THE DUBLIN ACADEMY OF EDUCATION

GEOGRAPHY

6TH YEAR

THE ROCK CYCLE & ASSOCIATED LANDSCAPES

TRACY GANNON

STILLORGAN WEEKLY GRINDS TIMETABLE

South Dublin weekly grinds take place in Stillorgan Plaza, Lower Kilmacud Road, Stillorgan,Dublin.

6th Year

SUBJECT	LEVEL	DATES	TIME
Accounting	H	Wednesdays	5:00pm - 6:15pm
Accounting	H	Saturdays	10:30am - 11:45am
Applied Maths	H	Mondays	5:00pm - 6:15pm
Applied Maths	H	Fridays	4:45pm - 6:00pm
Biology	H	Mondays	8:00pm - 9:15pm
Biology	H	Tuesdays	5:30pm - 6:45pm
Biology	H	Saturdays	9:00am - 10:15am
Business	H	Wednesdays	5:00pm - 6:15pm
Business	H	Saturdays	12:30pm - 1:45pm
Chemistry	H	Mondays	6:15pm - 7:30pm
Chemistry	H	Wednesdays	6:30pm - 7:45pm
Chemistry	H	Saturdays	9:00am - 10:15am
Economics	H	Mondays	6:30pm - 7:45pm
Economics	H	Saturdays	9:00am - 10:15am
English	H	Tuesdays	7:00pm - 8:15pm
English	H	Wednesdays	5:00pm - 6:15pm
English	H	Wednesdays	6:30pm - 7:45pm
English	H	Saturdays	10:30am - 11:45am
English	H	Saturdays	12:15pm - 1:30pm
French	H	Mondays	6:15pm - 7:30pm
French	H	Wednesdays	6:45pm - 8:00pm
French	H	Saturdays	9:00am - 10:15am
Geography	H	Tuesdays	5:30pm - 6:45pm
Geography	H	Thursdays	5:45pm - 6:45pm
German	H	Mondays	8:00pm - 9:15pm
History	H	Thursdays	5:45pm - 7:00pm
Home Economics	H	Tuesdays	5:30pm - 6:45pm
Irish	H	Mondays	8:15pm - 9:30pm
Irish	H	Wednesdays	6:45pm - 8:00pm
Irish	H	Saturdays	10:45am - 12:00pm
Maths	H	Mondays	8:00pm - 9:15pm
Maths	H	Tuesdays	7:00pm - 8:15pm
Maths	H	Wednesdays	5:00pm - 6:15pm
Maths	H	Wednesdays	8:15pm - 9:30pm
Maths	H	Saturdays	10:30am - 11:45am
Maths	H	Saturdays	12:15pm - 1:30pm
Maths (Fast Paced)	H	Fridays	6:15pm - 7:30pm
Maths	O	Tuesdays	7:00pm - 8:15pm
Maths	O	Saturdays	12:15pm - 1:30pm
Physics	H	Mondays	6:30pm - 7:45pm
Physics	H	Thursdays	7:15pm - 8:30pm
Spanish	H	Tuesdays	7:00pm - 8:15pm
Spanish	H	Saturdays	10:30am - 11:45am

5th Year

SUBJECT	LEVEL	DATES	TIME
Accounting	H	Saturdays	9:00am - 10:15am
Applied Maths	H	Thursdays	5:45am - 7:00pm
Biology	H	Thursdays	5:30pm - 6:45pm
Business	H	Mondays	5:00pm - 6:15pm
Chemistry	H	Wednesdays	5:00pm - 6:15pm
Chemistry	H	Saturdays	10:45am - 12:00pm
Economics	H	Thursdays	7:15pm - 8:30pm
English	H	Wednesdays	8:15pm - 9:30pm
English	H	Saturdays	9:00am - 10:15am
French	H	Wednesdays	5:00pm - 6:15pm
Geography	H	Tuesdays	5:30pm - 6:45pm
Geography	H	Thursdays	5:45pm - 7:00pm
German	H	Mondays	8:00pm - 9:15pm
Irish	H	Mondays	8:00pm - 9:15pm
Maths	H	Tuesdays	7:00pm - 8:15pm
Maths	H	Wednesdays	6:30pm - 7:45pm
Maths	H	Saturdays	10:30am - 11:45am
Maths	(O)	Tuesdays	7:00pm - 8:15pm
Maths	(O)	Saturdays	12:15pm - 1:30pm
Physics	H	Tuesdays	7:00pm - 8:15pm
Spanish	H	Tuesdays	5:30pm - 6:45pm

4th Year

SUBJECT	LEVEL	DATES	TIME
Biology	H	Thursdays	5:30pm - 6:45pm
English	H	Tuesdays	5:45pm - 6:45pm
Irish	H	Mondays	5:15pm - 6:15pm
Maths	H	Mondays	6:30pm - 7:30pm
Maths	H	Tuesdays	7:00pm - 8:00pm
Physics	H	Thursdays	5:30pm - 6:45pm

3rd Year

SUBJECT	LEVEL	DATES	TIME
English	H	Wednesdays	6:30pm - 7:30pm
English	H	Saturdays	10:30am - 11:30am
Irish	H	Mondays	6:30pm - 7:30pm
Maths	H	Tuesdays	5:45pm - 6:45pm
Maths	H	Thursdays	5:30pm - 6:30pm
Maths	H	Saturdays	9:15am - 10:15am
Science	H	Saturdays	12:15pm - 1:15pm

1st & 2nd Year

SUBJECT	LEVEL	DATES	TIME
English	H	Wednesdays	5:15pm - 6:15pm
Irish	H	Thursdays	5:30pm - 6:30pm
Maths	H	Mondays	5:15pm - 6:15pm
Maths	H	Thursdays	6:45pm - 7:45pm

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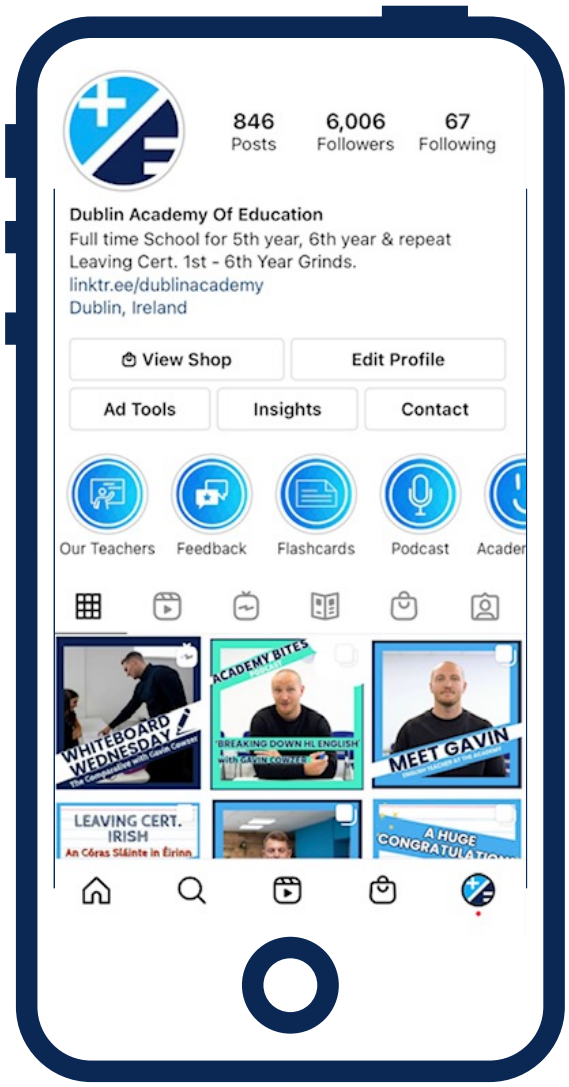

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Formation of Rocks

Rocks are classified according to the processes that form them. They can be divided into three main groups.

1. **Igneous**
2. **Sedimentary**
3. **Metamorphic.**

The **rock cycle** demonstrates the formation, breakdown, and reformation of a rock due to internal (**endogenic**) and external (**exogenic**) forces.

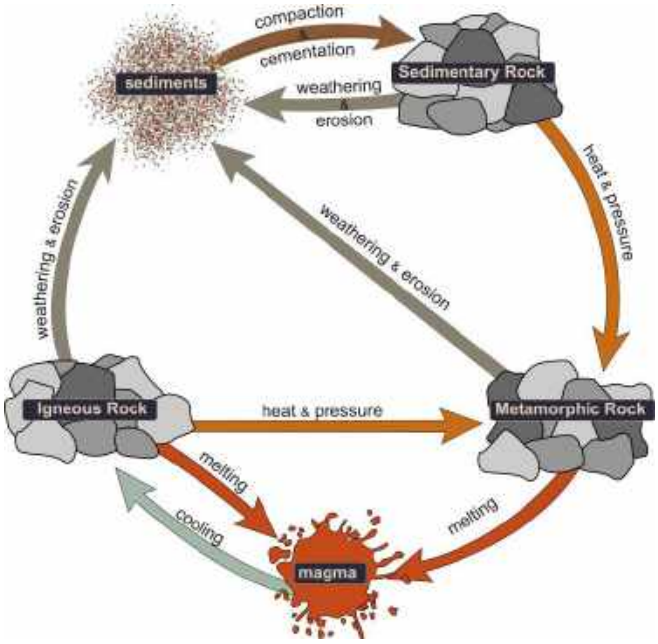


Figure 1:

The Rock Cycle

GROUP	FORMATION	TYPES
IGNEOUS	Formed when hot, molten volcanic material **cool and solidify**	**Granite**, **Basalt**, Dolerite, Gabbro
SEDIMENTARY	Formed from the **compressed and compacted** remains of plants, animals and other rocks	**Limestone**, **Sandstone**, Shale, Coal
METAMORPHIC	These rock were once igneous or sedimentary rocks which were changed by great **heat and/or pressure**	**Marble**, **Quartzite**, **Slate**, Schist, Gneiss

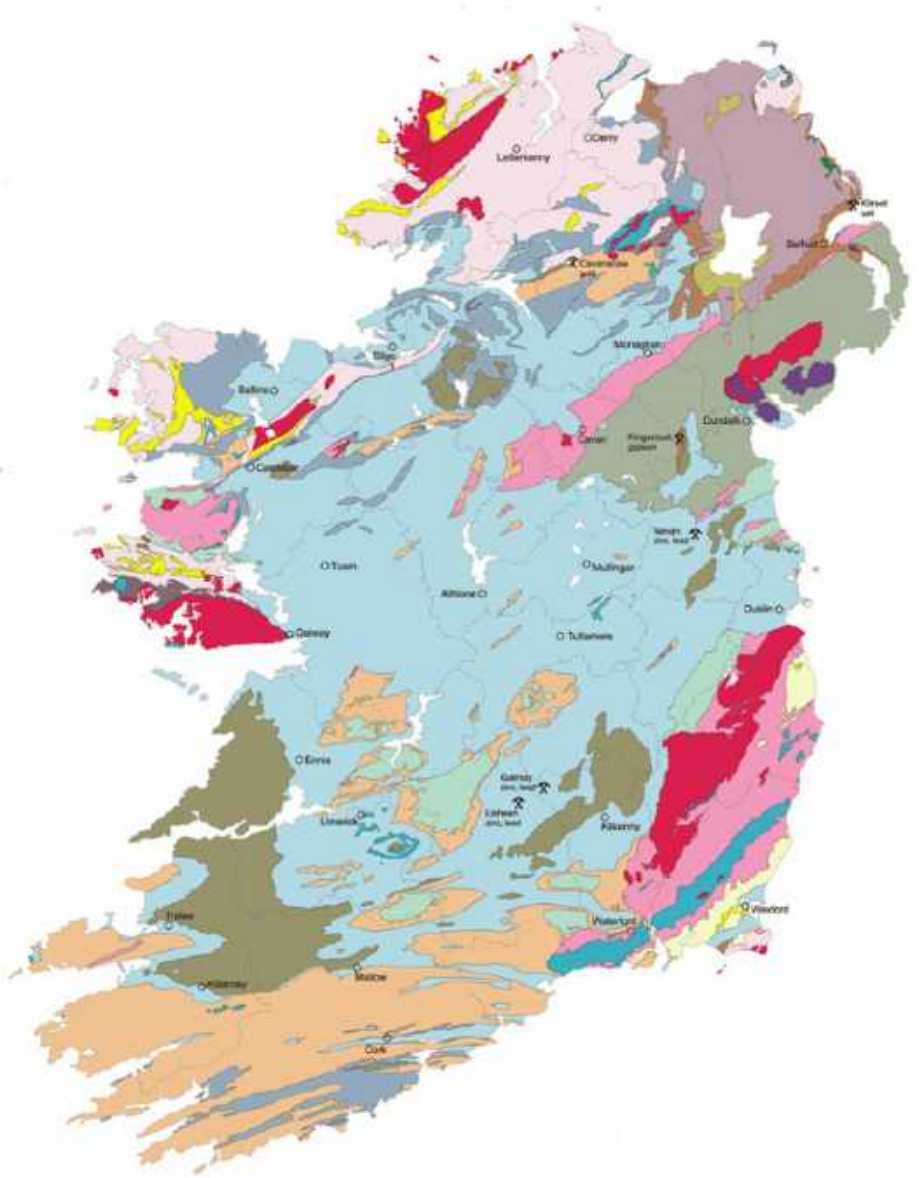


Figure 2: Geology Map of Ireland

Rock Type	Location
Granite	
Basalt	
Limestone	
Sandstone	
Marble	
Quartzite	

1. Igneous Rocks

2016

1B. Rocks
Explain the formation of **one** igneous rock and **one** metamorphic rock, with reference to Irish examples. **[30m]**

2014
1B. Rocks
Explain the formation of igneous rocks with reference to Irish examples. **[30m]**

2011
3B. Igneous Rock
Explain the formation of **two** igneous rocks, with reference to examples from Ireland. **[30m]**

2014 Marking Scheme

Two Irish igneous rocks named	2 + 2 marks
Explanation of formation	13 x SRPs

- Credit relevant labelled diagram for 1 x SRP.
- Credit extra relevant information on labelled diagram for 2 x SRPs.
- Diagram without labelling 0 marks.
- Credit 3rd named igneous rock for 1 x SRP.
- Max 2 x SRPs if merely a description of igneous rocks with no reference to formation.

Igneous rocks are formed from molten rock which **cools and solidifies** either on or below the earth's surface. Two groups of igneous rock can be recognised:

1. **Intrusive rocks** form when molten **magma** cools deep within the crust of the earth. As the magma cools very slowly these rocks have large crystals. Intrusive rocks can be of two types:
    - **Plutonic** rock e.g. **Granite**
    - **Intermediate (Hypabyssal**) rock e.g. Dolerite.

2. **Extrusive (volcanic) rocks** form when **lava** solidifies on or near the earth's surface. As the lava cools quickly crystals are small, e.g. **Basalt**.

Intrusive Rock: Granite

1. **Granite** is a plutonic (intrusive) igneous rock.
2. It is formed when molten magma **intrudes** into the earth's crust. The magma cools and solidifies slowly (over millions of years), as it insulated by surrounding rock layers of slate and quartzite. It has large crystals are formed due to this slow cooling.
3. Granite consists of three main minerals, **quartz, feldspar and mica**. The quartz grains are **clear and glassy**, the feldspar vary from **white to pink** and crystals of mica are **black**.
4. Granite normally has a **dark grey** colour, however, variations in colour can occur due to variations in mineral content.
5. Granite has a silica content close to **70%,** hence granite is an acidic rock. Feldspar and silica (quartz) form most of the rocks therefore, the term **felsic** is applied to it.
6. Granite is a **course-grained** rock that is very resistant to erosion and as a result it is in high demand as a building material for buildings and bridges.
7. Polished granite is used in countertops and floor tiles. When granite is broken down by weathering it produces Kaloin, or **china clay.** These are used in the porcelain industry.
8. In Ireland granite was formed **400 million** years ago during the **Caledonian** folding period. Today, this granite is exposed at the Leinster Batholith.

9. **Example: Wicklow Mountains, Co. Wicklow.**

1.	NAME	**Granite**
2	**FORMATION**	**I**ntrudes
3.	**MINERALS**	**Q**uartz (**C**lear & Glassy) **F**eldspar (White to **P**ink) **Mi**ca (**B**lack)
4.	**COLOUR**	**D**ark **G**rey
5.	**SILICA CONTENT**	**70%**
6.	**TEXTURE**	**C**ourse **G**rained
7.	**USE**	**C**hina **C**lay
8.	**IRELAND**	**C**aledonian (400)
9.	**EXAMPLE**	**W**icklow Mth

Extrusive Igneous Rock: Basalt

1. **Basalt** is the most common volcanic (extrusive) igneous rock.
2. Basalt forms when magma flows onto the **earth's surface**, at this point it is called lava. When lava is exposed to the air or water, it cools and solidifies rapidly due to the low silica content. As the lava cools quickly small crystals form.
3. Basalt is composed of **quartz** and **feldspar** minerals. Basalt has a high magnesium and iron content and the term **mafic** is often applied to basalt.
4. Basalt is a **black or dark grey** coloured rock, with microscopic crystals.
5. Basalt is a basic igneous rock as it contains less than **55%** silica.
6. Basalt is a **hard** rock and very resistant to weathering and erosion, which makes it suitable as a building stone.
7. Crushed basalt is used as **road chippings**. When basalt weathers it forms a deep fertile soil as is found in the coffee growing region of Brazil and cash crop regions of Italy.
8. In Ireland basalt covers areas such as the Antrim-Derry Plateau, which includes the **Giant's Causeway.** Formed approximately **60 million** years ago here the lava cooled, contracted and eventually cracked to form hexagonal columns.
   Basalt also covers areas such as the Deccan Plateau in India.

9. **Example: Giants Causeway, Co. Antrim.**

1.	NAME	**B**asalt
2	**FORMATION**	**E**arth's **S**urface
3.	**MINERALS**	**Q**uartz **F**eldspar
4.	**COLOUR**	**B**lack or **D**ark **G**rey
5.	**SILICA CONTENT**	**-55%**
6.	**TEXTURE**	**H**ard
7.	**USE**	**R**oad **c**hippings
8.	**IRELAND**	**A**ntrim **P**lateau **(60m)**
9.	**EXAMPLE**	**G**iants **C**auseway

Landforms Associated With Extrusive Igneous Rocks (Basalt)

2019

3b Landscape Development

Explain how different rock types produce distinctive landscapes in Ireland, with reference to examples you have studied. **[30m]**

2016

2B Landscape development

Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

2014

2C. Rocks and Landscapes

Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

2008/2006

3B. Rock Type and Landscape

Examine, with reference to an example you have studied, the formation of **one** rock-type and how it produces a distinctive landscape. **[30m]**

2008 Marking Scheme

Candidate must pick a rock-type and

(i) Examine its formation for 14 (16) marks

(ii) Examine its production of a distinctive landscape for 16 (14) marks

Rock Formation:		Distinctive Landscape:	
Identification:	2 marks	Identification:	2 marks
Named example:	2 marks	Named example:	2 marks
Examination:	5 (6) x SRPs	Examination:	6 (5) x SRPs

- Examination of distinctive landscape must follow on from rock formation.
- Credit relevant labelled diagrams to a max of 2 x SRPs.
- Question is not tied to Ireland.

Basalt

Basalt is the most common volcanic (extrusive) igneous rock.

Basalt forms when magma flows onto the **earth's surface**, at this point it is called lava. When lava is exposed to the air or water, it cools and solidifies rapidly due to the low silica content. As the lava cools quickly small crystals form.

Basalt is composed of **quartz** and **feldspar** minerals. Basalt has a high magnesium and iron content and the term **mafic** is often applied to basalt. Basalt is a **black or dark grey** coloured rock, with microscopic crystals.

Lava Plateaus in Ireland

Plate separation has influenced the Irish Landscape. When mantle convection currents cause tectonic plates to separate, the earth's crust splits, normal faults form and large valleys, called rift valleys form. Pressure on the mantle below is reduced and **basic magma** (less than 55% silica content) easily makes its way to the surface along the fissures on the floor of the rift valleys. Over time, numerous eruptions cause lava deposits to build up into high, flat-topped upland areas made of **basalt** rock.

The Antrim-Derry Plateaus

Sixty million years ago Antrim was subjected to intense volcanic activity when highly fluid molten rock was forced up through fissures in the chalk bed to form an extensive **lava plateau** which extends over 4,000kmsq.

The **lava flowed** out quick through cracks in the earth's surface, spreading out evenly. Theses flows are five to six meters thick and normally continued for long periods of time.

The lava cooled quickly causing the basalt to split into **columns** of four, five or six sides. The columns are mainly hexagonal however some have up to eight sides.

The dramatic cliff-like edge of the plateau forms the **Giants Causeway** coastline. The larger fissures, where the lava once flowed, are today visible as bands of dark rock which cut down the cliff faces and jut out towards the sea. There were three periods of volcanic activity which resulted in the flows, known as the Lower, Middle and Upper Basalts.

It is the Middle Basalt rocks which form the columns of the Giants Causeway. The rapidly cooling lava contracted and variations in the cooling rate resulting in the **world-famous columnar structure**.

Example: **The Antrim-Derry Plateau**

Figure 3: Basalt Plateau Diagram

Figure 4: The Antrim-Derry Plateau

2. Sedimentary Rocks

2019

2B. Rocks

Examine the formation of each of the following, with reference to examples you have studied.

- **One** sedimentary rock
- **One** metamorphic rock. **[30m]**

2015

2B. Sedimentary Rocks

Explain the formation of sedimentary rocks, with reference to Irish examples. **[30m]**

2012

1B. Sedimentary and Metamorphic Rocks

Describe the formation of **one** sedimentary rock that you have studied **and** briefly explain how this rock may be transformed into a metamorphic rock. **[30m]**

2009

2B. Rocks

Examine, with reference to examples from Ireland, the formation of sedimentary rocks. **[30m]**

2015 Marking scheme

Irish examples of sedimentary rocks	2 + 2 marks
Explanation of formation	13 x SRPs

- Credit relevant labelled diagram for 1 x SRP.
- Credit extra relevant information on labelled diagram for 2 x SRPs.
- Diagram without labelling 0 marks.
- Credit 2 named associated Irish locations for 2 x SRPs from the explanation. Location must be linked to named rock.
- Max 2 x SRPs if merely a description of sedimentary rocks with no reference to formation.
- The examination need not be confined to the two named rocks. A general account of the formation of sedimentary rocks is acceptable.
- The focus of the question is on the formation of sedimentary rock.

Sedimentary rocks are formed from the **compression and compaction** of the remains of plants, animals and/or other rocks sediment, deposited by moving glaciers, water and wind.

Sedimentary rocks can be divided into 3 groups:

1. **Organically formed** sedimentary rocks are formed from the remains of once living organisms, **e.g. Limestone, Peat, Coal.**

2. **Inorganically/Mechanically formed** sedimentary rocks are formed from sediments that were broken down by weathering and erosion from pre-existing rocks. The sediments were **lithified (lithification)**, this is the process whereby newly deposited sediments are converted into solid rock by **compaction and cementation**, **e.g. Sandstone, Conglomerate, Shale.**

3. **Chemically formed** sedimentary rocks are termed evaporates and are formed as water is evaporated from a sea or salt water lake, **e.g. Salt, Gypsum.**

Limestone: Organically formed Sedimentary Rock

Limestone, the most **common** rock type in Ireland, is an organically formed sedimentary rock. It is **exposed** in such regions as the Burren, Co. Clare and it is covered by peat and boulder clay in the Central Plain of Ireland.

Pure limestone is almost white in colour however impurities in the rock such as clay cause the colour to vary from grey to black.

Limestone is composed primarily of calcium carbonate ($CaCO_3$) in the form of the mineral **calcite**. Limestone is a stratified rock, laid down far from the shore on the bed of a warm clear sea. It was formed from skeletal remains (teeth, bones and shells) of marine creatures (fish, sea urchins and coral). These **accumulated** over millions of years and were **compacted and cemented** to form limestone rock.

Today the remains of some of these creatures can be seen within the rocks as **fossils**. Fossils are often found in sedimentary rock, as these rock form at temperature and pressure that do not destroy fossil remains.

Limestone is a **permeable** rock (allows water to pass through it) meaning it is particularly vulnerable to the chemical weathering process known as carbonation.

Irish limestone was formed approximately 300 million years ago, when Ireland lay under a warm, shallow sea close to the **equator**.

Limestone is used in making of cement and glass. Farmers use crushed limestone (**lime**) as a soil conditioner, as it neutralises acidic soil.

The main **types** of limestone are:

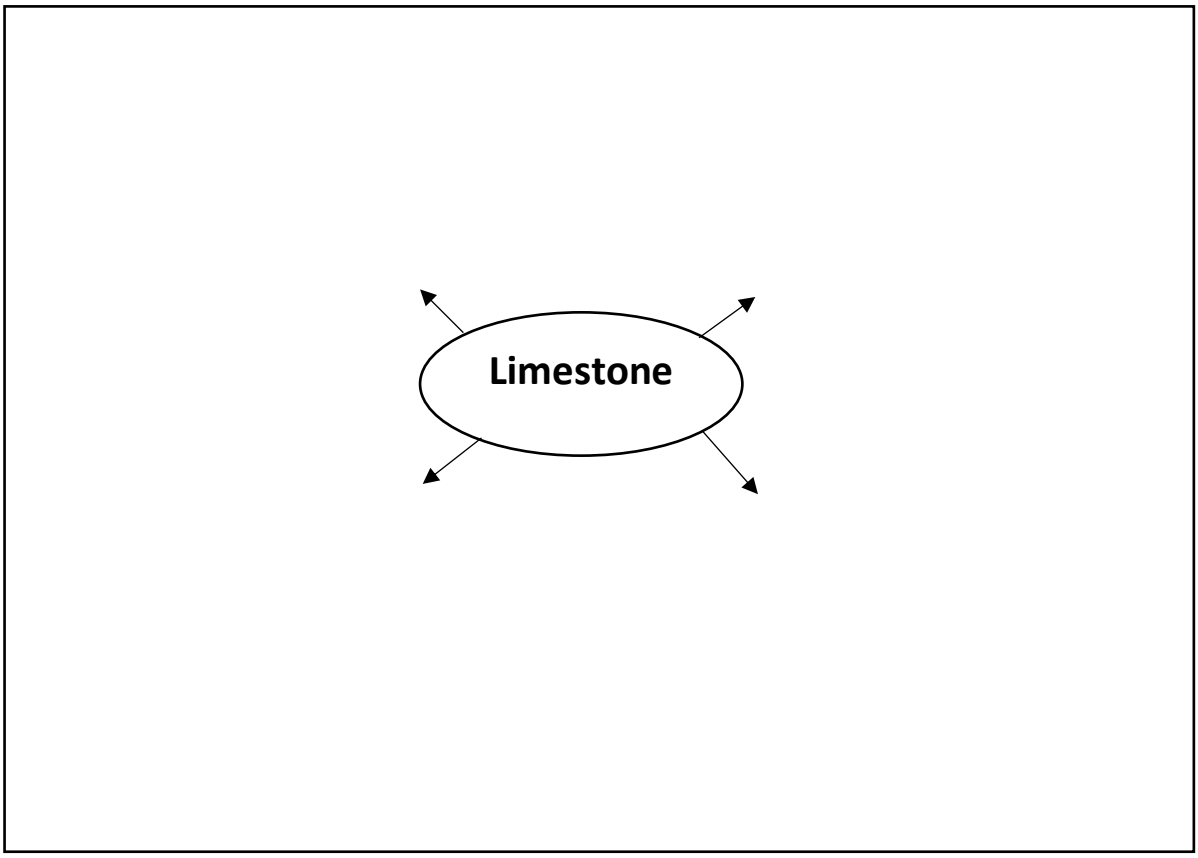
- **Carboniferous limestone**: is a hard, grey in colour and consists of at least 50% calcium carbonate. This makes it particularly vulnerable to the carbonation. It is well jointed and allows for the development of a particular type of landscape called Karst.
- **Dolomite**: contains traces of the mineral magnesium. It varies in colour from light grey to black and is found in Cork and Kilkenny.
- **Chalk**: is a pure limestone, white in colour and very easily eroded.

Example: **The Burren, Co. Clare**

Keywords

1. Common
2. Exposed
3. Impurities
4. Calcite
5. Accumulation
6. Fossils
7. Permeable
8. Equator
9. Lime
10. Types
11. Burren

Figure 5: Limestone Pavements, the Burren, Co. Clare



Peat

Peat forms from the accumulation of decomposed vegetation in waterlogged areas.

Example: **The Shannon Basin**

Coal

Peat forms from the compression of peat deposits.

Example: **Arigna, Co. Roscommon**

Landforms Associated with Sedimentary Rocks (Limestone)

2019

3b Landscape Development

Explain how different rock types produce distinctive landscapes in Ireland, with reference to examples you have studied. **[30m]**

2016

2B Landscape development

Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

2014

2C. Rocks and Landscapes

Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

3C. Sedimentary Structures

Examine how sedimentary structures, such as bedding planes and joints, influence the development of landforms. **[30m]**

2008 (2006 also)

2B. Rock Type and Landscape

Examine, with reference to an example you have studied, the formation of **one** rock-type and how it produces a distinctive landscape. **[30m]**

3C. Karst Landscapes

With reference to the Irish landscape, examine the processes which have influenced the development of any landform in a karst region. **[30m]**

2008 2B Marking Scheme

Landform identified:	2 marks
Named processes:	2 marks
Irish example:	2 marks
Discussion:	12 x SRPs

- Description only - max 6 x SRPs.
- Credit annotated diagrams to a max of 2 x SRPs.
- Feature or process can be starting point.

Limestone Rock

Limestone, the most **common** rock type in Ireland, is an organically formed sedimentary rock.

Limestone is composed primarily of calcium carbonate (CaCO3) in the form of the mineral **calcite**. Limestone is a stratified rock, laid down far from the shore on the bed of a warm clear sea. It was formed from skeletal remains (teeth, bones and shells) of marine creatures (fish, sea urchins and coral). These **accumulated** over millions of years and were **compacted and cemented** to form limestone rock.

Carboniferous is the type of limestone associated with the unique landscape known as **karst landscape found** in the Burren, Co. Clare. It is hard, grey in colour and consists of at least 50% calcium carbonate (calcite), meaning it is particularly **vulnerable** to the chemical weathering process **Carbonation**. This process creates **distinct features** such as limestone pavements **AND/OR** dripstone features.

Surface Feature: Limestone Pavement

A limestone pavement is a large flat area of **exposed limestone** rock on the earth's surface.

First, the **soil cover** is removed. The exposed limestone is chemically weathered by carbonation. **Carbonation** is the process where carbon dioxide from the atmosphere or soil mixes with rainwater forming a **weak carbonic acid**.

Carbon dioxide	+	Water	⟶	Carbonic Acid
CO_2	+	H_20	⟶	H_2CO_3

When this falls on the exposed limestone, it alters the insoluble calcium carbonate to soluble calcium bicarbonate, which is then removed by solution. Regular rainwater ensures that this process is ongoing.

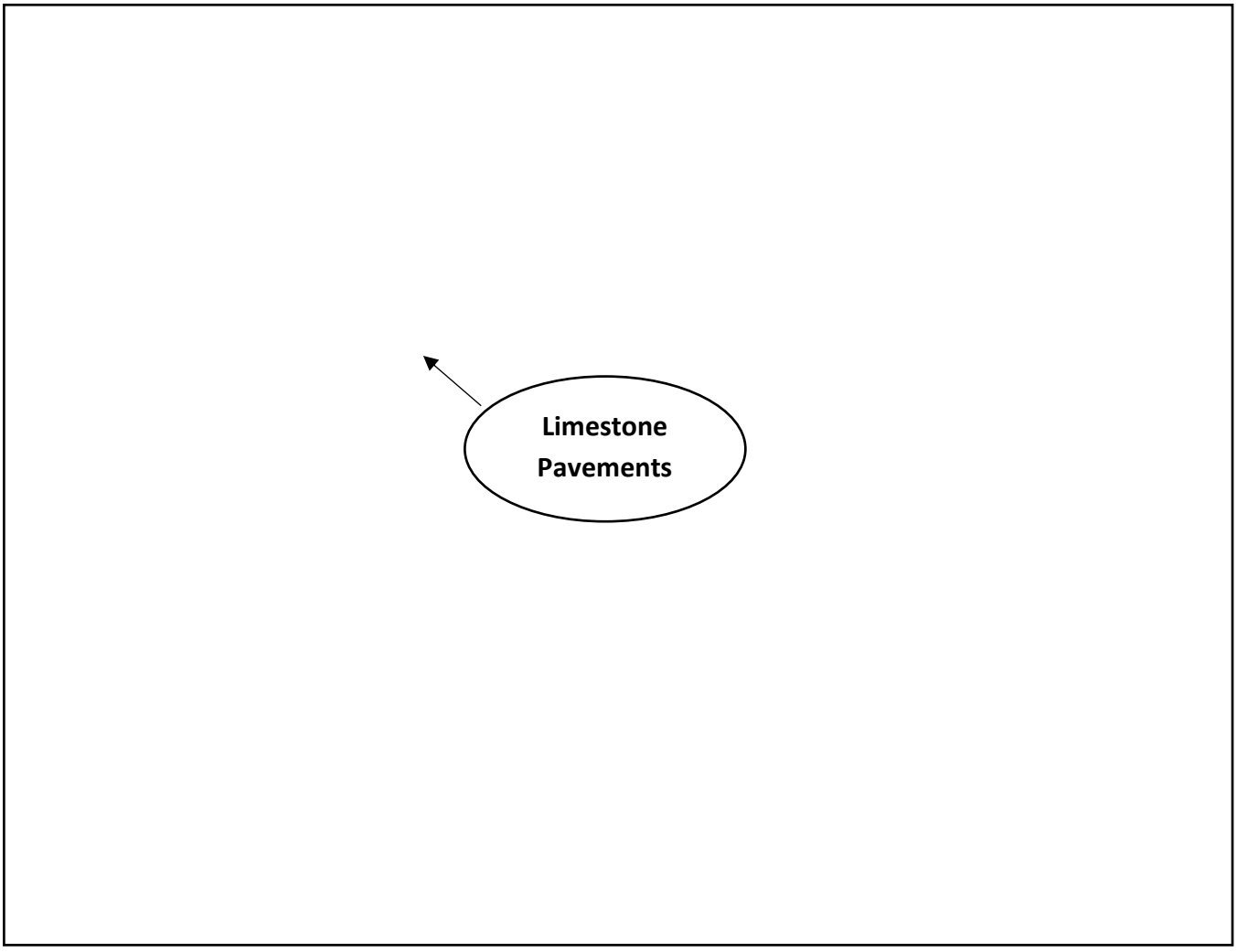
Carbonic acid	+	Calcium Carbonate	⟶	Calcium bicarbonate
H_2CO_3	+	$CaCO_3$	⟶	$Ca(HCO_3)_2$

Percolating through the **permeable** limestone, the carbonic acid weaknesses the rocks vertical joints and horizontal bedding planes.

The vertical joints become wider and deeper to form **grikes**. Rectangular blocks of limestone called **clints** separate the grikes. This combination of clints and grikes is called limestone pavements. When carbonic acid settles on the surface of the clint, small hollows called **karren** are formed. Overtime the grikes continue to widen and deepen. A thin layer of soil which develops in the grikes is often home to unusual plants and flowers.

Example: **The Burren, Co. Clare**

Figure 6: Limestone Pavements Diagram



Subsurface Features: Stalactites and Stalagmites

Stalactites and Stalagmites are known as dripstone features which form in an underground cave.
They are formed by the influence of water flowing downwards from the surface through limestone. The process involved in their formation is the opposite of carbonation. Water seeps down from the surface as the limestone is permeable. The chemical weathering process of carbonation is active and calcite is dissolved by carbonic acids in the water. The dissolved material is called calcium bicarbonate and is carried away in solution by the water. Water which is saturated with calcium bicarbonate then reaches the roof of the cave.
The process of carbonation is reversed and some of the calcium bicarbonate will form back into calcite due to the evaporation of the water.
Specks of calcite are then deposited on the cave ceiling. The deposited calcite will grow downwards because of gravity and will gradually build up to form an icicle-shaped feature called a stalactite.
Water continuing calcium bicarbonate may fall onto the cave floor and evaporation again causes the calcite to build upon the floor and gradually a dome-shaped stalagmite. Where a stalagmite and stalactite join a limestone pillar is formed.
Eventually, stalactites and stalagmites join to form columns or pillars.

Example: **Ailwee Caves, Co. Clare.**

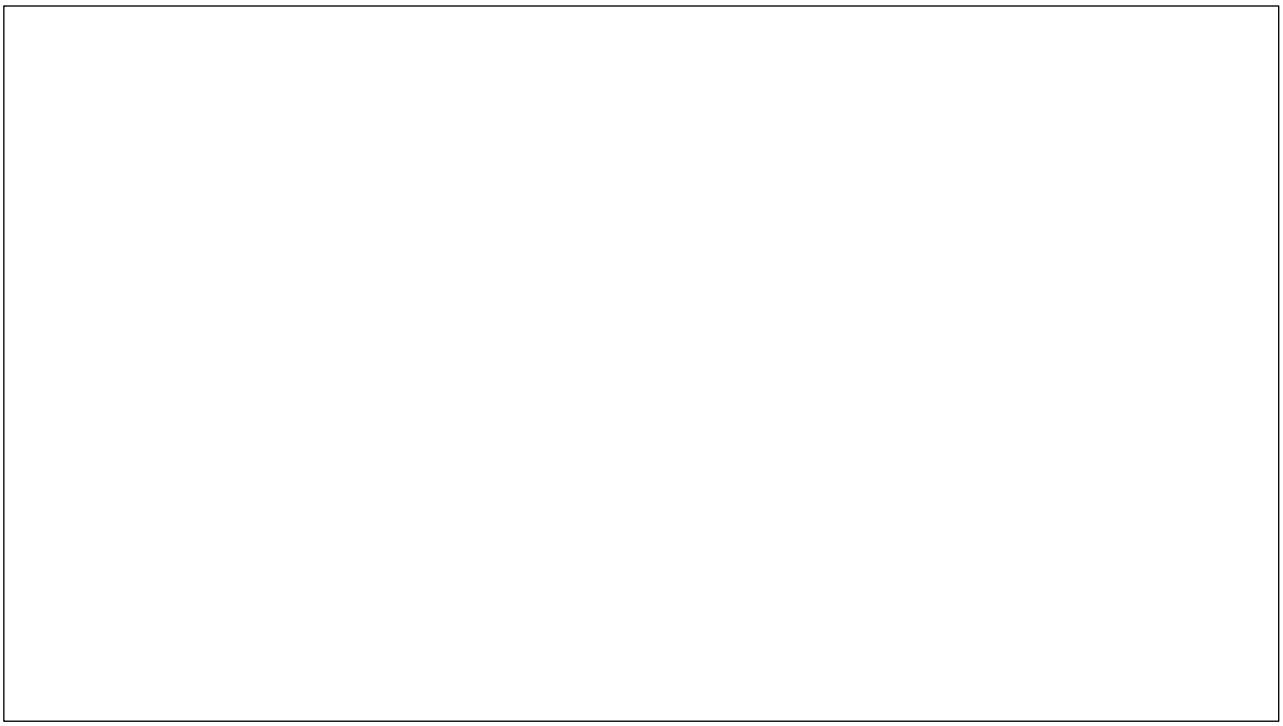
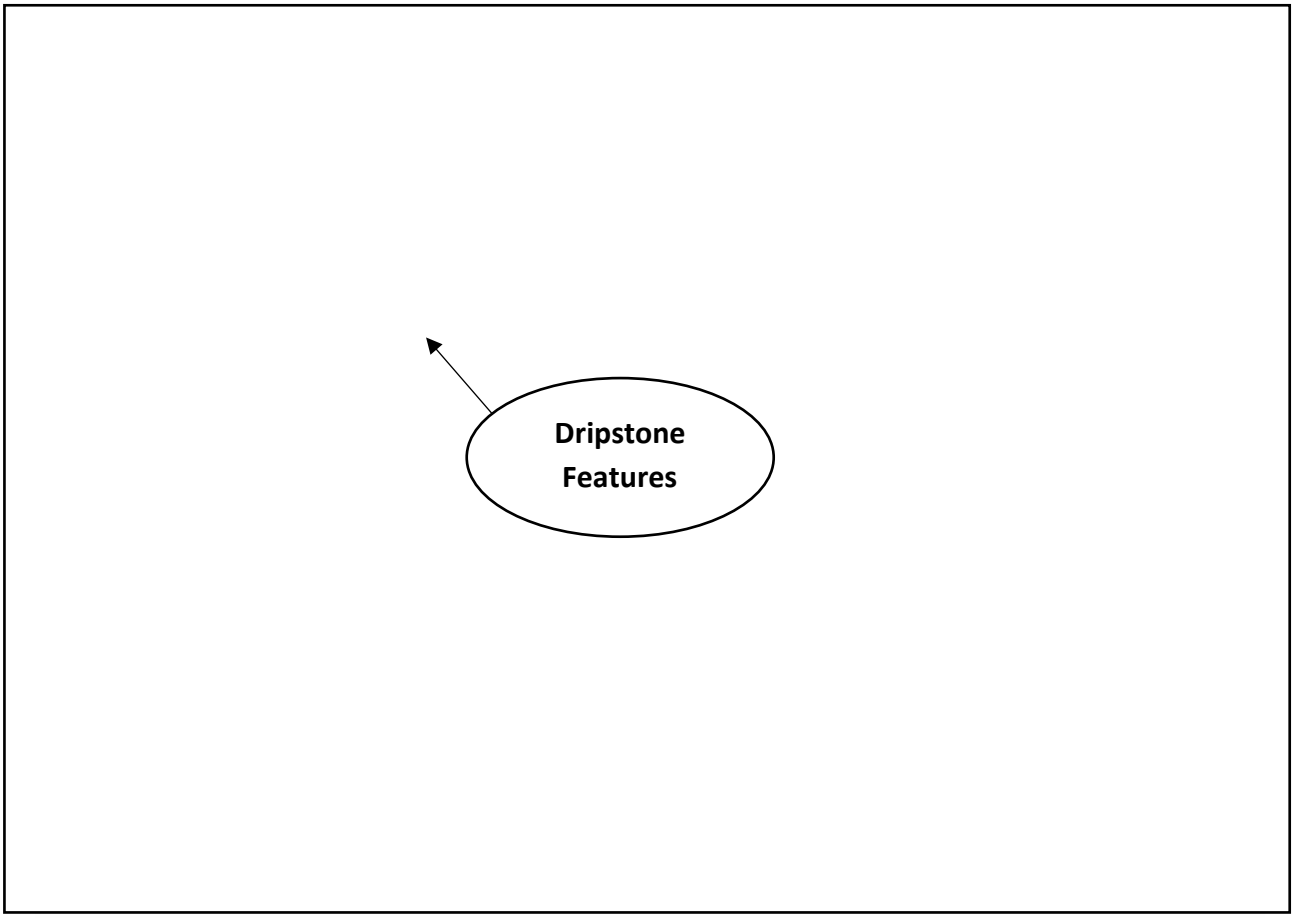


Figure 7: Dripstone Features Diagram



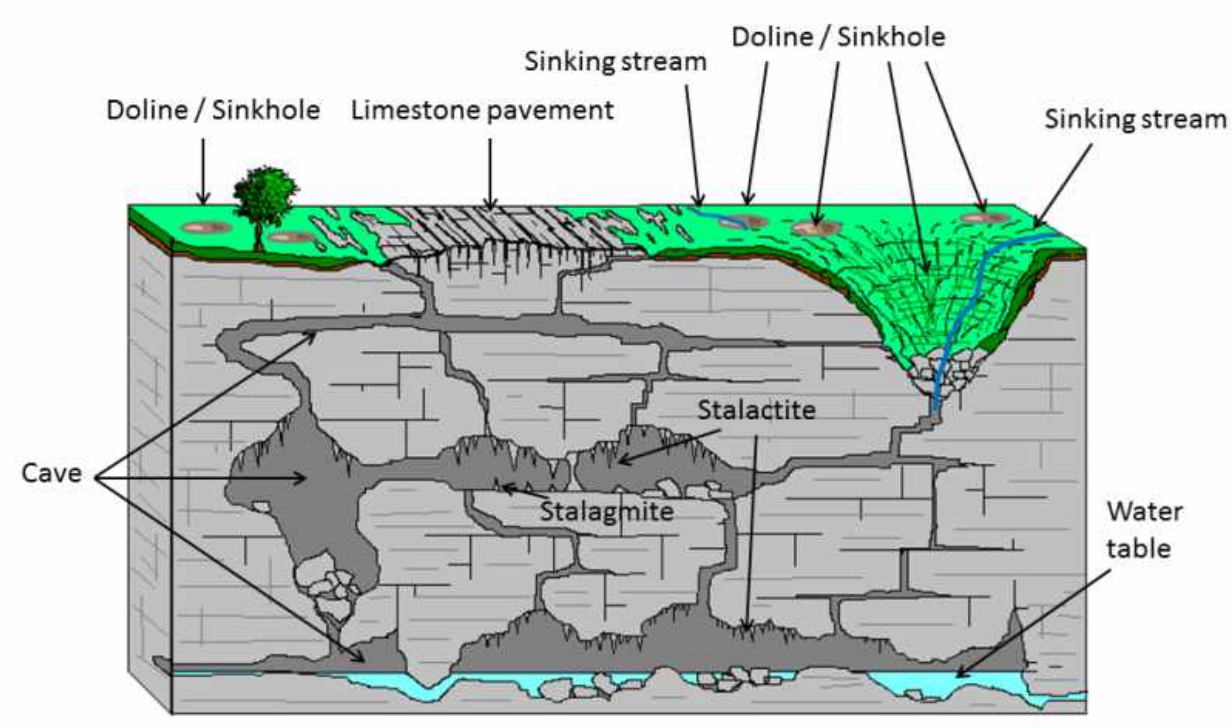


Figure 8: Karst Landscape

Mechanically Formed Sedimentary Rocks

Sandstone

Sandstone is formed when **particles** of eroded igneous, metamorphic and other sedimentary rocks are carried by rivers and accumulate on the sea bed or in lakes.

Irish sandstone formed 350-400 million years ago when Ireland by 30^{o} south of the equator. During this time Ireland was experiencing very **dry desert conditions**.

Old red sandstone is the most common sandstone in Ireland. Old red sandstone was laid down almost 400 million years ago. At this stage, the **Caledonian Mountains** of Galway, Mayo, Donegal and Wicklow were broken down by weathering and erosion. Flooding caused all this loose material to be deposited in the sea and lakes and the deposits were lithified.

Old Red Sandstone has a **brown-red or purple colour** due to the presence of iron oxide.

Example: **Cork and Kerry Mountains**

Conglomerate

If rock particles are rounded as a result of river or wave action the rock is called conglomerate. The particles become compressed with sand and mud.

Example: **Skerries, Co. Dublin**

Shale

Shale is compressed of fine particles of silt and clay. These were deposited in very thin layers on the beds of lakes and seas and lithified.

Example: **South Co. Clare.**

Chemically Formed Sedimentary Rocks

Chemically formed sedimentary rocks are termed **evaporates** and are formed as water is evaporated from a sea or salt water lake. They include gypsum and rock salt.

Gypsum

is used in the manufacture of cement and for plasterboard.

Example: **Kingscourt, Co. Cavan.**

Rock salt

Example: **Near Carrickfergus, Co. Antrim**

3. Metamorphic Rocks

2019

2B. Rocks

Examine the formation of each of the following, with reference to examples you have studied.

- **One** sedimentary rock
- **One** metamorphic rock. **[30m]**

2016

Rocks
Explain the formation of **one** igneous rock and **one** metamorphic rock, with reference to Irish examples **[30m]**

2013

Metamorphic Rocks

Explain the formation of metamorphic rocks, with reference to examples from Ireland. **[30m]**

2012

1B. Sedimentary and Metamorphic Rocks

Describe the formation of **one** sedimentary rock that you have studied **and** briefly explain how this rock may be transformed into a metamorphic rock. **[30m]**

2013 Marking Scheme

Name two metamorphic rocks	2 + 2 marks
Explanation	13 x SRPs

- Credit relevant labelled diagram for 1 x SRP
- Credit extra relevant information on labelled diagram for 2 x SRPs
- Credit 3rd named metamorphic rock for 1 x SRP
- Diagram without labelling 0 marks.

Metamorphic rocks arise from the transformation of existing **rock** types, in a process called **metamorphism**.

Metamorphic rocks igneous or sedimentary rocks that has gone through some physical and chemical change as a result of heat and/or pressure.

Factors that determine the rock produced are:

- The **pressure** and amount of **liquid** within the changing rock.
- The length of **time** the rock is subjected to high temperatures or pressure.
- Whether the changing rock is **compressed** or **twisted**.

There are three types of metamorphism:

1. **Thermal Metamorphism**: the heat of the magma intrusion 'cooks' the original rock. Quartzite is an example as sandstone is baked by the heat from the magma below and changes into quartzite.

2. **Regional Metamorphism**: this occurs where rocks are changed by both heat and pressure. This type of metamorphism occurs over large areas and is due to the pressure. This type of metamorphism over large areas and is due to the gradual movement of earth's plates, e.g. **Gneiss**.

3. **Dynamic Metamorphism**: this occurs where rocks are changed by great due to plate movement, e.g. **Slate**.

The following changes have occurred due to metamorphism:	
Granite	Gneiss
Limestone	Marble
Shale	Schist or Slate
Sandstone	Quartzite

Thermal Metamorphism

Marble

Marble rock is a hard crystalline rock and is formed by heat and pressure on limestone. Marble is formed when limestone is pushed down deep by buckling rock layers when plates collide at destructive boundaries. When limestone comes into contact with this cooling magma changes into marble.

Marble is a coarse-grained rock, whose parent rock was either limestone or chalk. White marble results from pure limestone changing composition.

Often the limestone from which the marble forms contains impurities either can be seen in the marble. The presence of iron oxide can give a pink or red colour (cork), serpentine gives green colour (Connemara) and carbon gives a dark grey colour.

Example: **Green marble, Connemara, Co. Galway.**

Quartzite

Quartzite is formed when layers of sandstone are buckled and pushed deep down by colliding plates and come in contact with cooling magma. The intense heat and pressure changes sandstone into quartzite.

Quartzite is a very hard rock and it is formed of the great and the little sugar loafs in county Wicklow, the peak of Croagh Patrick, County Mayo and Errigal in Donegal. Quartzite is primarily used for road surfacing.

Example: **Errigal, Co. Donegal.**

Regional Metamorphism

Gneiss

Gneiss is formed from the regional metamorphism of Granite. Many of the original minerals are still present but have become segregated into pale and dark wavy bands.

Example: **Belmullet Peninsula, Co. Mayo.**

Dynamic Metamorphism

Slate

Slate forms where layers of shale are squeezed intensely as a result of colliding plates. Heat only plays a small part in the formation of slate. This means that slate was formed when it was a farther distance from magma than marble or quartzite.

When slate is found close to the magma it forms schist rather than slate.

Slate is a fine-grained rock that is dark grey or black. Slate is used for roofing.

Example: **Slate-Valentia, Co Kerry.**

Schist: Ballycastle, Co. Antrim.

Name:	Marble	Quartzite	Slate
Type			
Formation			
Use			
Example			

4. Human Interaction With The Rock Cycle

2018/2015/2013/2009/2007/2006

Human Interaction with the Rock Cycle

Humans interact with the rock cycle in a number of ways.
Describe and explain how this interaction with the rock cycle takes place, with reference to one of the following:

- Mining
- Extracting building materials
- Oil/gas exploitation
- Geothermal energy production. **[30m]**

2010/2011

Human Interaction

Humans interact with the rock cycle in many ways. Discuss this with reference to any **one** human interaction you have studied. **[30m]**

2018 Marking Scheme

Description/Explanation 15 x SRP's

- Credit 2 x SRP's for named specific examples. Examples may be a named company, location etc.
- Credit relevant labelled diagram for 1 x SRP. Diagram without labelling 0 marks.
- Credit additional relevant information on a labelled diagram for 2 x SRP's. This must be information not already awarded in the written account.
- Information awarded on a diagram if presented must be valid and relevant to the set question.
- Question is not tied to Ireland.
- Discussion may be positive or negative.

Geothermal Energy Production

Geothermal energy is the heat from the earth. It is clean and sustainable.

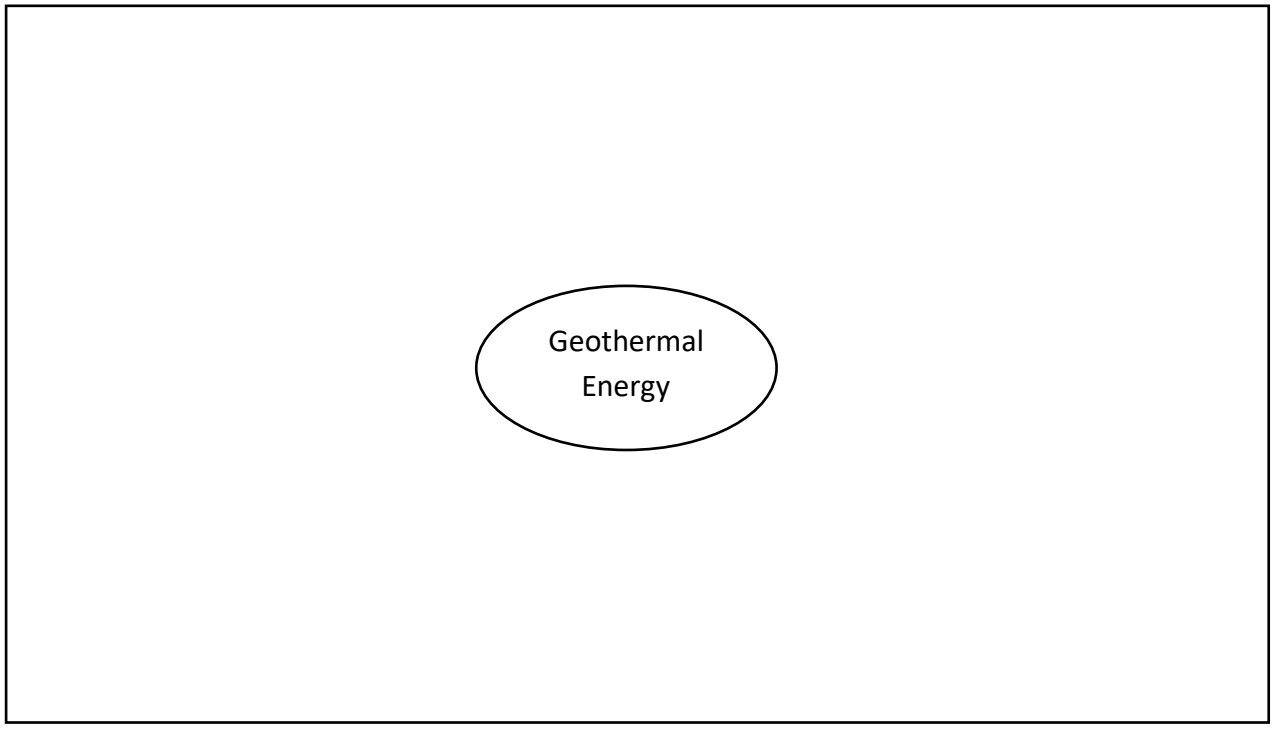
Geothermal energy is produced when underground heat is transferred to the surface of the earth by water. The water is heated through contact with the hot igneous rock and magma to generate steam which can be used to produce electricity.

Geothermal energy uses the rock cycle to provide **heat and power**. Geothermal energy can be tapped either at or near the surface or from magma miles below the surface of the earth.

Geothermal heating is a method of heating and cooling a building. It takes advantage of the natural warmth stored in the earth. Geothermal power is the use of geothermal heat to generate electricity.

Iceland is a pioneer in the use of geothermal energy for **space heating**. The generation of electricity using geothermal energy has increased dramatically over the past decade. Currently, geothermal power generates 25% of the country's total electricity production.

Throughout the **20th century**, Iceland transformed itself from one of Europe's poorest countries, dependant on peat and imported coal for its energy, to a country with a high standard of living where practically all stationary energy is derived from renewable resources. Presently, approximately 9 out of 10 Icelandic households are heated with geothermal energy.



A **geyser** is a hot spring that is under pressure and erupts, sending jets of water and steam into the air. Geysers are common in Iceland s it is a volcanic island formed by the tectonic forces operate along the Mid-Atlantic Ridge. The magma that rises close to the surface heats water to create natural features as well as a source of energy. The term geyser is an Icelandic word for gusher.

Iceland uses its geothermal energy reserves to provide a **native source of energy**, reduce the need for fuel imports and tourism.

In the south of Iceland and the **Hengill volcano** is a good example of how energy is produced. At the **Nesjavellir power plant**, cold water is pumped into the wells that have been drilled in the rock. The water is heated and turns to steam. The steam, when it returns to the surface, it passed through turbines to generate electricity.

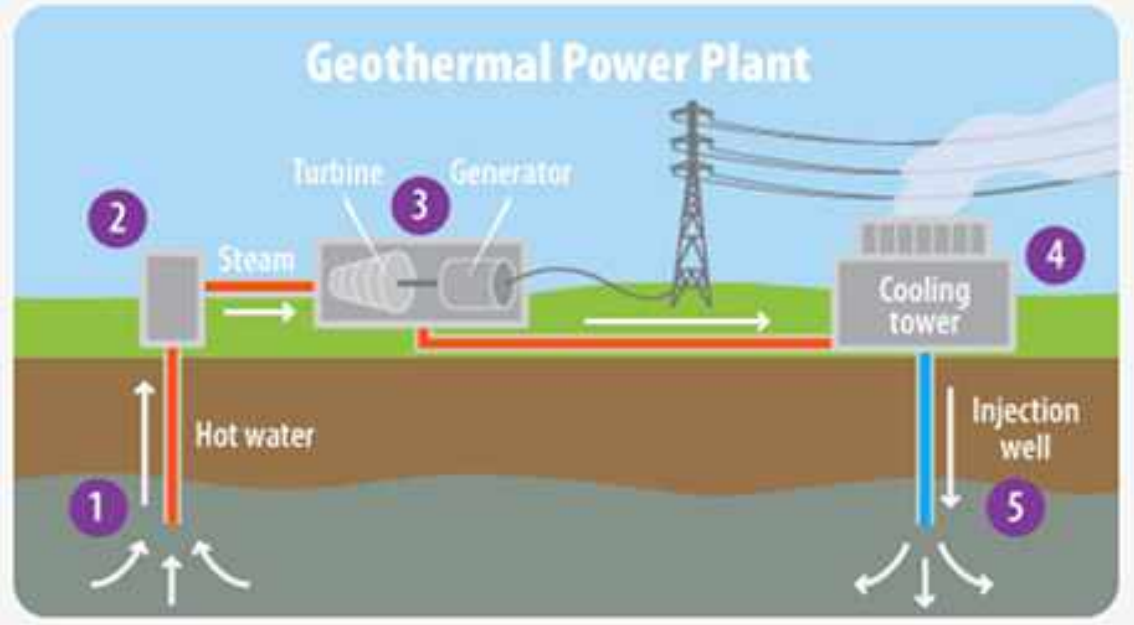
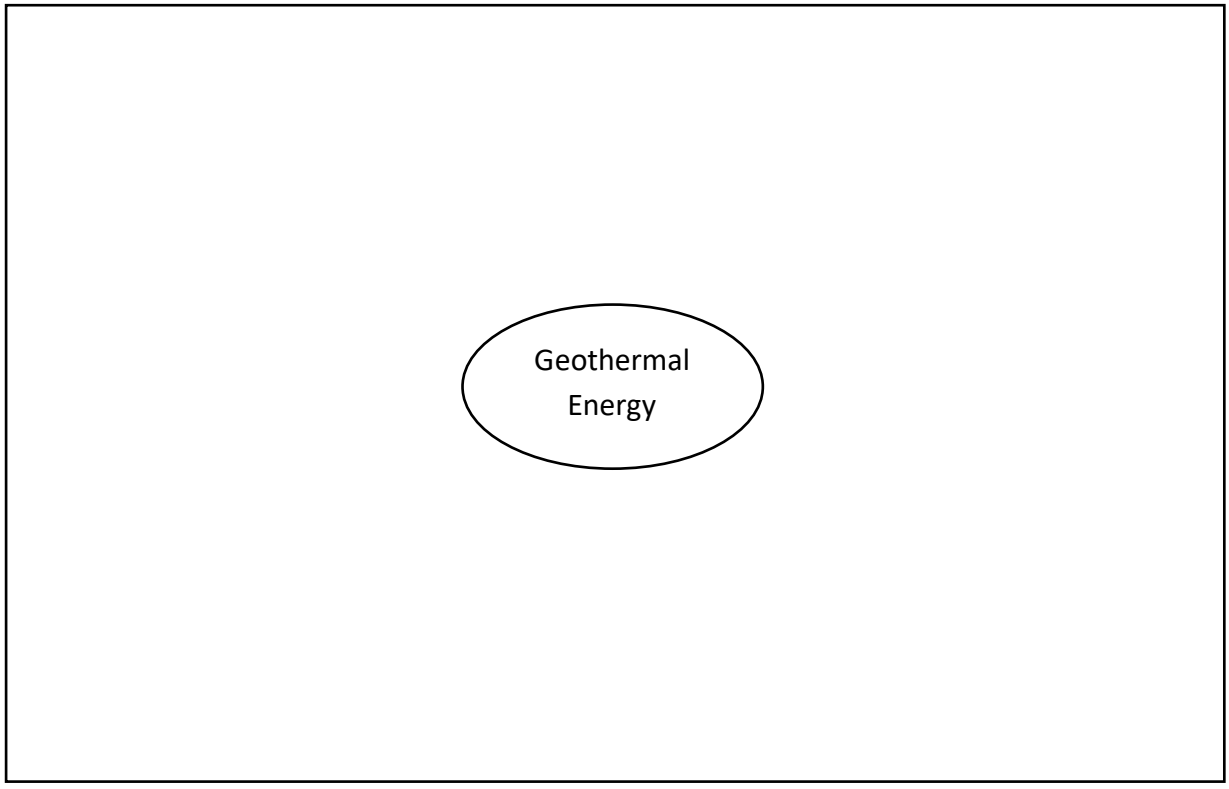


Figure 7: Geothermal Power Plant

The heated water is then piped to the capital, Reykjavik, and is used for **central heating** in homes, offices and industries (for example to heat glasshouses for market gardening). As a result, Reykjavik is one of the cleanest cities in the world.

In Iceland geothermal energy attracts **tourists**. The **blue lagoon** geothermal spa is one of the most visited attractions in Iceland. The blue lagoon is a man-made lagoon which is fed by the water output of the nearby geothermal plant.

The warm water is rich in **minerals** such as sulphur and silica and bathing in the blue lagoon is reputed to help some people suffering from skin diseases. Superheated water is vented from the ground near a lava flow and used to run turbines that generate electricity.



The Rock Cycle: Long Questions

2019

2B. Rocks

Explain the formation of each of the following, with reference to examples that you have studied:

- One sedimentary rock
- One metamorphic rock. **[30m]**

3B Landscape Development

Explain how different rock types produce distinctive landscapes in Ireland, with reference to examples that you have studied. **[30m]**

2018

3B. Human Interaction with the Rock Cycle

Humans interact with the rock cycle in a number of ways.
Describe and explain how this interaction with the rock cycle takes place, with reference to one of the following:

- Mining
- Extracting building materials
- Oil/gas exploitation
- Geothermal energy production. **[30m]**

2016

1B. Rocks

Explain the formation of one igneous rock and one metamorphic rock, with reference to Irish examples. **[30m]**

2B Landscape development

Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

2015

2B. Sedimentary Rocks

Explain the formation of sedimentary rocks, with reference to Irish examples. **[30m]**

3C. Human Interaction with the Rock Cycle

Humans interact with the rock cycle in a number of ways.
Describe and explain how this interaction with the rock cycle takes place, with reference to one of the following:

- Mining
- Extracting building materials
- Oil/gas exploitation
- Geothermal energy production. **[30m]**

2014

1B. Rocks
Explain the formation of igneous rocks with reference to Irish examples. **[30m]**

2C. Rocks and Landscapes
Examine how different rock types produce distinctive landscapes, with reference to examples that you have studied. **[30m]**

3C. Sedimentary Structures
Examine how sedimentary structures, such as bedding planes and joints, influence the development of landforms. **[30m]**

2013

1B. Rocks
Explain the formation of metamorphic rocks, with reference to examples from Ireland. **[30m]**

2C. Human Interaction
Examine how humans interact with the rock cycle, with reference to **one** of the following:

- Mining
- Extracting building materials
- Oil/gas exploitation
- Geothermal energy production. **[30m]**

2012

1B. Sedimentary and Metamorphic Rocks
Describe the formation of **one** sedimentary rock that you have studied **and** briefly explain how this rock may be transformed into a metamorphic rock. **[30m]**

2011

1C. Human Interaction
Explain, with reference to **one** human interaction with the rock cycle, that you have studied, how humans benefit economically from this interaction. **[30m]**

3B. Igneous Rock
Explain the formation of **two** igneous rocks, with reference to examples from Ireland. **[30m]**

2010

1C. Rocks
Examine, with reference to examples from Ireland, the formation of metamorphic rocks. **[30m]**

2C. Human Interaction
Humans interact with the rock cycle in many ways. Discuss this with reference to any **one** human interaction you have studied. **[30m]**

2009

2B. Rocks
Examine, with reference to examples from Ireland, the formation of sedimentary rocks. **[30m]**

2C. Human Interaction

Discuss, with reference to **one** of the following, how humans interact with the rock cycle:

- Mining
- Extracting building materials
- Oil/gas exploitation
- Geothermal energy production. **[30m]**

2008

3B. Rock Type and Landscape

Examine, with reference to an example you have studied, the formation of **one** rock-type and how it produces a distinctive landscape. **[30m]**

3C. Karst Landscapes

With reference to the Irish landscape, examine the processes which have influenced the development of any landform in a karst region. **[30m]**

2007

2C Interaction with the Rock Cycle

Referring to any **one** of the following, examine how humans interact with the rock cycle:

- Mining,
- Quarrying
- Oil/gas exploration
- Geothermal energy production. **[30m]**

2006

1B Landforms & Rock Type

With reference to any **one** rock type, explain how it was formed **and** how it can produce a distinctive landscape. **[30m]**

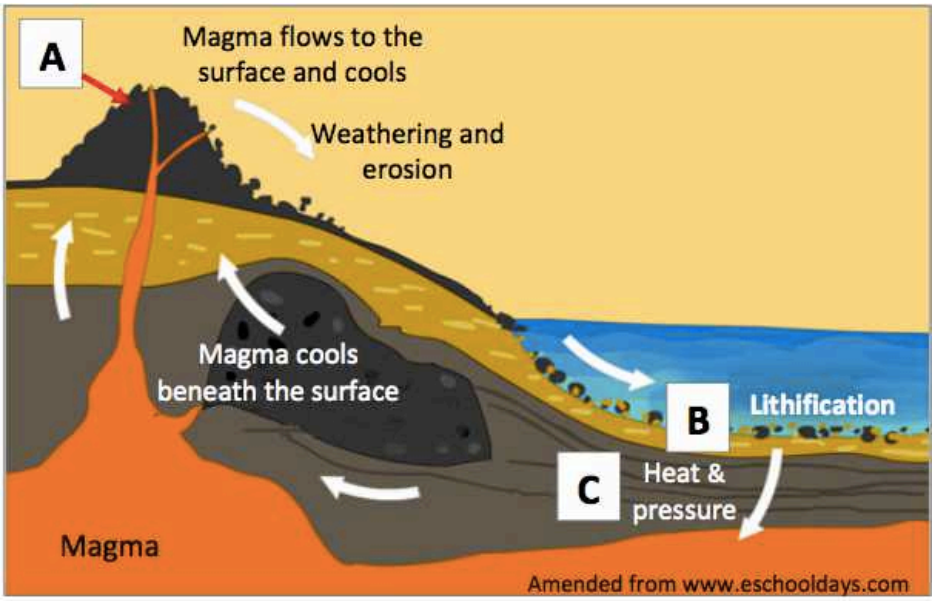
1C Human Interaction With Rock Cycle

Examine how humans interact with the rock cycle in the case of **one** of the following: mining, quarrying, oil/gas exploration, geothermal energy production. **[30m]**

The Rocks Cycle: Part A's

2017

3A. Rock cycle



Examine the diagram of the rock cycle above and answer each of the following questions.

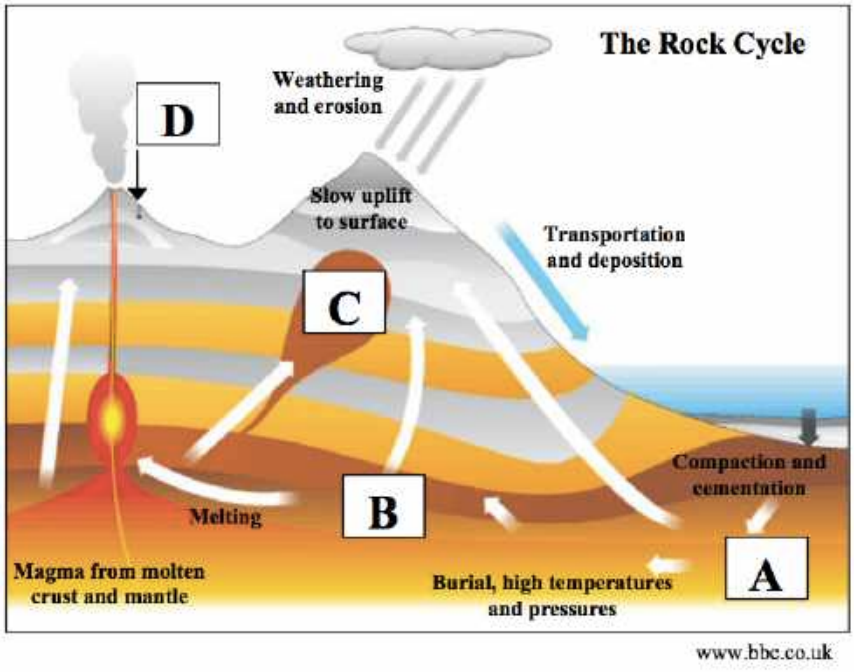
i. Name the category of rock formed at A and the category of rock formed at B.
ii. Name the category of rock formed at C and name one specific Irish location where this rock can be found.
iii. Explain briefly what is meant by the term lithification.
iv. Explain briefly what is meant by the term plutonic rock.
v. Explain briefly how rocks are changed by either thermal metamorphism or regional metamorphism. **[20m]**

Marking Scheme

(i)	A	Igneous rock	2 marks
	B	Sedimentary rock	2 marks
(ii)	C	Metamorphic rock	2 marks
		One Irish location	2 marks
(iii)	Valid explanation		2 + 2 marks
(iv)	Valid explanation		2 + 2 marks
(v)	Valid explanation		2 + 2 marks

2012

3A. Rock Cycle



Examine the diagram of the rock cycle above and answer the following questions.

i. Name the category of rock formed at A and name one example of this category of rock.
ii. Name the category of rock formed at B and name one example of this category of rock.
iii. Name one example of an igneous rock which is formed at C.
iv. Name one example of an igneous rock which is formed at D.
v. Briefly explain the difference between the process of weathering and the process of erosion. **[20m]**

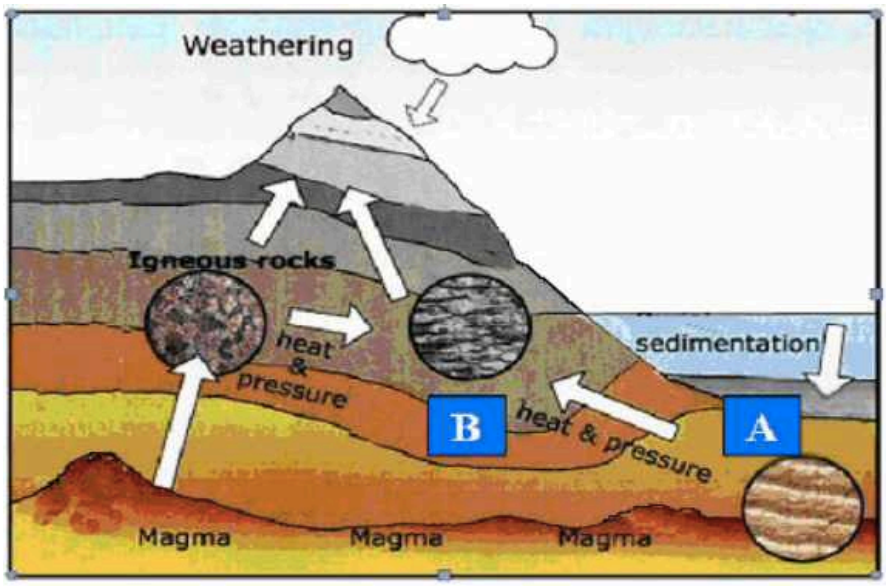
Marking Scheme

5 Parts @ 4 marks each

(i)	A - Sedimentary	2 marks
	Example	2 marks
(ii)	B - Metamorphic	2 marks
	Example	2 marks
(iii)	C - Any valid example	4 marks
(iv)	D - Any valid example	4 marks
(v)	Any valid explanation	2 + 2 marks

2009

3A. The Rock Cycle



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Examine the diagram above and answer the following **in your answer book**:

i. Identify the rock group found at **A**.
ii. Name **one** example of a rock within the rock group named in part
iii. Identify the rock group found at **B**.
iv. Name **one** igneous rock formed **below** the earth's surface.

[20m]

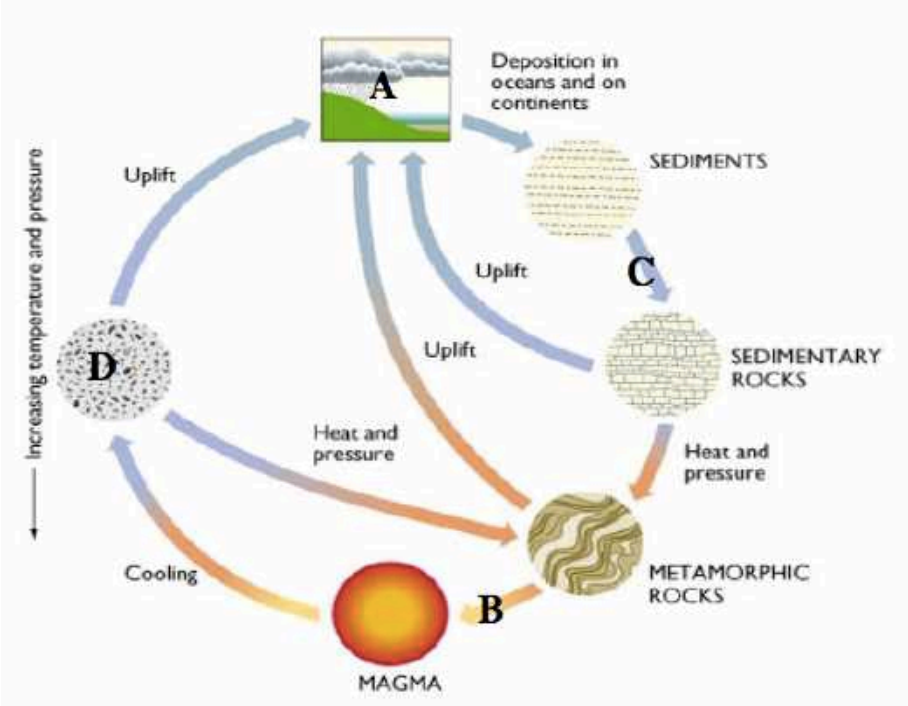
Marking Scheme

Four answers @ 5 marks each
No grading / scaling of marks.

(i) **A** = Sedimentary
(ii) Any valid example
(iii) **B** = Metamorphic
(iv) Granite / or any other intrusive igneous rock

2006

1A. Rock Cycle



In your answer-book, match **each** of the descriptions below with the correct label A to D in the diagram above:

- Igneous rock
- Burial and lithification
- Weathering and erosion
- Melting **[20m]**

Marking Scheme

Four sections @ 5 marks each
- No grading / scaling of marks