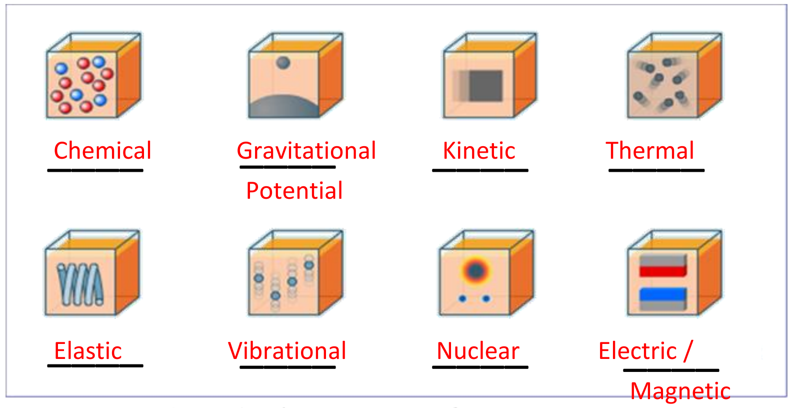
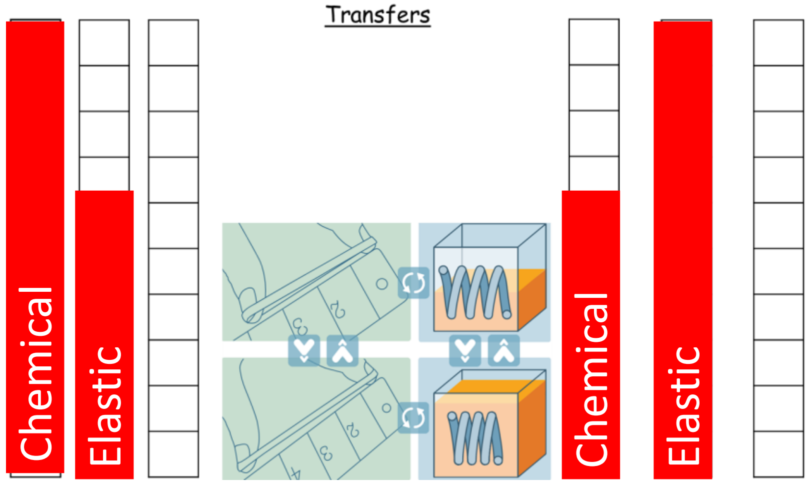
CP8 Revision Mat – Grade 4 - Grade 5



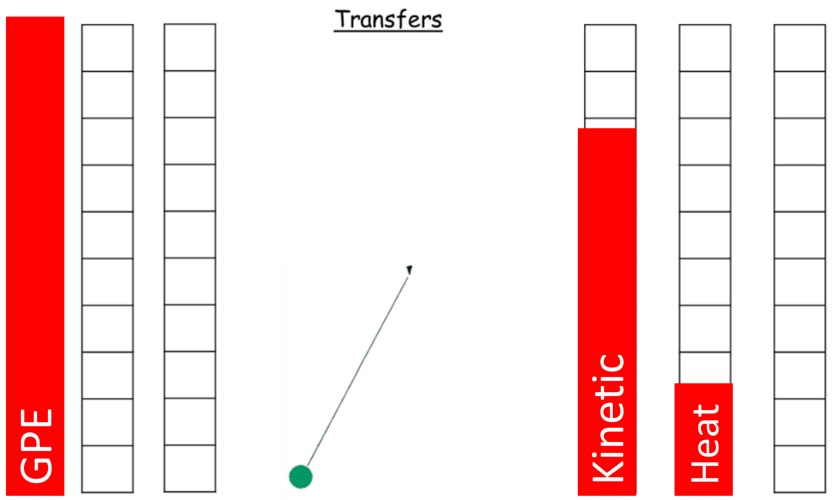
Describe the energy transfers in a stretching elastic band

Energy Store(s) | Transfers | Energy Store(s)

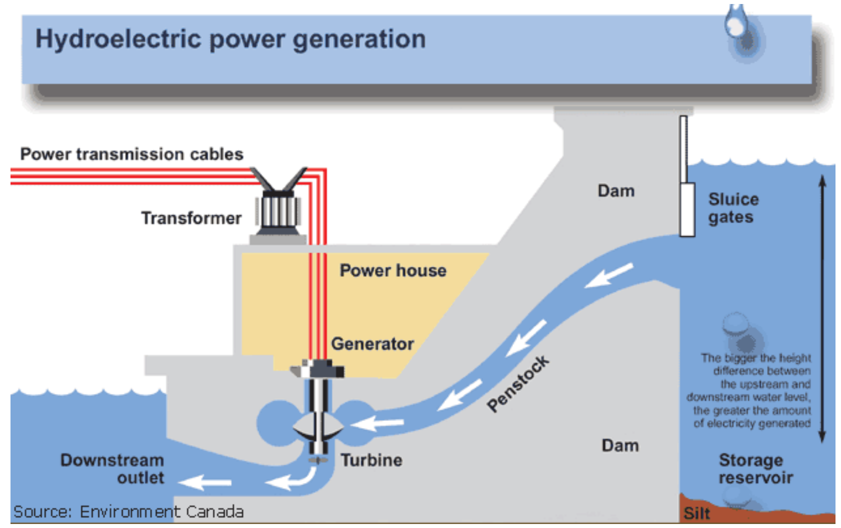


Describe the energy transfers in a swinging pendulum

Energy Store(s) | Transfers | Energy Store(s)



Where there are energy _changes_ in a closed _system_ there is no _change_ to the total _energy_ in that system



Describe the changes involved in the way energy is stored in the system above. Starting at the Sluice Gates on the right. Include the energy stores and transfers at each stage.

At sluice gates, water has gravitational potential energy. When the gates are open the water flows down the penstock. The Gravitational Potential energy is transferred by forces to a kinetic store in the water. Energy is dissipated by friction to a thermal store in the penstock.

The kinetic energy of the water is transferred to the turbine by forces to a kinetic store in the turbine. Energy is dissipated by friction to the thermal store.

The kinetic store of the turbine is transferred by forces in generator and electrically through wires to domestic stores.

Draw a simple box and arrow diagram to show the energy transfers from sluice gates to the penstock; the penstock to the turbine; the turbine to the generator; and the generator to a household electric heater.

- GPE in water → (Force of Gravity) → KE in water
- KE in water → (Mechanical Forces) → KE in turbine
- KE in turbine → (Mechanical Forces) → KE in Generator
- KE in Generator → (Electrical Work) → Thermal Store in Heater

Mr McKelvie was pushing a box over the ground, filled with test papers to mark. He pushed it from 2S2 to 2S6. Describe how to measure the work done including the calculation needed.

Work done (J) = Force (N) x Distance (m)

Calculate the work done to move the box using a newtonmeter or calculating the frictional forces on the bottom of the box.

Measure the distance using a trundle wheel or tape measure.

USE E=F x d to calculate the energy transferred..

Mr McKelvie had to use more force than was needed to push the box over the floor. If the distance was 24m and the mass was 85Kg. Why did Mr McKelvie need 2200N of force to push the box.

Frictional forces will be acting against the movement of the box.

More energy will be needed to move the box because the frictional forces will work against the movement of the box.

Explain what Mr McKelvie could have done to reduce the amount of work needed to push the box along the corridor?

Lubricate the bottom of the box or the corridor

To reduce the effects of friction

Explain the term dissipated.

Dissipation is the transfer of energy from one store, to a less useful store in the environment.

Explain what happens to dissipate energy in an engine and what the effect of that dissipation is.

In an engine, surfaces are in contact and moving over each other.

The result of the contact is a transfer of kinetic energy to thermal energy by frictional forces.

This thermal energy store is dissipated to the environment by heating.

This reduces the efficiency of the engine

Define the term power and explain the difference between work and power.

Power is the amount of energy transferred in a particular amount of time.

Work is the amount of energy transferred.

Power can also refer to the amount of work done, in a certain amount of time.

The unit of power is Watts, the unit of work is Joules.

11	W = F x d	d	Distance Moved in Direction of Force	m
		F	Force	N
		W	Work Done	J

d	F	W
6	50	300
15	8	120
1.5	**85.3**	128
150	**240**	36 000
12	5	**60**
2.5	50	**125**

d	F	W
800	125	100 000
30.6	200	6120
135	**30**	4050
0.003	**2000**	6
0.5	750	**375**
3.75	7.2	**27**

Work Done

a. 140 J

b. 4 N

c. 4×10^{4} m

12	$P = \frac{E}{t}$	E	Energy Transferred	J
		P	Power	W
		t	Time	s

E	P	t
150	50	3
15000	1000	15
4800	**40**	120
7440	**531.4**	14
96	3	**32**
110	550	**0.2**

E	P	t
1300.8	24	54.2
878.92	120.4	7.3
842 240	**4812.8**	175
4650	**375**	12.4
1311	43	**30.49**
66 500	536	**124.07**

Power & Energy

a. 1.5 W

b. 3.166.67 s

c. 43200 J

Power & Work

a. 20 W

b. 0.3 s

c. 2 400 000 J (2 400 KJ)

Energy Transferred & Power

a. 360 J

b. 4 s

c. 8809.52 W

CP9 Revision Mat – Grade 4 - Grade 5

Describe how the following forces interact including the action reaction pairs. Use labelled force diagrams in your answers:

A satellite orbiting Mars.

The gravitational pull of mars on the satellite is equal to the force of gravity of the satellite on Mars. The interactions are equal in magnitude and opposite in direction.

A negatively charged balloon sticking to a wall

The contact force of the balloon on the wall is equal to the contact force of the wall on the balloon. The negative charge of the balloon on the wall is equal to the induced positive charge of the wall on the balloon. The interactions are equal in magnitude and opposite in direction.

A magnet stuck on a fridge

The contact force of the magnet on the fridge is equal to the contact force of the fridge on the magnet. The magnetic force of the magnet o the fridge is qual to the induced magnetic force of the fridge on the magnet. The interactions are equal in magnitude and opposite in direction.

A mug resting on a table

The contact force of the mug on the table is equal to the contact force of the table on the mug. The gravitational pull of the earth on the mug is equal to the gravitational force of the mug on the earth. The interactions are equal in magnitude and opposite in direction.

A box being pushed along the floor.

The contact force of the floor on the box is equal to the contact force of the box on the floor. The frictional force of the surface of the floor is equal to the thrust force of the box on the surface on the floor. The interactions are equal in magnitude and opposite in direction.

Explain why forces are represented as vectors while scalar objects are not including examples.

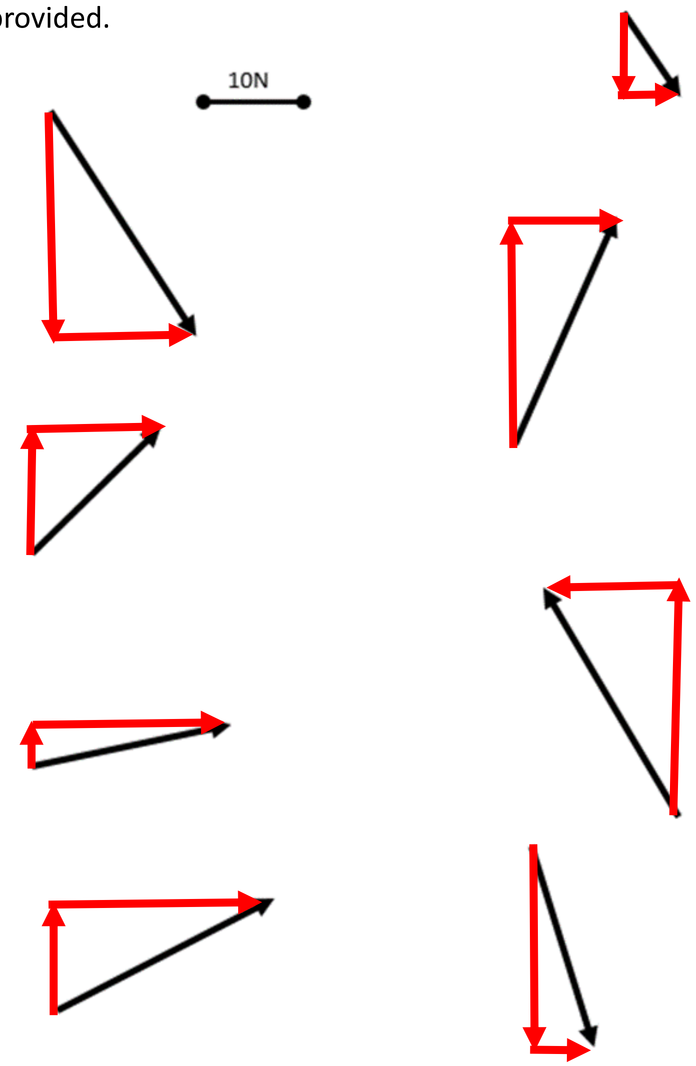
Forces always have a direction and a magnitude. Vectors have a direction and a magnitude. Scalars only have magnitude and no direction. Forces are therefore vectors.

Explain how to reduce the effects of friction on objects that are being affected by contact forces.

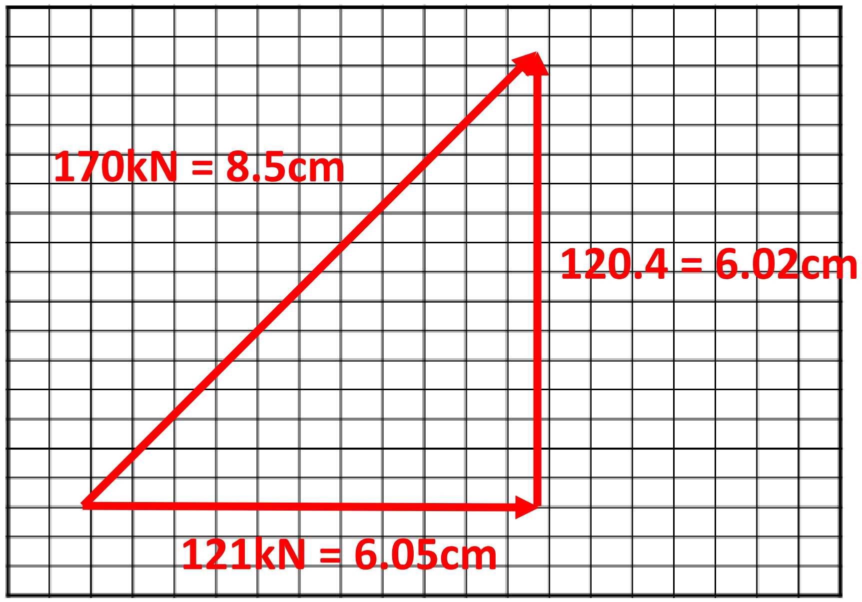
Reduce the weight acting on the surface by reducing the mass of the object.

Add a lubricant between the surfaces, to reduce the interlocking of surfaces.

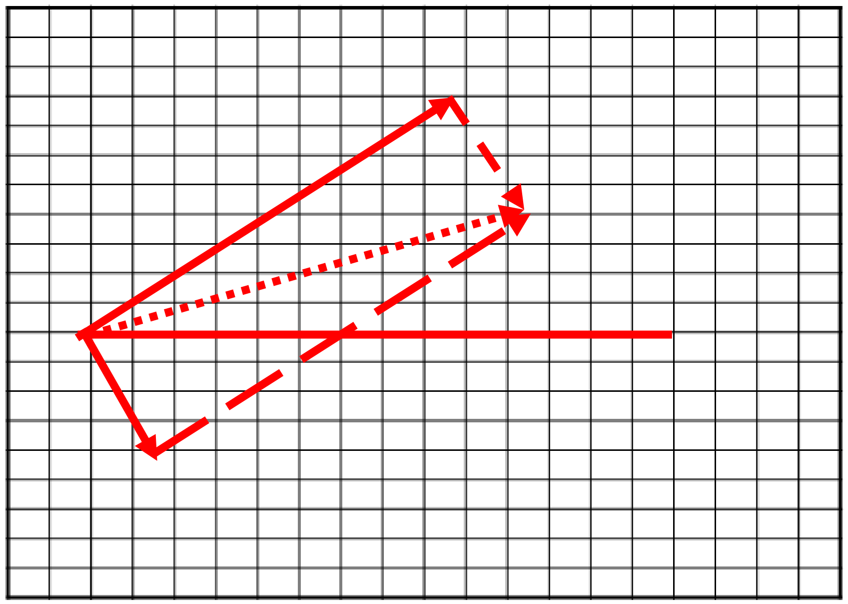
Resolve the forces below using the scale provided.



The F-25 Raptor takes off at an angle of 45^0 with a force of 170kN. Use a scale drawing to calculate the vertical and horizontal components of the resultant force.



The wind at an airport was blowing 50^0 compared to the runway with a force of 150kN. The engine gives out 60KN of force 60^0 from the runway. What is the resultant force? Explain if the plane will land safely.



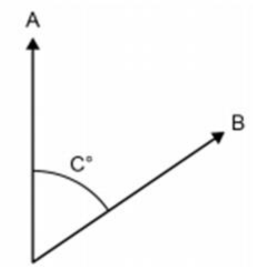
The plane will not land safely, because the resultant force of 173.1kN is not in line with the runway as shown in the scale drawing.

1 The diagram shows two forces at an angle. Draw **scale diagrams** to work out the size and direction of the **resultant force** if:

a A = 50 N, B = 25 N, C = 90°

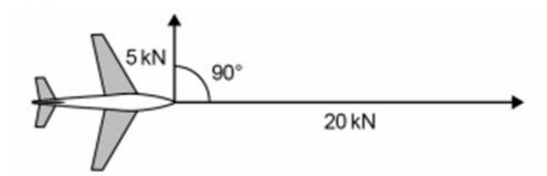
b A = 100 N, B = 40 N, C = 60°

c A = 20 N, B = 50 N, C = 40°

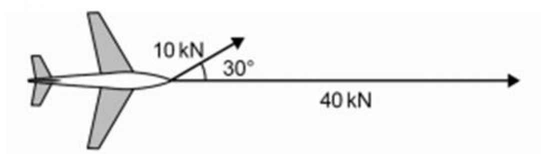


2 The diagrams show aeroplanes flying in different wind conditions.

a



b



For each aeroplane:

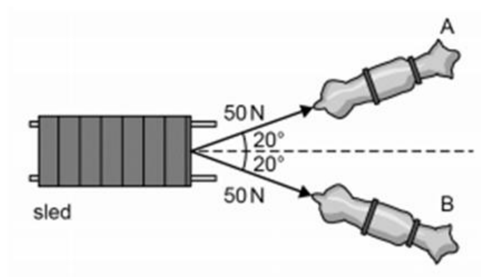
- explain the approximate direction in which the resultant force acts
- draw a scale diagram to help you work out the size and direction of the resultant force
- give the direction of the resultant as an angle from the direction in which the aeroplane is pointing.

3 The diagram shows a sled being pulled by two dogs. The sled is moving along the direction shown by the dotted line.

a Explain in which direction the resultant force is acting.

b Suggest approximately what size you expect the resultant force to be. Explain your reasoning.

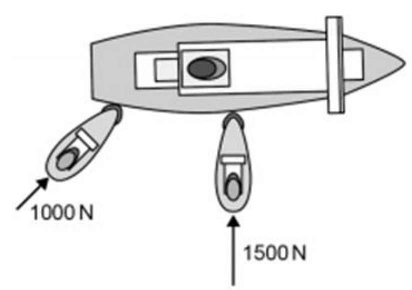
c Draw a scale diagram to help you work out the size and direction of the resultant force.



4 Two tug boats are pushing a ship. The angle between the two 'pushes' is 45°.

a What approximate size and in what approximate direction do you expect the resultant force to be? Explain your answer.

b Draw a scale diagram to help you work out the size and direction of the resultant force.



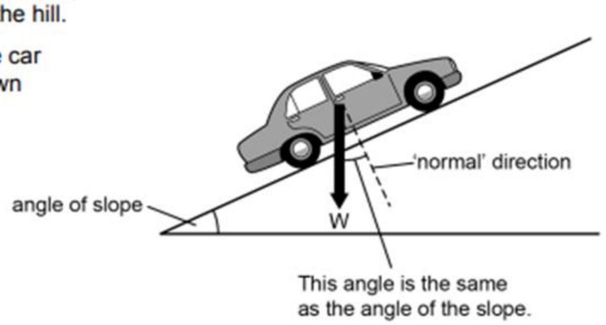
5 When a car is driven up a hill, part of its weight is acting normal to the surface, and part is acting to pull it down the hill.

Use scale diagrams to **resolve** the weight of the car into **components** normal to the surface and down the hill for these conditions.

a weight = 1200 N, angle = 10°

b weight = 2000 N, angle = 5°

c weight = 1500 N, angle = 20°



6 A skier is going down a steep slope that is at an angle of 60° to the horizontal. The weight of the skier and her skis is 800 N.

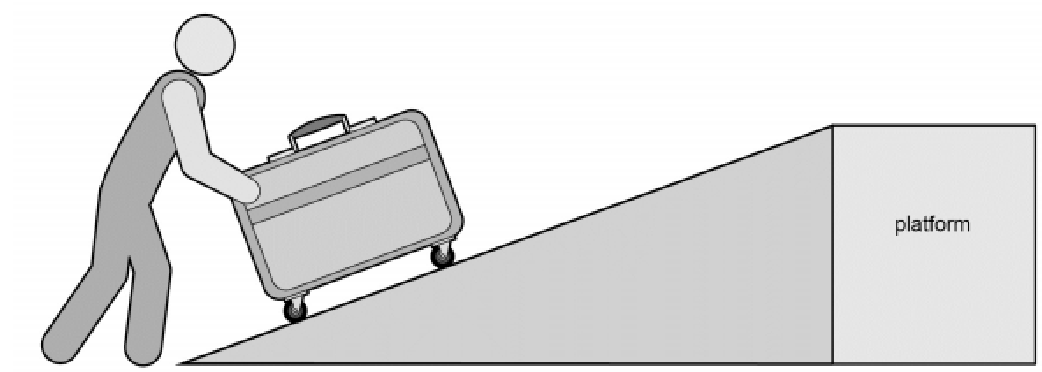
a Draw a sketch to show the slope and the direction in which the skier's weight is acting.

b Draw a scale diagram to help you work out the component of the skier's weight that is acting to accelerate her down the hill.

c How big would the force pulling the skier down the hill be if the angle of the slope were only 30°? (You need to draw another scale diagram to work this out.)

Ramps can make it easier to lift things.

The weight of the object being moved acts vertically downwards, but the person pushing it only needs to exert a force equal to the component of the weight acting down the ramp.



7 Draw scale diagrams to work out the force needed to push the suitcases below.

a weight = 1000 N, angle of ramp = 15°

b weight = 500 N, angle of ramp = 35°

1 Answers will depend on the accuracy of students' drawings, but should be close to the following values.

a 56 N at an angle of 27° to A

b 126 N at an angle of 16° to A

c 68 N at an angle of 29° to A

2 a The resultant will act between the two forces shown, closer to the direction of the 20 kN force than the 5 kN force.

The resultant is 21 kN at an angle of 14° from the direction the aeroplane is pointing.

b The resultant will act between the two forces shown, closer to the 40 kN force than the 10 kN force.

The resultant is 48 kN at an angle of 6° from the direction the aeroplane is pointing.

3 a Along the direction the sled is moving – if it is the only force on the sled, the force and the direction of movement must be the same (or the forces are symmetrical about the line of movement, so the resultant must be along that line).

b If the two forces were in line, the resultant would be 100 N; as they are at an angle it must be a bit less than this. Accept answers between 80 N and 95 N.

c resultant = 90 N

4 a The resultant will be at an angle to the right of vertical on the diagram. Its size will be less than the sum of the two forces – accept estimates between 2000 N and 2400 N.

b resultant = 2317 N at an angle of 18° to the right of the line of the 1000 N force

5 a normal component = 1182 N, component along slope = 208 N

b normal component = 1992 N, component along slope = 104 N

c normal component = 1409 N, component along slope = 513 N

CP10 Revision Mat – Grade 4 - Grade 5

Name	Definition	Equation symbol	Unit	Unit Symbol
Energy transferred	Energy converted from one form to another	E	joules	J
Charge flow	Relative amount of charge moved in a given time period	Q	coulombs	C
Power	Rate of energy transfer	P	watts	W
Potential difference	Energy transferred per unit charge	V	volts	V
Resistance	Anything that opposes flow of electric charge	R	ohms	
Current	Rate of flow of electric charge	I	amps	A
Time		t	seconds	s

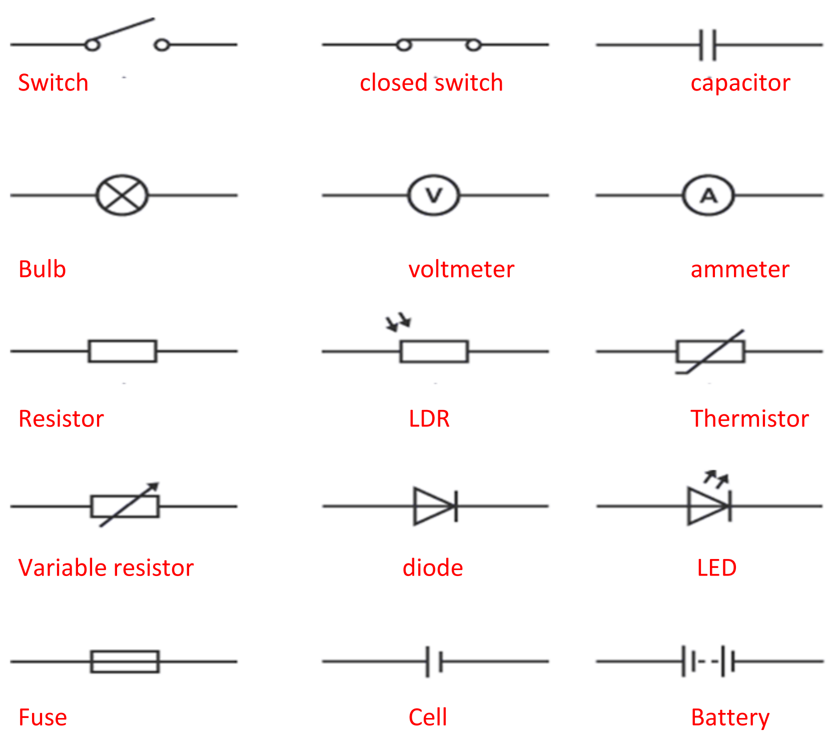
Describe the structure of the atom, including all the subatomic particles, their mass, charge and location.

Neutron – nucleus, neutral charge, relative mass 1

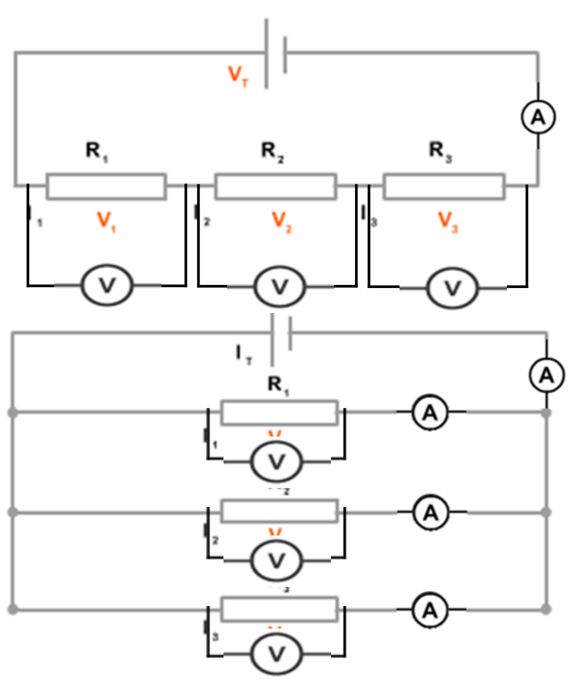
Proton – nucleus, positive charge, relative mass 1

Electron – orbits / shells, negative charge, relative mass 0

Label the circuit symbols:



Draw two circuits, one series and one parallel. Include two resistors, 3 ammeters (per branch from parallel) and a voltmeter over each resistor..



Compare the voltage, current and resistance in series and parallel circuits. Use general equations were possible.

Series

$I_{tot} = I_1 = I_2 = I_3 \ldots$

$V_{tot} = V_1 + V_2 + V_3 \ldots$

$R_{tot} = R_1 + R_2 + R_3 \ldots$

Parallel

$I_{tot} = I_1 + I_2 + I_3 \ldots$

$V_{tot} = V_1 = V_2 = V_3$

$R_{tot} = 1/R_1 + 1/R_2 + 1/R_3$

Explain why, if two resistors are in series, the net resistance is increased, whereas with two in parallel the net resistance is decreased

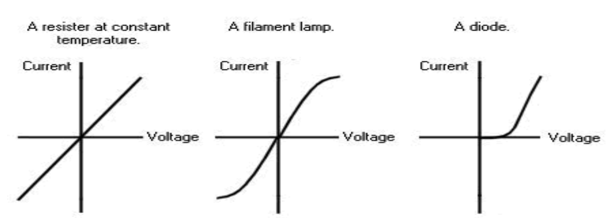
Explain how to design circuits to test the current, voltage and resistance in series and parallel circuits.

Current: ammeter in series with each component

Voltage: voltmeter in parallel around each component

Resistance: R = V/I using ammeter and voltmeter readings OR ohmmeter

Complete the graphs and explain the trends seen for Ohmic resistors, filament lamps and diodes.



Ohmic resistor: V = I x R, so current is directly proportional to voltage for a resistor with a constant resistance

Filament lamp: As current increases temperature increases. As temperature increases, resistance increases. V = I x R, so resistance = 1/gradient, so the graph curves and flattens as current increases.

Diode: Current only flows in one direction through a diode.

Describe how the resistance changes for LDRs and Thermistors.

LDR:

As light intensity increases resistance decreases

Thermistor:

As temperature increases resistance decreases

Explain the term "resistance". Fully.

Resistance is opposition to the flow of electric charge

As electrons move through a component they collide with the ions in the component transferring energy to the ions

This decreases the current (flow of electric charge)

Series:

When another resistor is added in series, the **total circuit p.d.** is shared across more resistors

So the p.d. **across each resistor** is lower

A lower p.d. across each resistor means a lower current through **each resistor**

In series, current is the same at all places in the circuit

So **total circuit current** must have decreased

As resistance is anything which decreases current, the **total circuit resistance** must have increased

Parallel:

Adding another loop in parallel gives the current another path to flow down

So more current can flow

So **total circuit current** must have increased

So the **total circuit** resistance must have decreased

14	E = Q x V			
		Q	Charge	C
		E	Energy Transferred	J
		V	Potential Difference	V

Q	*E*	*V*	*Q*	*E*	*V*
22.9	16800	734	0.015	0.23	15.1
208	500 000	2400	95.9	175 000	1825
2.4	7.2	3	785	3925	5
3	51	17	4.3	6.45	1.5
27	15	0.56	74	239	3.23
0.6	72	120	30	600	20

- Electrical energy transferred and charge:
  a. Calculate the energy transferred by 4.0C in 6.0s. 4 x 6 = 24 J
  b. How much charge must flow through 8.0V to do 4.0J of work? $\frac{4}{8}$ = 0.5 C
  c. A spark transfers 0.20μC of charge doing 0.040J of work – what was the p.d.? $\frac{0.04}{0.0000002}$ = 200 000 V

15	Q = I x t			
		Q	Charge	C
		I	Current	A
		t	Time	s

Q	*I*	*t*	*Q*	*I*	*t*
171	3	57	1.61	0.015	107
780	13	60	261	10.2	25.6
180	10	18	0.0155	2.07	0.0075
0.6	0.017	36	10.8	0.199	54.2
160	0.4	400	0.50	0.04	12.5
40	0.7	57.1	560	3.2	175

- Charge flow:
  a. Calculate the charge carried by a current of 2.0A in 6.0s. 2 x 6 = 12 C
  b. How long will it take a current of 10A to transfer 200C of charge? $\frac{200}{10}$ = 20 s
  c. What current flows from a mobile phone's battery if it transfers 300C per hour? $\frac{300}{60 \times 60}$ = 0.083 A

16	V = I x R			
		I	Current	A
		V	Potential Difference	V
		R	Resistance	Ω

I	*V*	*R*	*I*	*V*	*R*
3	9	3	13.5	230	17
0.0167	2	120	0.012	230	19 000
0.5	9	18	450	14,850	33
0.25	0.30	1.2	0.025	32.5	1300
2	6	3	0.05	350	7,000
3	18	6	32	42 000	1310

- "Ohm's Law"
  a. Calculate the potential difference across a 3.0Ω resistor with 4.0A flowing through. 2 x 6 = 12 C
  b. What is the resistance of a 230V lamp with 0.25A flowing in it? $\frac{230}{0.25}$ = 920 Ω
  c. A 4.7kΩ resistor is connected to a 1.5V cell. How much current flows? $\frac{1.5}{4700}$ = 0.00032 A

17	P = I x V			
		I	Current	A
		P	Electric Power	W
		V	Potential Difference	V

I	*P*	*V*	*I*	*P*	*V*
4500	9000	2	60	15000	250
110	55	0.5	2000	24 000	12
4	9	2.25	0.05	225	4500
6	225	37.5	850	17000	20
1.4	4.2	3	6.1	1403	230
0.2	0.25	1.25	1.2	6.16	5.13

- Electrical power and p.d.:
  a. Calculate the power of a 230V lamp with 0.25A flowing in it. 230 x 0.25 = 57.5 W
  b. What p.d. is needed across a 0.040W LED to cause a current of 0.020A? $\frac{0.04}{0.02}$ = 2 V
  c. A 3kW kettle is connected to the mains. How much current will flow? $\frac{3000}{230}$ = 13 A

18	$P = I^2 \times R$			
		I	Current	A
		P	Electrical Power	W
		R	Resistance	Ω

I	*P*	*R*	*I*	*P*	*R*
3	36	4	0.2	2.4	60
0.5	6	24	0.229	52.4	1000
0.8	9.6	15	0.21	11.5	260
0.4	0.32	2	0.004	528	33×10^6
2	1280	320	3.2	4813	470
4	53	3.3	0.89	375	473

- Electrical power and resistance:
  a. Calculate the power of a 16Ω resistor with 4.0A flowing through it. 4 x 4 x 16 = 256 W
  b. What is the resistance of a 1200W heater when 3A flows? $\frac{1200}{3 \times 3}$ = 133 Ω
  c. How much current flows through a 2.0mW LED with a resistance of 0.50Ω? $\sqrt{\frac{0.002}{0.5}}$ = 0.063 A

24	$E = V \times I \times t$			
		I	Current	A
		E	Energy	J
		V	Potential Difference	V
		t	Time	s

I	*E*	*V*	*t*
250	0.6	240	10×10^{-6}
3.8	54 300	11.9	1200
0.25	90000	5	72×10^3
1.5	5400	30	120
40×10^{-3}	8.6	1.19	180
2.55	195	4.50	17
50×10^{-3}	9.94×10^5	230	86400
3.5	1890	12	45

CP10 Revision Mat – Grade 4 - Grade 5

Explain what happens when there is a current moving through a resistor (use the keywords dissipate, ions, transfer and work).

Electrons collide with metal ions in the resistor, transferring energy to the ions. This causes the ions to vibrate more, so the resistor heats up.

The electrons have to do work (transfer energy) against the resistance of the resistor. Some of this energy is dissipated to the thermal energy stores of the resistor.

Explain how to reduce unwanted energy transfers through wires.

- Increasing the voltage decreases the current so less energy is wasted
- Using a lower resistance wire decreases the energy wasted overcoming resistance

Describe the advantages and disadvantages of the heating effect of an electric current.

Advantages:

- Heating effect can be useful, e.g. in a toaster, kettle, electric heater

Disadvantages:

- Reduces the efficiency, which can increase the cost
- Too great a heat will melt components in the circuit

Describe the energy transfers below, you may use a labelled diagram:

A battery powered torch

Chemical → (Radiation) → Thermal

A mains powered fan

Electrostatic → (Electrically) → Kinetic

Electrostatic → (Electrically) → Thermal

A battery powered toothbrush

Chemical → (Electrically) → Kinetic

A mains powered washing machine.

Electrostatic → (Electrically) → Kinetic

Describe the difference between A.C and D.C. current.

A.C. charges constantly change direction, D.C. charges move only in one direction.

A.C. is produced by an alternating voltage, D.C. is produced by a direct voltage.

Describe the UK domestic energy supply in terms of current, voltage and frequency.

Alternating current (A.C.)

Voltage of 230 V

Frequency of 50 Hz

Explain the difference between the live and neutral wires in domestic mains input wires.

- Electricity flows **in** through the live wire, **out** through the neutral wire
- Live wire is brown, neutral wire is blue
- Live wire alternates between +230 V and -230 V, neutral wire is always at 0 V

Explain the function of the earth wire.

Earth wire provides a low resistance path to earth

In case of a fault (e.g. live wire touches casing) the current is carried away along the earth wire

This is a very low resistance path so a very big current flows, melting the fuse and breaking the circuit

This is for safety (stops casing from becoming live) and to protect the plug wiring

Explain the function of fuses and circuit breakers.

If a large current (surge) flows through the circuit the fuse will melt/circuit breaker will trip

This breaks the circuit and cuts off the live supply

This prevents risk of fire or electric shock

Explain why switches and fuses should be connected in the live wire of the domestic circuit.

So that when the fuse melts/circuit breaker trips it cuts off the live supply

So the casing does not become live

Describe the potential differences in a properly wired mains plug.

Between the live and neutral wire: 230 V

Between the live and earth wire: 230 V

Between the neutral and earth wire: 0 V

Explain the dangers of providing any connection between the live wire and earth.

The earth is at 0 V

The live wire is at 230 V

The potential difference between the live wire and earth is large (230V)

So if they connect a large current will flow

This could cause a fire or electric shock1

Describe the relationship between power ratings and the changes in stored energy when they are in use.

The power rating tells you the maximum amount of energy transferred between stores per second when an appliance is in use

800W

Store Electrostatic → 800 J transferred per second by electrical work → Store Thermal

1500W

Store Electrostatic → 1500 J transferred per second by electrical work → Store Thermal

500W

Store Electrostatic → 500 J transferred per second by electrical work → Store Kinetic

14 E = Q x V

Q	Charge	C
E	Energy Transferred	J
V	Potential Difference	V

Q	E	V	Q	E	V
22.9	16800	734	0.015	0.23	15.1
208	500 000	2400	95.9	175 000	1825
2.4	7.2	3	785	3925	5
3	51	17	4.3	6.45	1.5
27	15	0.56	74	239	3.23
0.6	72	120	30	600	20

- Electrical energy transferred and charge:
  a. Calculate the energy transferred by 4.0C in 6.0s. 4 x 6 = 24 J
  b. How much charge must flow through 8.0V to do 4.0J of work? $\frac{4}{8}$ = 0.5 C
  c. A spark transfers 0.20µC of charge doing 0.040J of work – what was the p.d.? $\frac{0.04}{0.0000002}$ = 200 000 V

15 Q = I x t

Q	Charge	C
I	Current	A
t	Time	s

Q	I	t	Q	I	t
171	3	57	1.61	0.015	107
780	13	60	261	10.2	25.6
180	10	18	0.0155	2.07	0.0075
0.6	0.017	36	10.8	0.199	54.2
160	0.4	400	0.50	0.04	12.5
40	0.7	57.1	560	3.2	175

- Charge flow:
  a. Calculate the charge carried by a current of 2.0A in 6.0s. 2 x 6 = 12 C
  b. How long will it take a current of 10A to transfer 200C of charge? $\frac{200}{10}$ = 20 s
  c. What current flows from a mobile phone's battery if it transfers 300C per hour? $\frac{300}{60 \times 60}$ = 0.083 A

16 V = I x R

I	Current	A
V	Potential Difference	V
R	Resistance	Ω

I	V	R	I	V	R
3	9	3	13.5	230	17
0.0167	2	120	0.012	230	19 000
0.5	9	18	450	14,850	33
0.25	0.30	1.2	0.025	32.5	1300
2	6	3	0.05	350	7,000
3	18	6	32	42 000	1310

- "Ohm's Law"
  a. Calculate the potential difference across a 3.0Ω resistor with 4.0A flowing through. 2 x 6 = 12 C
  b. What is the resistance of a 230V lamp with 0.25A flowing in it? $\frac{230}{0.25}$ = 920 Ω
  c. A 4.7kΩ resistor is connected to a 1.5V cell. How much current flows? $\frac{1.5}{4700}$ = 0.00032 A

17 P = I x V

I	Current	A
P	Electric Power	W
V	Potential Difference	V

I	P	V	I	P	V
4500	9000	2	60	15000	250
110	55	0.5	2000	24 000	12
4	9	2.25	0.05	225	4500
6	225	37.5	850	17000	20
1.4	4.2	3	6.1	1403	230
0.2	0.25	1.25	1.2	6.16	5.13

- Electrical power and p.d.:
  a. Calculate the power of a 230V lamp with 0.25A flowing in it. 230 x 0.25 = 57.5 W
  b. What p.d. is needed across a 0.040W LED to cause a current of 0.020A? $\frac{0.04}{0.02}$ = 2 V
  c. A 3kW kettle is connected to the mains. How much current will flow? $\frac{3000}{230}$ = 13 A

18 $P = I^2 \times R$

I	Current	A
P	Electrical Power	W
R	Resistance	Ω

I	P	R	I	P	R
3	36	4	0.2	2.4	60
0.5	6	24	0.229	52.4	1000
0.8	9.6	15	0.21	11.5	260
0.4	0.32	2	0.004	528	33×10^6
2	1280	320	3.2	4813	470
4	53	3.3	0.89	375	473

- Electrical power and resistance:
  a. Calculate the power of a 16Ω resistor with 4.0A flowing through it. 4 x 4 x 16 = 256 W
  b. What is the resistance of a 1200W heater when 3A flows? $\frac{1200}{3 \times 3}$ = 133 Ω
  c. How much current flows through a 2.0mW LED with a resistance of 0.50Ω? $\sqrt{\frac{0.002}{0.5}}$ = 0.063 A

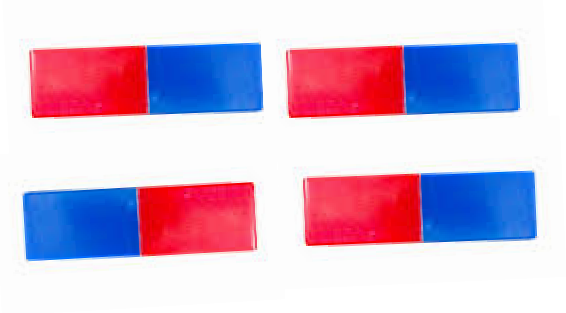
24 $E = V \times I \times t$

I	Current	A
E	Energy	J
V	Potential Difference	V
t	Time	s

I	E	V	t
250	0.6	240	10×10^{-6}
3.8	54 300	11.9	1200
0.25	90000	5	72×10^3
1.5	5400	30	120
40×10^{-3}	8.6	1.19	180
2.55	195	4.50	17
50×10^{-3}	9.94×10^5	230	86400
3.5	1890	12	45

CP12 Revision Mat – Grade 4 - Grade 5

Annotate the diagram and indicate of the magnets will attract or repel.



Describe the uses of permanent and temporary magnetic materials including cobalt, steel, iron and nickel

Permanent magnets:

- Fridge doors (magnetic strip to keep the door closed)
- AC (electricity) generators

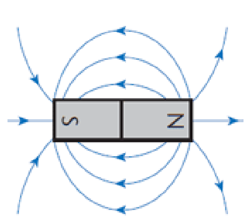
Temporary magnets:

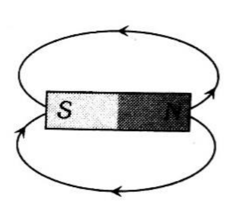
- Cranes / magnetic separators
- Doorbells
- Maglev trains
- MRI machines

Explain the difference between permanent and temporary magnets.

- Permanent magnets produce their own magnetic field all the time
- Temporary magnets only produce a magnetic field while they're in another magnetic field. When you take away the magnetic field the temporary magnet quickly loses its field.

Describe the shape and direction of the magnetic field around bar magnets. Draw and annotate a bar magnet showing a strong magnetic field and a weak magnetic field.





Magnetic field goes from north to south around magnet
Field is strongest at the poles
Field gets weaker the further away from the magnet you get

Describe how to show the shape of a magnetic field around bar magnet using a plotting compass and iron fillings.

Place a magnet on the table; cover it with a blank sheet of paper
Use a salt/pepper shaker to scatter iron filings over the paper

Put a magnet in the centre of a piece of blank paper; draw around it
Place a plotting compass on the paper near the magnet
Mark with a pencil the direction the compass is pointing
Move the compass to the tail end of the needle and repeat

Describe how to show the shape of a magnetic field around the Earth using a compass.

Take a compass
Stand in open ground away from any buildings/magnets that could affect the reading
Compass needle will point to magnetic north
Repeat in different areas

Describe how to show that a current can create a magnetic effect around a long straight conductor, include the shape and direction of the magnetic field.

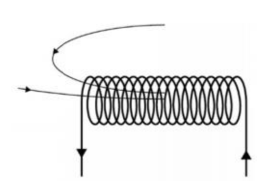
Suspend a long straight conductor using a clamp stand
Run a current through the conductor
Move a compass around conductor
Needle points in direction of magnetic field

Describe the factors that effect the strength of the magnetic field around a long straight conductor with a current flowing through it.

Size of the current through the conductor
The greater the current the stronger the magnetic field

Distance from conductor
The greater the distance from the conductor the weaker the magnetic field

Annotate the diagram to show the shape of the magnetic field around a solenoid. Describe the shape and strength of the magnetic field.



Inside the solenoid:
The magnetic field lines are close together and in one direction
So the field is strong and uniform

Outside the solenoid:
The field is weak apart from at the ends of the coil

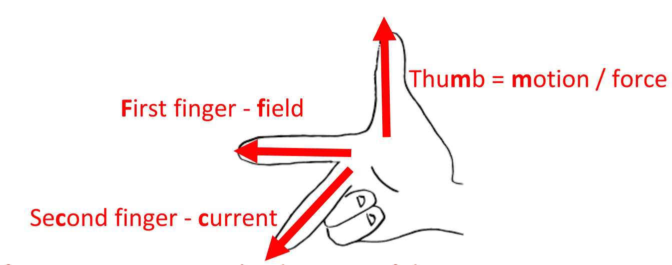
Describe the force interaction between a magnet and a current carrying conductor, refer to Newton's third law in your answer.

When a current carrying conductor is placed in a magnetic field it experiences a force perpendicular to the electric and magnetic fields causing the force
The direction of the force can be found using Fleming's left hand rule
Newton's third law: if object A exerts a force on object B, object B exerts a force equal in magnitude and opposite in direction on object A
So the current carrying conductor also exerts a force on the magnet, equal in magnitude but opposite in direction

Explain the causes of magnetic forces referring to magnetic fields.

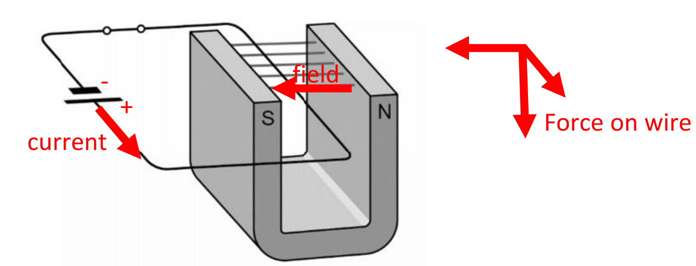
Place two **opposite** poles near each other and their field lines will align to create a strong uniform field
So the magnets attract/move towards each other
Place two **like** poles near each other and their field lines will bend away from each other
So the magnets repel/push away from each other

Annotate the diagram and describe Fleming's left-hand rule.



First finger – point in the direction of the permanent magnetic field (North to South)
Second finger – point in the direction of the current through the wire
Thumb – then points in the direction of the force so the direction the wire will move

Annotate the diagram and explain the directions of the forces on the wire and the magnet and compare their sizes.



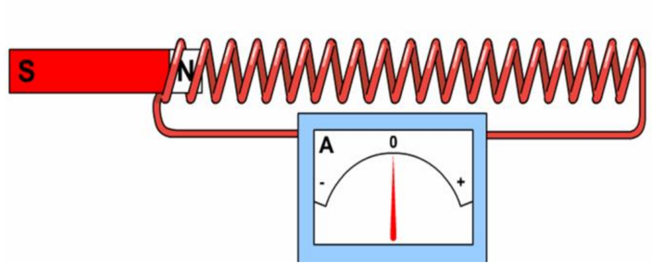
Fleming's left hand rule shows that the force on the wire acts downwards
Newton's third law: if object A (magnet) exerts a force on object B (wire) then object B exerts a force **equal in size** and **opposite in direction** on object A
So the wire exerts a force upwards on the magnet (**opposite in direction**)
And of equal size (**equal in size**)
a = F/m (Newton's 2nd law). F is the same for both the wire and magnet, but the magnet has a greater mass so will experience a smaller acceleration.

25	$F = B \times I \times l$	I	Current	A
		F	Force on a Conductor in a Magnetic Field	N
		l	Length	m
		B	Magnetic Flux Density	T

I	F	l	B
13.34	18	7.1	0.19
5.45	0.09	0.05	0.33
8.0	0.64	0.40	0.20
2.1	0.0315	0.30	0.05
0.19	0.4	1.4	1.5
4.3	12	39.9	0.07
12	8.4	4.7	0.15
5	0.024	0.06	0.08

CP13 Revision Mat – Grade 4 - Grade 5

Describe the factors that affect the size and direction of the induced potential difference from the diagram below.



The strength of the magnet will induce a larger potential difference.

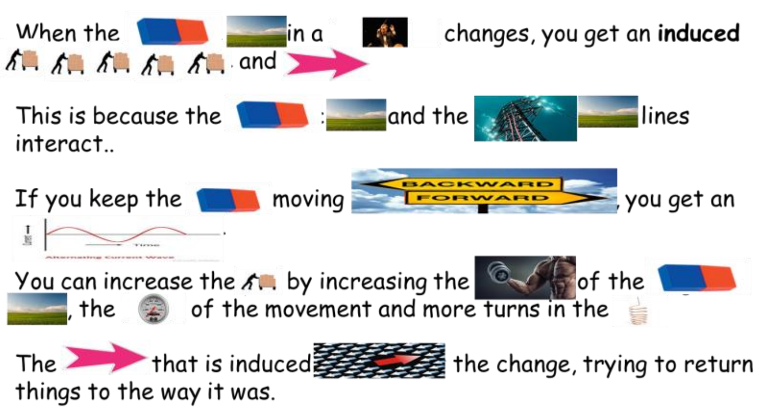
More turns on the coil will induce a larger potential difference.

Moving the magnet through the coil faster will induce a larger potential difference.

Moving it from left-to-right will induce a negative potential difference.

Moving it from right-to-left will induce a positive potential difference.

Use the pictures to describe the factors that affect induced potential difference.



When the magnetic field in a conductor changes, you get an induced potential difference and current.

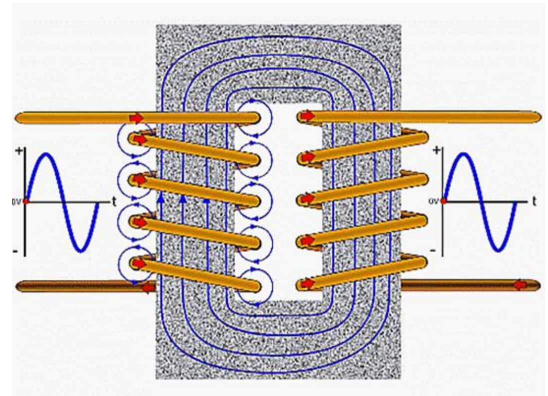
This is because the magnetic field and the electric field lines interact.

If you keep the magnet moving backwards and forwards, you get an alternating current.

You can increase the potential difference by increasing the strength of the magnetic field, the speed of the movement and more turns in the coil.

The current that is induced opposes the change, trying to return things to the way it was.

Explain how an alternating current in one circuit can induce an alternating current in another circuit in a transformer.



The coil of the circuit in the primary coil is carrying an alternating current, which produces an alternating magnetic field.

Iron is a magnetic material, so the iron core gains a magnetic field, which is alternating as the magnetic field of the coil is also alternating.

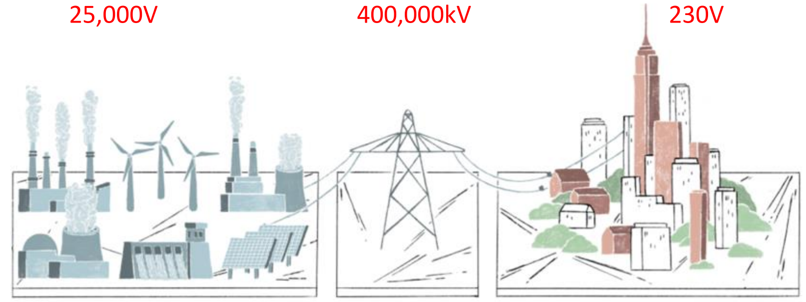
The change in the magnetic field, because it is alternating, means an alternating potential difference is induced in the secondary coil.

This potential difference induces an alternating current.

The potential difference is the same on each coil as they have the same number of turns.

Annotate the diagram to show the size of the potential difference at the production stage, the transmission stage and the domestic stage.

25,000V 400,000kV 230V



Describe the function of the step-up and step-down transformers.

Step-up transformers have more turns on the secondary coil and increase potential difference.

Step-down transformers have fewer turns on the secondary coil than the primary and increase the potential difference.

Explain why, in the national grid, electrical energy is transferred at high voltages.

If a current flows through a wire, energy is lost by heating. This is wasteful and bad for energy companies. $P = I^2R$, where P is the power lost to heating, means the lower the current, the lower the power lost.

Using $P = IV$ if we increase the potential difference the current is lowered.

Therefore step-up transformers are used to increase the potential difference, and lower the current, so less energy is wasted.

Explain why, in domestic uses, electrical energy is transferred at low voltages.

High voltages are dangerous and pose a risk to people and electrical appliances.

Therefore, step-down transformers are used to reduce the voltage to 230V, a safer voltage, which poses a much smaller risk.

Explain where and why step-up and step-down transformers are used in the transmission of electricity in the national grid.

A step-up transformer is used to increase the voltage of the electricity generated to 400kV, to reduce energy losses while the electricity is transferred.

Once the electricity is closer to cities, a step-down transformer reduces the voltage to 33kV; this is used by some factories.

Closer to homes the voltage is again decreased by a step-down transformer to a safer value.

26	$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$	N_P	Number of Turns on the Primary Coil	
		N_S	Number of Turns on the Secondary Coil	
		V_P	Potential Difference in the Primary Coil	V
		V_S	Potential Difference in the Secondary Coil	

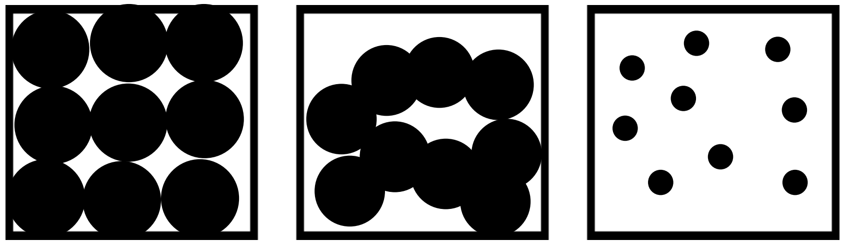
V_p	V_s	N_p	N_s	Step-up or step-down?
100	300	20	60	Up
400 000	25 000	40	2.5	Down
230	7.2	575	18	Down
12	240	2.5	50	Up
120	30	1000	250	Down
24	8	450	150	Down
100.8	28	180	50	Down
1240	62	4600	230	Down

27	$$V_p \times I_p = V_s \times I_s$$	I_P	Current in the Primary Coil	A
		I_S	Current in the Secondary Coil	
		V_P	Potential Difference of the Primary Coil	V
		V_S	Potential Difference of the Secondary Coil	

V_p	V_s	I_p	I_s	Step-up or step-down?
420.6	1003	3.1	1.3	Up
213.9	31	0.5	3.45	Down
922	65.9	0.15	2.1	Down
500	5	0.02	2	Down
110	230	8.57	4.1	Up
128000	230	0.00898	5.0	Down
6	24	3	0.75	Up
30	40	20.0	15	Up

CP14 and CP15 Revision Mat – Grade 4 - Grade 5

In the boxes below, use 9 particles to develop a diagram for solids, liquids and gases. Explain the different states of matter in terms of movement and arrangement of particles.



Solids – particles are arranged close together in a fixed, regular structure. They don't have much kinetic energy so do not move much.

Liquid – arranged close together but in an irregular arrangement. More kinetic energy than a solid so are able to move more.

Gas – particles are not touching and move in random directions at high speeds; they have high kinetic energies.

Explain the differences in density between the different states of matter using particle theory.

Density is found by using $\rho = \frac{m}{V}$.

A solid has its particles more closely packed, so has more mass in a smaller volume, therefore it has a higher density.

A liquid has its particles less tightly packed, so has a lower mass in the same volume, so a lower density.

A gas' particles are not touching and are even more spread out, so their density is even lower.

Explain what is meant by the conservation of mass.

Mass cannot be created or destroyed.

Explain the difference between chemical and physics changes.

Physical changes – the form of a substance changes, they can be reversed.

Chemical changes – the substances create new substances, the change cannot be reversed.

Explain how heating a system changes the energy stored in the system. Refer to heating and changing state in your answer.

Heating a system increases the kinetic energies of the particles, so they vibrate more.

If the temperature gets hot enough, then the substance will change state.

At this point the temperature does not increase and the particles do not gain kinetic energy, all the energy going in is being used to break bonds between particles.

After the substance has changed state it will again gain kinetic energy when being heated.

Describe the terms "specific heat capacity" and "specific latent heat".

Specific heat capacity – the energy needed to raise the temperature of 1kg of a substance by 1K.

Specific latent heat – the energy needed to change the state of 1kg of a substance. Temperature does not rise.

Explain the difference between "specific heat capacity" and "specific latent heat".

Specific heat capacity is only used when a substance is being heated up or cooled down and refers to the energy needed. It is about how much the particles move.

Specific latent heat is used when a substance is changing state, it is the amount of energy needed to break bonds or forces between the particles. The temperature does not increase when changing state.

Explain the causes of gas pressure referencing particles.

The particles of gas collide with an object and, since there is a change of momentum, exert a force on it. (Newton's Second Law)

Therefore a pressure is exerted.

There are lots of gas particles, so the total pressure on a container is equal to the total force exerted divided by the area of the walls.

Explain why heating a gas causes an increase in gas pressure.

If a gas is heated up, its particles move with higher speeds.

Therefore the change of momentum and force exerted in any collision is greater.

So the pressure increases.

Describe the term "absolute zero".

The temperature at which particles have as little kinetic energy as possible.

They stay still

0K, -273°C.

Explain the difference between "specific heat capacity" and "specific latent heat".

Specific heat capacity is only used when a substance is being heated up or cooled down and refers to the energy needed. It is about how much the particles move.

Specific latent heat is used when a substance is changing state, it is the amount of energy needed to break bonds or forces between the particles. The temperature does not increase when changing state.

Convert these temperatures from °Celsius to Kelvin: 0°C, -12°C, 1400°C 7 and these temperatures from Kelvin to °Celsius: 0K, 100K, 300K.

273K, 261K, 1673K

-273°C, -173°C, 27°C

Explain why stretching, bending or compressing requires more than one force.

If there were only one force, the object would just move.

Describe the difference between elastic and inelastic distortion.

Elastic distortion – will return to its original shape after forces have been removed.

Inelastic distortion – does not return to its original shape after forces have been removed, it has gone past its elastic limit.

Describe the difference between linear and non-linear relationships between force and extension.

Linear means as the force increases, the extension increase by the same amount, so the graph has a constant gradient and is straight. This is elastic distortion.

Non-linear is when force and extension don't increase by the same amount, so the graph is curved. This is inelastic distortion.

19	$\rho = \frac{m}{v}$	ρ	Density	Kg/m³
		m	Mass	Kg
		V	Volume	m^3

ρ	m	V
2667	160	0.06
20000	10 000	0.5
3500	11830	3.38
685	3630.5	5.3
7700	60	0.00779
1900	0.0073	3.84×10^{-6}

ρ	m	V
2703	500	0.185
0.122	0.5	4.1
11×10^3	352	0.032
1.2	4.2×10^5	3.5×10^5
2.1×10^9	8.4	4×10^{-9}
8.52×10^3	613	0.0719

- Density:
  a. Calculate the density of a piece of metal, mass 3000kg and volume 0.70m³. 4286 kg/m³
  b. What is the volume of 65kg of air with a density of 1.1kg/m³? 59.1 m³
  c. What is the mass of 3.0cm³ of salt water if it has a density of 1 100kg/m³? 0.0033 kg

20	F = k x e	e	Extension	m
		F	Force Exerted	N
		k	Spring Constant	N/m

e	F	k
30	900	30
0.0125	0.5	40
3	7.5	2.5
0.8	320	400
180	60	0.33
0.25	10	40

e	F	k
20500	820	0.04
0.37	10.4	28
0.037	1.59	43
0.04	1.2	30
79	16 000	203
3.4×10^{-3}	40	11800

- Force and extension of a spring:
  a. Calculate the force needed to extend a spring with a spring constant of 20N/m by 0.020m. 0.4 N
  b. If a spring stretches by 0.020m when 26N is attached, what is the spring constant? 1300 N/m
  c. A car's suspension has *four* springs, *each* with a spring constant of 1.2×10^5N/m. By how much will the car sink when an 900N passenger gets into the car? 1.9×10^{-3} m

28	$E = m \times c \times \theta$	θ	Change in Temperature	
		E	Energy Transferred	J
		m	Mass	kg
		c	Specific Heat Capacity	

E	m	c	θ
672000	2	4200	80
1.05×10^7	100	2100	50
7200	2	900	4
7200	4.6	390	4
1600	0.3	152	35
9 000 000	15	35000	17
450 000	5.8	130	597
198 000	8.9	850	26.2

29	$E = m \times L$	E	Energy Transferred	J
		m	Mass	Kg
		L	Specific Latent Heat	J/kg

E	m	L
98000	70	1400
1670000	5	334×10^3
80	0.16	500
195 800	178	1100
634 000	2.3	276 000
950	0.38	2500

E	m	L
41400	0.018	2.3×10^6
271 000	0.82	3.3×10^5
512	0.0600	8540
115 000	5.09	22.6×10^3
756	0.03	25200
1.05×10^7	167	62900