GRAYS TUITION CENTRE – Online Tutoring

WEEK: 11

Week Beginning: (01/03/2021)

Subject: SCIENCE

Year: 8

Lesson Objective:

- Group 0 Elements
- Formation of Ions

Keywords/ Concepts

- Unreactive
- Colourless
- Ions
- Transfer of electrons

Class Questions

1. What does the group number of an element tell you about its electrons?
2. Do metals form positive or negative ions?
3. State two trends as you go down Group 1?
4. How do the boiling points of halogens (Group 7 elements) change as you go down the group?
5. Why are Group 0 elements single atoms?
6. How do the boiling points change as you go down Group 0?
7. Do elements from Group 1 form positive or negative ions?
8. What's the charge on the ions formed by Group 7 elements?

Homework

- Worksheets

Additional Notes

- Answers to last week's homework can be found below.

Answers to h/w (week 10)

Topic P1 — Energy

Pages 173-174 — Energy Stores, Systems and Conservation of Energy

Warm-Up

mechanical — the energy transfer when a force does work on an object

electrical — the energy transfer when a moving charge does work

by heating — when energy is transferred from a hotter object to a colder object

1

Situation	Energy is transferred to the...
An apple falling from a tree.	**kinetic** energy store.
A pan of soup being heated.	**thermal** energy store.
A hair tie being stretched.	**elastic potential** energy store.
A battery being charged.	**chemical** energy store.
A ball travelling upwards.	**gravitational potential** energy store.

2 C

Energy is transferred electrically by the electric current in the heater to thermal energy stores.

3 12 000 J

As the car and its surroundings are assumed to be a closed system, the energy in the car's kinetic energy store before braking = energy in the car's kinetic energy store after braking + energy transferred to the car and surroundings. So, energy in the car's kinetic energy store after braking = 41 000 − 29 000 = 12 000 J

4 a) Energy is transferred mechanically from the chemical energy stores of the weightlifter's muscles to the kinetic energy stores of her arms and the weights. Some of this energy is transferred mechanically from the kinetic energy stores of the arms and weights to the gravitational potential energy store of the arms and weights.

b) Energy is transferred mechanically from the gravitational potential energy store of the weights to their kinetic energy store.

Pages 175-176 — Kinetic and Potential Energy Stores

Warm-Up

energy in kinetic energy store = ½ × mass × (speed)² / $E_k = \frac{1}{2}mv^2$

energy in gravitational potential energy store = mass × gravitational field strength × height / $E_p = mgh$

1 a) As the cart rolls down the slope, the speed of the cart increases. This means that the amount of energy in the cart's kinetic energy store **increases**. If there are no frictional forces acting on the cart, **all** of the energy transferred out of the cart's gravitational potential energy store is transferred to the cart's kinetic energy store as it rolls down the slope.

b) $E_k = \frac{1}{2}mv^2$
$= \frac{1}{2} \times 500 \times 12^2$
$= 36\,000$ J = **40 000 J (to 1 s.f.)**

2 a) $E_e = \frac{1}{2}ke^2$
$= \frac{1}{2} \times 280\,000 \times 0.0050^2$
$=$ **3.5 J**

b) The energy stored in the lead's elastic potential energy store increases.

You can see from $E_e = \frac{1}{2}ke^2$ that the greater the extension of an object, e, the more energy that's stored in its elastic potential energy store.

3 a) $E_p = mgh$
$= 25 \times 9.8 \times 1.2$
$= 294$ J
$=$ **290 J (to 2 s.f.)**

b) $E_k = \frac{1}{2}mv^2$, so:
$m = 2E_k \div v^2$
$= (2 \times 150\,000) \div 10^2$
$=$ **3000 kg**

Pages 177-178 — Specific Heat

Warm-Up

Specific heat capacity is the amount of transferred to 1 kg of a substance to i by **1 °C**.

1 a) true, true, false

You can see from $\Delta E = mc\Delta\theta$ that a lar means more energy is transferred to the oi temperature. The colour of the oil has no transferred.

b) $\Delta E = mc\Delta\theta$
$= 0.025 \times 1670 \times 44$
$= 1837$ J
$=$ **1800 J (to 2 s.f.)**

c) 44 °C

The change in energy, the mass and the sp same values as those in b). So, the chang same as well.

2 a) Temperature at 400 J = 37.5
Temperature at 0 J = 20 °C
Temperature change = 37.5 -

Temperature at 400 J can be accepted be so the temperature change can be accepte

b) $\Delta E = mc\Delta\theta$ so:
$c = \Delta E \div m\Delta\theta$
$= 400 \div (0.018 \times 17.5)$
$= 1269.8...$
$=$ **1300 J/kg°C (to 2 s.f.)**

c) lower

The change in temperature for liquid B is g it must need less energy per kg to change i liquid A.

3 $\Delta E = mc\Delta\theta$, so
$m = \Delta E \div c\Delta\theta$
$= 43\,000 \div (1700 \times 50)$
$= 0.50588...$
$=$ **0.51 kg (to 2 s.f.)**

Pages 179-180 — Power and Rec Transfers

Warm-Up

When a system changes, some energy wasted energy ends up in **useless** energ 1 joule of energy transferred per secon

1 a) B

Room B has the thinnest walls with the high room B has the highest rate of cooling.

b) A

The thicker the walls and the lower the therr rate of cooling.

2 a) kettle B

b) Each kettle needs to transfer th to heat the water. Kettle B has will transfer the most energy e will transfer the energy needec

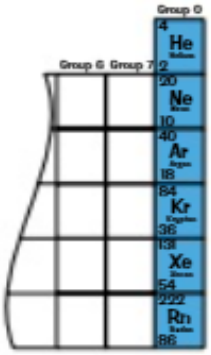
3 a) Power of engine, $P = E \div t$
$= 12\,500 \div$
$=$ **500 W**

Classwork

Group 0 Elements

The Group 0 elements are known as noble gases — the most respectable gases you'll ever come across. They don't react with very much and you can't even see them. This makes them, well, a bit dull really.

Group 0 Elements are All Unreactive, Colourless Gases



1) Group 0 elements are called the noble gases.
They include the elements helium, neon and argon (plus a few others).
2) All elements in Group 0 are colourless gases at room temperature.
3) They all have eight outer shell electrons, apart from helium which has two.
This means they have a stable full outer shell.

Helium only has electrons in the first shell, which only needs 2 to be filled.

4) This stability makes them very unreactive (inert). This means they don't form molecules easily. So the elements are single atoms.
5) Because noble gases are unreactive, some reactions are carried out in an atmosphere that only contains a noble gas, instead of air.
6) This is done if the reactants could react with things in the air (e.g. oxygen or water) instead of taking part in the reaction you're trying to do. It's also done if the products react with things in the air.

There are Patterns in the Properties of the Noble Gases

1) As you go down Group 0, the relative atomic masses of the elements increase.
2) This means that as you go down the group, the elements have more electrons.
3) More electrons means stronger forces between atoms.
4) The stronger the forces, the higher the boiling point.
So as you go down Group 0, the boiling points increase.
5) If you're given the boiling point of one noble gas you can predict the boiling point for another one.
So make sure you know the pattern.

Noble Gas
helium
neon
argon
krypton
xenon
radon

Increasing boiling point

EXAMPLE: Neon is a gas at 25 °C. Predict what state helium is at this temperature.

Helium has a lower boiling point than neon as it is further up the group.

So, helium must also be a gas at 25 °C.

EXAMPLE: Radon has a boiling point of –62 °C and krypton has a boiling point of –153 °C. Predict the boiling point of xenon.

Xenon comes in between radon and krypton in the group.

So, you can predict that its boiling point would be between their boiling points.

E.g. xenon has a boiling point of –100 °C.

The actual boiling point of xenon is –108 °C — which is between –62 °C and –153 °C. Just as predicted.

Arrrgon — the pirate element...

As noble gases don't really react there isn't too much to learn about them. If you understand why they are unreactive and the trend in boiling points as you go down the group you're sorted.

Q1 Does xenon or neon have the higher boiling point? [1 mark]

Formation of Ions

Ions crop up all over the place in chemistry. You need to know what they are and how they form. Luckily for you, this page has got that covered. So crack on with it.

Ions are Made When Electrons are Transferred

1) Ions are charged particles — for example Cl^- or Mg^{2+}.
2) Ions are formed when atoms gain or lose electrons.
3) They do this to get a full outer shell — like a noble gas.
4) This is because a full outer shell is very stable.
5) Metal atoms lose electrons from their outer shell to form positive ions.
6) Non-metal atoms gain electrons into their outer shell to form negative ions.
7) The number of electrons lost or gained is the same as the charge on the ion.
8) If 2 electrons are lost, the particle now has two more protons than electrons. So the charge is 2+.
9) If 3 electrons are gained, the particle now has three more electrons than protons. So the charge is 3–.

Ions will always have a '+' or '–' sign after the formula. A '+' tells you the ion is positive. A '–' sign tells you the ion is negative.

The noble gases are in Group 0 of the periodic table.

You can Work Out What Ions are Formed by Groups 1 & 2 and 6 & 7

1) Group 1 and 2 elements are metals. They lose electrons to form positive ions.
2) Group 6 and 7 elements are non-metals. They gain electrons to form negative ions.
3) Elements in the same group all have the same number of outer electrons. So they have to lose or gain the same number to get a full outer shell. And this means that they form ions with the same charges.
4) You don't have to remember what ions most elements form. You can just look at the periodic table.

Group 1 elements form ions by losing one electron. They form 1+ ions.

Group 2 elements form ions by losing two electrons. They form 2+ ions.

Group 6 elements form ions by gaining two electrons. They form 2– ions.

Group 7 elements form ions by gaining one electron. They form 1– ions.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

Noble gases

Dougal was a few electrons short of a full shell.

- A sodium atom (Na) is in Group 1 so it loses 1 electron to form a sodium ion (Na^+).
- A magnesium atom (Mg) is in Group 2 so it loses 2 electrons to form a magnesium ion (Mg^{2+}).
- A chlorine atom (Cl) is in Group 7 so it gains 1 electron to form a chloride ion (Cl^-).
- An oxygen atom (O) is in Group 6 so it gains 2 electrons to form an oxide ion (O^{2-}).

A '+' by itself means the ion has a 1+ charge. A '–' by itself means the ion has a 1– charge.

I've got my ion you...

You need to be able to predict the ions the atoms in Groups 1, 2, 6 and 7 will form. So have a look at the periodic table above to make sure you know what charged ion each group forms. Keep looking till you've got it sorted.

Q1 What is an ion? [1 mark]

Q2 Predict the charges of the ions formed by these elements:
a) Bromine (Br) b) Calcium (Ca) c) Potassium (K) [3 marks]

Homework

Group 0 Elements

What comes after Group 7? Group 0 of course...

Warm-Up

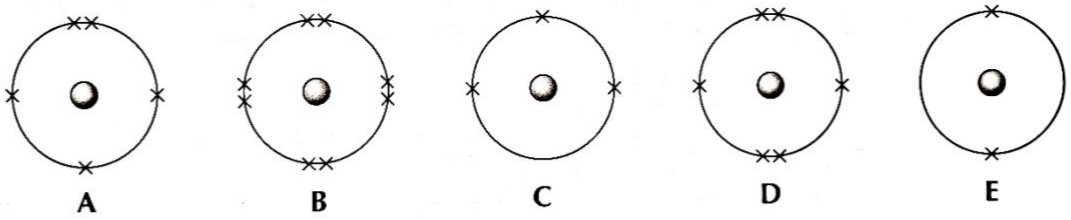
The Group 0 elements are also known as the noble gases. They are found on the far right of the periodic table. They're all unreactive gases at room temperature.

Tick the statements below which are true:

- ☐ **A** The noble gases are non-metals.
- ☐ **B** The noble gases exist as molecules made of pairs of atoms.
- ☐ **C** The noble gases have full outer electron shells.
- ☐ **D** The noble gases easily form both positive and negative ions.

Q1 **Figure 1** shows the outer shell electron arrangements of five atoms, **A-E**.

Figure 1



a) Which of the five atoms could be Group 0 elements?

.....

b) Explain your answer.

.....

.....

Q2 Mariya tries to burn a sample of neon gas in air.

What happens? Tick **one** box.

- ☐ **A** The neon burns with a bright white flame.
- ☐ **B** The neon reacts with nitrogen from the air.
- ☐ **C** The neon atoms lose electrons and become 1+ ions.
- ☐ **D** Nothing.

Q3 There are trends in the properties of the Group 0 elements.

a) i) Complete **Table 1** to show the relative atomic masses and the boiling points of the Group 0 elements. Use the numbers in the boxes on the left.

4 −246 −186 40

Table 1

Element	Relative atomic mass	Boiling point (°C)
Helium	.....	−269
Neon	20	.....
Argon	.....	.....

ii) The melting points of the elements increase moving down Group 0. Argon is a solid at −200 °C. Predict the state of krypton at −200 °C. Explain your prediction.

Prediction: .....

Explanation: .....

.....

.....

b) The densities of the Group 0 elements increase as you go down Group 0. **Table 2** shows the densities of helium and argon at 20 °C.

Table 2

Element	Density (g/cm^3)
Helium	0.0002
Argon	0.0018

Predict the density of neon at 20 °C.

..... g/cm^3

Q4 Some light bulbs contain a thin metal filament (wire). If these bulbs were filled with air, oxygen would react with the filament and cause it to burn away. To avoid this, the light bulbs are filled with argon.

Explain why argon is suitable for this use.
You should talk about the outer shell electrons of an argon atom in your answer.

.....

.....

.....

.....

Ions and Ionic Bonding

Ions sound pretty space age. They're even more exciting than that, believe me.

Warm-Up

Ions are particles which have a charge.
They form when atoms gain or lose electrons. They do this so they can have a full outer shell of electrons — like a noble gas.

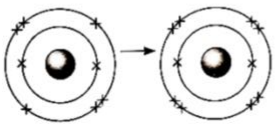
A metal atom can transfer the electrons it loses to a non-metal atom. This forms a positive metal ion and a negative non-metal ion. The two oppositely charged ions are attracted to each other by electrostatic forces. This is called an ionic bond.

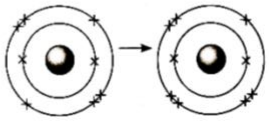
Sort the elements on the left into the correct column of the table on the right.

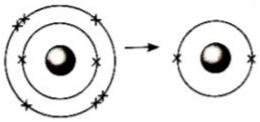
lithium magnesium caesium sulfur bromine fluorine

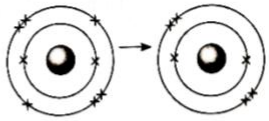
Forms a positive ion	Forms a negative ion

Q1 Which of the following diagrams shows an oxide ion (O^{2-}) forming from an oxygen atom?

☐ A 

☐ B 

☐ C 

☐ D 

Q2 Different atoms need to gain or lose different numbers of electrons to get a full outer shell.

a) How many electrons do the following elements need to lose to get a full outer shell? Write your answers in the boxes.

lithium ☐ calcium ☐ potassium ☐

b) How many electrons do the following elements need to gain to get a full outer shell? Write your answers in the boxes.

sulfur ☐ chlorine ☐ fluorine ☐