanically</td><td>C. Electrically</td><td>D. By heating</td></tr></table></td></tr>
<tr><td>1d</td><td>
</td><td>The diagram to the left is a Sankey diagram and show the input energy and useful energy output for an energy transfer.
State the amount of wasted energy. (1)</td></tr>
<tr><td>1e</td><td colspan="2">State the equation used to calculate the efficiency of an energy transfer. (1)</td></tr>
<tr><td>1f</td><td colspan="2">Calculate the efficiency of the above energy transfer. (2)</td></tr>
<tr><td>2</td><td colspan="2">A rock falls off the top of a cliff. The Earth exerts a force of 150 N on the rock. The work done by this force when the rock falls from the top to the bottom of the cliff is 2700 J.</td></tr>
<tr><td>2a</td><td colspan="2">Calculate the height, h, of the cliff. (2)</td></tr>
<tr><td>2b</td><td colspan="2">State the value of the kinetic energy of the rock just before it hits the ground. (1)</td></tr>
<tr><td>2c</td><td colspan="2">The mass of the rock is 15 kg.
Calculate the velocity of the rock just before it reaches the bottom of the cliff. (3)</td></tr>
<tr><td>3</td><td colspan="2">A man pulls a suitcase for 80 m along a horizontal path. The mass of the man and the suitcase is 85 kg. The man does 1200 J of work on the suitcase as he pulls the suitcase along. He walks with an average velocity of 1.5 m/ s.</td></tr>
<tr><td>3a</td><td colspan="2">Calculate the kinetic energy of the man and the suitcase. (2)</td></tr>
<tr><td>3b</td><td colspan="2">Calculate the horizontal force that the man exerts on the suitcase. (2)</td></tr>
<tr><td>3c</td><td colspan="2">The man runs up a set of stairs carrying his suitcase. Explain whether he does more total work if he walks up the same stairs instead of running. (2)</td></tr>
<tr><td>3d</td><td colspan="2">The man lifts his 12 kg suitcase & increases its gravitational potential energy by 264 J. (g = 10 N/kg). Calculate the vertical height the suitcase is raised. (3)</td></tr>
<tr><td>4a</td><td colspan="2">A large box is placed upon a table. Draw a free body diagram to show the forces acting on the box. (3)</td></tr>
<tr><td>4b</td><td colspan="2">The box pushes down on the table with a force of 250 N. Describe the action-reaction force that completes the Newton's third law pair. (2)</td></tr>
<tr><td>4c</td><td colspan="2">Compare the balanced forces acting on the box with forces acting as part of a Newton's third law pairs. (3)</td></tr>
<tr><td>4d</td><td>
</td><td>HIGHER ONLY
This diagram shows two astronauts in space pushing a satellite. Force F_1 acts to the right and is 3.0 N. Force F_2 acts upwards as is 2.0 N.
Draw a vector diagram to determine the magnitude of the resultant force. (4)</td></tr>
<tr><td>4e</td><td>
</td><td>Later the satellite is pushed with a resultant force of 4.5 N at an angle of 30°.
Draw a vector diagram to determine the horizontal of vertical components on this force. (4)</td></tr>
<tr><td>5a</td><td colspan="2">Describe what happens to some energy during all energy transfers. (2)</td></tr>
<tr><td>5b</td><td colspan="2">Explain how unwanted energy transfers are reduced in mechanical systems. (2)</td></tr>
<tr><td>5c</td><td>
</td><td>A wrecking ball is used to knock down a wall. After knocking down a wall it is left to swing freely. This graph shows how the height of the ball above the ground varies with time during these swings.
Explain how the energy within the system changes during this time. (6)</td></tr>
</table>

Topic 12 & 13: Magnetic forces - Exam Questions

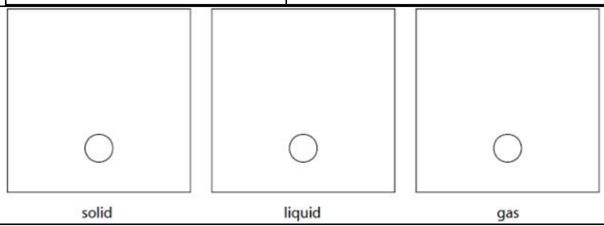
1a	State the name of the device used to change the size of an alternating voltage. (1)
1b	**Which statement is true for transformers?** (1) A. Transformers can only step-up voltages. | B. Transformers can only step-down voltages | C. Transformers can work with direct current. | D. Transformers have primary and secondary coils.
1c	**Which of these is a magnetic material?** (1) A. aluminium | B. carbon | C. cobalt | D. copper
1d	**Which of these is NOT a way to increase the size of an induced current when a magnet is passed through a coil of wire** (1) A. move the magnet faster | B. use a stronger magnet | C. turn the magnet around | D. have more turns of wire
1e	Describe one way that you can change the direction of an induced current when a magnet is passed through a coil of wire. (1)
2a	This diagram shows a magnet holding some paper clips. Describe how a student could show that the paper clips are induced magnets. (2) 
2b	Describe how you could show that the Earth has a magnetic field. (2)
2c	The same student uses a solenoid to make an electromagnet. Describe what a solenoid is. (2)
2d	Explain where the magnetic field produced by a solenoid is strongest (2)
3a	 A student uses iron filings to show the pattern of a magnetic field around a bar magnet. This diagram shows the pattern the student produced. Describe how you can tell where the magnetic field is strongest. (2)
3b	The bar magnet is placed on a sheet of paper. Describe how the student could plot the shape and show the direction of the magnetic field around the magnet. (3)
3c	A student has a power pack, a long piece of wire, a stiff card and some iron filings. Describe how the student could use this equipment to show the shape of the magnetic field produced by a current in the wire. You may draw a diagram to help. (4)
3d	This diagram shows two magnetic poles facing each other. The magnetic field between the poles is uniform. Make a sketch of the diagram, draw the magnetic field lines between the two poles, and show the direction of this magnetic field. (3) 
4a	Complete the following sentences using the phrases from the right. **Efficiency is reduced** **The national grid** **A power station** **Heat loss is reduced** **A transformer**
i	Electrical power is generated at… (1)
ii	Electricity is transmitted over long distances by transmission lines that are part of… (1)
iii	Electricity is transmitted at high voltages so that… (1)
4b	In a small transformer • the primary voltage is 230 V • the primary current is 0.020 A • the secondary voltage is 5.0 V Calculate the secondary current. (2) Use the equation $I_s = \frac{V_p \times I_p}{V_s}$
4c	In a small transformer, the primary voltage is 230 V. The secondary current is 0.02 A and the secondary voltage is 4600 V. Calculate the primary current using the equation: $V_p \times I_p = V_s \times I_s$
4d	Explain how an alternating current, in the primary coil, can induce a current in the secondary coil of a transformer. (4)
4e	Compare and contrast the structure of the transformers in questions 4b and 4c. (6)

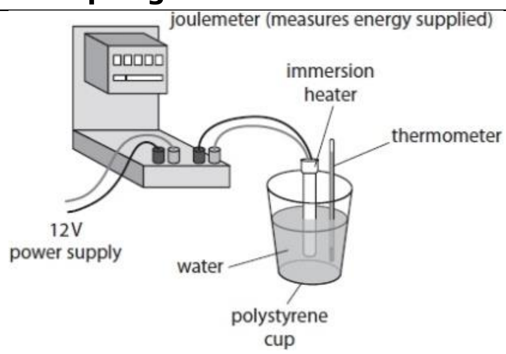
Topic 14 & 15: The Particle Model - Exam Questions

1a	**Which process describes the change from solid to liquid?** (1) A. freezing | B. melting | C. condensation | D. evaporation
1b	**Which of these kelvin temperatures is 0 °C?** (1) A. 273 K | B. 0 K | C. 100 K | D. 293 K
1c	**Which of these words best describes an object that returns to its own shape when a force is removed?** (1) A. flexible | B. inelastic | C. rigid | D. elastic
1d	Describe how to identify a linear relationship between two variables on a graph. (1)
1e	State the equipment used to measure the mass of an object. (1)
2	A student is investigating the density of a metal block and a small stone.
2b	The student found the volume of the metal block by multiplying the area of its base by its height. Describe how the student could measure the volume of the small stone. (3)
2c	The student calculates the volume of the block as 14 cm^3. She finds that the mass of the block is 100 g. Calculate the density of the block in g/cm^3. (2)
2d	The volume of the stone is 250 cm^3 and the mass is 760 g. Calculate the density of the stone in g/cm^3. (2)

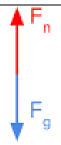
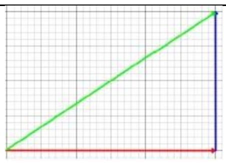


$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

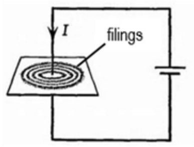
3a	Kinetic theory describes the movement of particles in the three states of matter. Gas is one of the states of matter. Name the other two states of matter. (2)
3b	**The average kinetic energy of the particles in a gas is directly proportional to** (1) A. the pressure of the gas | B. the temperature of the gas in degrees Celsius | C. the temperature of the gas in Kelvin | D. the volume of the gas
3c	 Copy similar boxes and draw the particle model to show how particles are arranged in a solid, liquid and gas. (3)
3d	Use ideas about the particle model to explain why solids and liquids cannot be compressed but liquids can be poured. (3)
3e	A technician takes and ice cube from the freezer and slowly heats it until it becomes a liquid. Explain what would happen to the temperature whilst the ice cube is melting. (3)
3f	The specific latent heat of fusion of is 3.34 x 10^5 J/kg. Calculate the energy needed to melt 350 g of ice. (2) **Energy transferred = specific latent heat x mass**
4	A student has a spring that is 4 cm long and stretches it to 32 cm with 4.48 N of force.
4a	Calculate the extension of the spring, give your answer in metres (2)
4b	Calculate the spring constant of the spring. (3)
4c	Calculate the energy stored in the spring. (2) **Energy = ½ spring constant x extension²**
5a	Describe a method that would allow a student to calculate the specific heat capacity of water using the equipment shown. (4)
5b	State two ways that the apparatus could be adapted to improve the method. (2)
5c	3.36 x 10^4 J of energy is used to heat 400 g of water, changing the temperature by 20 °C. Show that the specific heat capacity of water is 4200 J/kg°C. (3) **Energy = mass x specific heat capacity x temperature change**



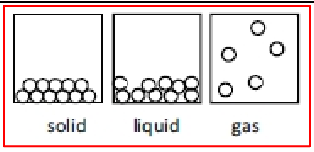
Topic 8 & 9: Energy and Forces - Exam mark scheme

1a	C. Renewable (1)
1b	D. Magnetic (1)
1c	A. Chemically (1)
1d	50 – 38 = **12 J** of energy wasted (1)
1e	Efficiency = useful energy ÷ total input energy (1)
1f	Efficiency = 38 ÷ 50 (1) Efficiency = **0.76** or **76 %** (1) Correct answer on its own gets both marks
2a	Work done = force x distance 2700 = 150 x h (1) 2700 ÷ 150 = h h = **18 m** (1) Correct answer on its own gets both marks
2b	2700 J (1)
2c	KE = ½ m x v^2 2700 = ½ 15 x v^2 (1) 2700 ÷ 7.5 = v^2 (1) v = √360 v = **19 m/s** (1) Correct answer on its own gets all 3 marks
3a	KE = ½ m x v^2 KE = ½ 85 x 1.5^2 (1) KE = 42.5 x 2.25 KE = **95.6 J** (1) Correct answer on its own gets both marks
3b	Work done = force x distance moved 1200 = F x 80 (1) 1200 ÷ 80 = F F = **15 N** (1) Correct answer on its own gets both marks
3c	The work done is the same (1) because work done depends on force and distance only/does not depend on time (1)
3d	GPE = mass x g x height 264 = 12 x 10 x h (1) 264 ÷ 120 = h (1) h = **2.2 m** (1) Correct answer on its own gets all 3 marks
4a	 Upward force labeled as normal contact force or upthrust (1) Downwrads force labeeld as weight or gravity (1) Both arrows same size but opposite directions (1)
4b	The table pushes up on the box (1) With a forces of 250 N (1)
4c	Both examples have forces that are the same size (1) and act in opposite directions (1) Balanced forces act on same object (1) Newton's 3rd law forces act on different objects (1)
4d	 Two vector arrows drawn at right angles (1) with an appropriate scale (1) Line drawn to complete a triangle/parallelogram (1) Resultant force **= 3.6 (±0.2) N** (1)
4e	Arrow drawn at 30° with appropriate scale (1) Horizontal & Vertical components drawn (1) H component = **3.9 (±0.2) N** (1) V componenet = **2.3 (±0.2) N** (1)
5a	Dissipated (spread out into less useful forms) (1) to the surroundings (1)
5b	Use of lubrication/oil (1) to reduce friction (1)
5c	6 marks from: Changing height means that GPE is changing during each swing (1) when height is at highest point so is GPE (1) when height is at lowest point so is GPE (1) During each swing GPE is changed into KE (and back) (1) KE at highest when height is lowest (1) KE at lowest when height at highest (1) Height of swing decreases so max GPE/KE also decreases (1) this is because energy is dissipated (1) to the surroundings (1) due to air resistance/friction (1)

Topic 12 & 13: Magnetic forces - Exam mark scheme

1a	Transformer (1)	
1b	D. Transformers have primary and secondary coils. (1)	
1c	C. cobalt (1)	
1d	C. turn the magnet around (1)	
1e	Move the magnet in the opposite direction (1) turn the magnet around/ put the other pole of the magnet into the coil (1)	
2a	Separate the magnet and the paperclips (1) paperclips are no longer attracted to each other (no longer magnetic) (1)	
2b	Use a compass (1) which will always point in the same direction / will always point north (1)	
2c	A solenoid is a coil of wire (1) with current flowing through it (1)	
2d	The magnetic field is strongest inside the solenoid (1) because the fields add together (1)	
3a	Concentration / amount of iron filings (1) is greatest where the field is strongest (1) at the poles of the magnet (1)	
3b	Use a (plotting) compass (es) (1) mark a dot in the direction the arrow points (1) place at various positions (around the magnet) (1) join the dots to show the shape of the field (1) the direction of the field is the direction the arrow points (1)	
3c	Put the wire through the card (1) put iron filings on the card / around the wire (1) allow current to flow through the wire / connect wire to power source (1) the iron filings will move (1) and show the shape of the magnetic field (1) 	
3d	At least one straight, vertical line from pole to pole (1) At least 4 straight, vertical line from pole to pole (1) Arrow on any line,pointing from north to south (1) any arrow pointing south to north means this third mark can not be given	
4a	Complete the following sentences using the phrases from the right.	
i	Electrical power is generated at… **A power station** (1)	
ii	Electricity is transmitted over long distances by transmission lines that are part of… **The national grid** (1)	
iii	Electricity is transmitted at high voltages so that… **Heat loss is reduced** (1)	
4b	$I_s = \frac{230 \times 0.02}{5.0}$ (1) I_s = **0.92 A** (1)	Accept 0.9 A Correct answer gains both marks
4c	$230 \times I_p = 4600 \times 0.02$ (1) $I_p = \frac{4600 \times 0.02}{230}$ (1) $I_P = 0.4$ A (1)	Correct answer gains all three marks
4d	The alternating current produces a changing magnetic field in the primary coil (1) The magnetic field is strengthened by the iron core (1) The magnetic field produces a changing voltage in the secondary coil (1) The changing voltage produces an (alternating) current in the secondary coil. (1)	
4e	Compare and contrast the structure of the transformers in questions 4b and 4c. (6) Both transformers are made from an iron core (1) with two separate coils of wire (1) The transformer in 4b is a step-down transformer (1) the transformer in 4c is a step-up transformer (1) The step-down transformer has {more turns of wire on the primary coil / less turns of wire on the secondary coil} (1) The step-up transformer has {more turns of wire on the secondary coil / less turns of wire on the primary coil} (1)	

Topic 14 & 15: The Particle Model - Exam mark scheme

1a	B. melting (1)
1b	A. 273 K (1)
1c	D. elastic (1)
1d	The graph will be a straight line (1)
1e	Balance (1)
2b	Fill a displacement can with water (1) place (fully immerse) the stone inside the water (1) volume of water displaced = volume of stone (1) or Part fill a measuring cylinder and record volume (1) fully immerse stone in the cylinder and record new volume (1) Volume of stone = new volume – starting volume (1)
2c	Density = 100 ÷ 14 (1) Density = **7.1 g/cm³** (1) Correct answer gains both marks
2d	Density = 760 ÷ 250 (1) Density = **3.04 g/cm³** (1) Correct answer gains both marks
3a	Solid (1) and liquid (1) Any order
3b	C. the temperature of the gas in Kelvin
3c	 In each box- solid: regular alignment and particles touching (1) liquid: irregular arrangement and most particles touching (1) gas: random and spaced out (1)
3d	3 marks from: In both solids and liquids the particles are (already) touching (1) so they cannot be pushed closer together (1) In a liquid the forces that hold the particles together are weaker (1) so particles are able to move past each other (and be poured) (1) ORA for solids
3e	The temperature would remain {the same / at 0°C} (1) because the energy is being used to weaken bonds (1) rather than make the molecules {vibrate / move} faster (1)
3f	Energy = $3.34 \times 10^5 \times 0.35$ (1) ($3.34 \times 10^5 \times 350$ = 1 mark only) Energy = **117,000 J** (allow 116,900) Correct answer gains both marks
4a	32 – 4 = 28 cm (1) 28 ÷ 100 = **0.28 m** (1)
4b	4.48 = k x 0.28 (1) k = 4.48 ÷ 0.28 (1) k = **16 N/m** (1) Correct answer gains all three marks
4c	Energy = ½ x 16 x 0.28^2 (1) Energy = **0.63 J** (1) Correct answer gains both marks
5a	Measure the {mass / volume} of water (1) Measure the temperature (1) Measure the start and end temperature to find change (1) Measure the energy supplied by the heater (1)
5b	Add a lid (1) Add insulation / lagging (1) Use a stirrer (1) Use a digital thermometer (1)
5c	This is a 'show that' question- so each stage is needed, not just the answer. 3.36×10^4 = 0.4 x SHC x 20 (1) SHC = 3.36×10^4 ÷ (0.4 x 20) (1) SHC = **4200 J/kg°C** (1)