

Surname	Centre Number	Candidate Number
Other Names		0

**GCSE**

4250/01



S15-4250-01-R1

GEOLOGY**Theory Paper****(Paper version of on-screen assessment)**

A.M. WEDNESDAY, 20 May 2015

1 hour 30 minutes

For Examiner's use only		
Section	Maximum Mark	Mark Awarded
1.	9	
2.	19	
3.	15	
4.	10	
5.	21	
6.	18	
7.	8	
Total	100	

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010001**ADDITIONAL MATERIALS**

In addition to this examination paper you will need a:

- Data Sheet;
- calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets alongside each question.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answers to **Section 3 Q4** and **Section 5 Q5**.

Answer **all** questions in each section.

Section 1 – answer questions 1-3

Figure 1 is a photograph of a river valley.



Figure 1

1. Which **two** of the following apply to this river and the valley? Tick (✓) only **two** boxes.

[2]

V-shaped valley

☐

meandering river channel

☐

eroded by ice

☐

upland area

☐

flat flood plain

☐

forms a delta

☐

2. Erosion involves the transport of solid weathered material by water, wind, ice or gravity. Draw a line from each of the following descriptions to the correct geological term. [4]

	traction
wearing down of a river bed by the impact of sediment being carried in the water	attrition
angular fragments at the foot of a steep slope	saltation
wearing down of grains due to collision with other grains carried by the wind	suspension
grains bouncing along a river bed	abrasion
	scree

Figure 2 is a photograph of a *sinkhole* – a large hole which suddenly appears in the ground. Sinkholes are an increasing problem in Britain where the bedrock is well jointed limestone.



Figure 2

Figure 3 shows how a *sinkhole* forms.

clay and soil
suddenly collapse
into a cavity in the
well jointed limestone
creating a sinkhole

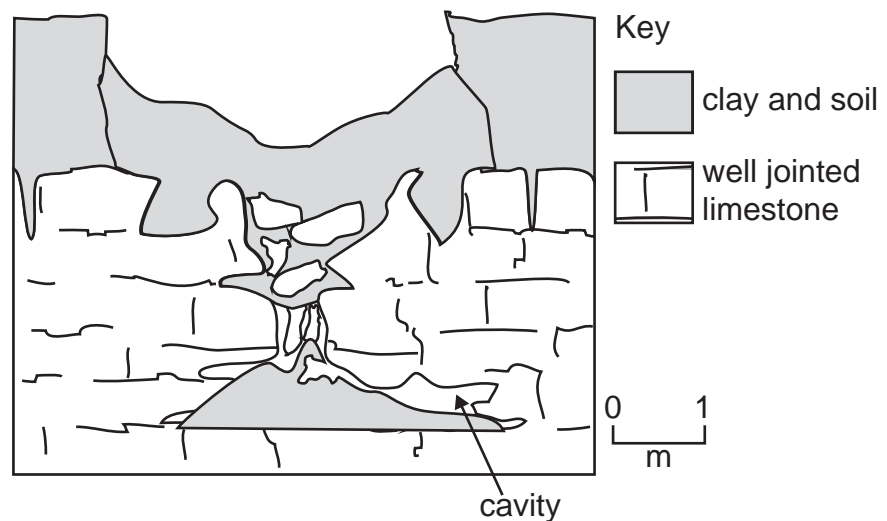


Figure 3

3. Describe the **weathering process** which produces the cavity in the underlying well jointed limestone. [3]

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Section 2 – answer questions 1-11

Examiner
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1. Which **two** of the following statements are **incorrect**? Tick (✓) only **two** boxes.

[2]

a bed is a layer of sedimentary rock more than 1 cm thick

☐

strike is the compass bearing of a horizontal line on a bedding plane

☐

angle of dip is the maximum angle of dip of a bedding plane from the vertical

☐

if the strike direction is N–S the bed could be dipping west

☐

if the direction of dip of a bed is NE then the strike is NE–SW

☐

on a horizontal surface the outcrop of a bed is narrower if the angle of dip is steeper

☐

Figure 4 is a geological map.

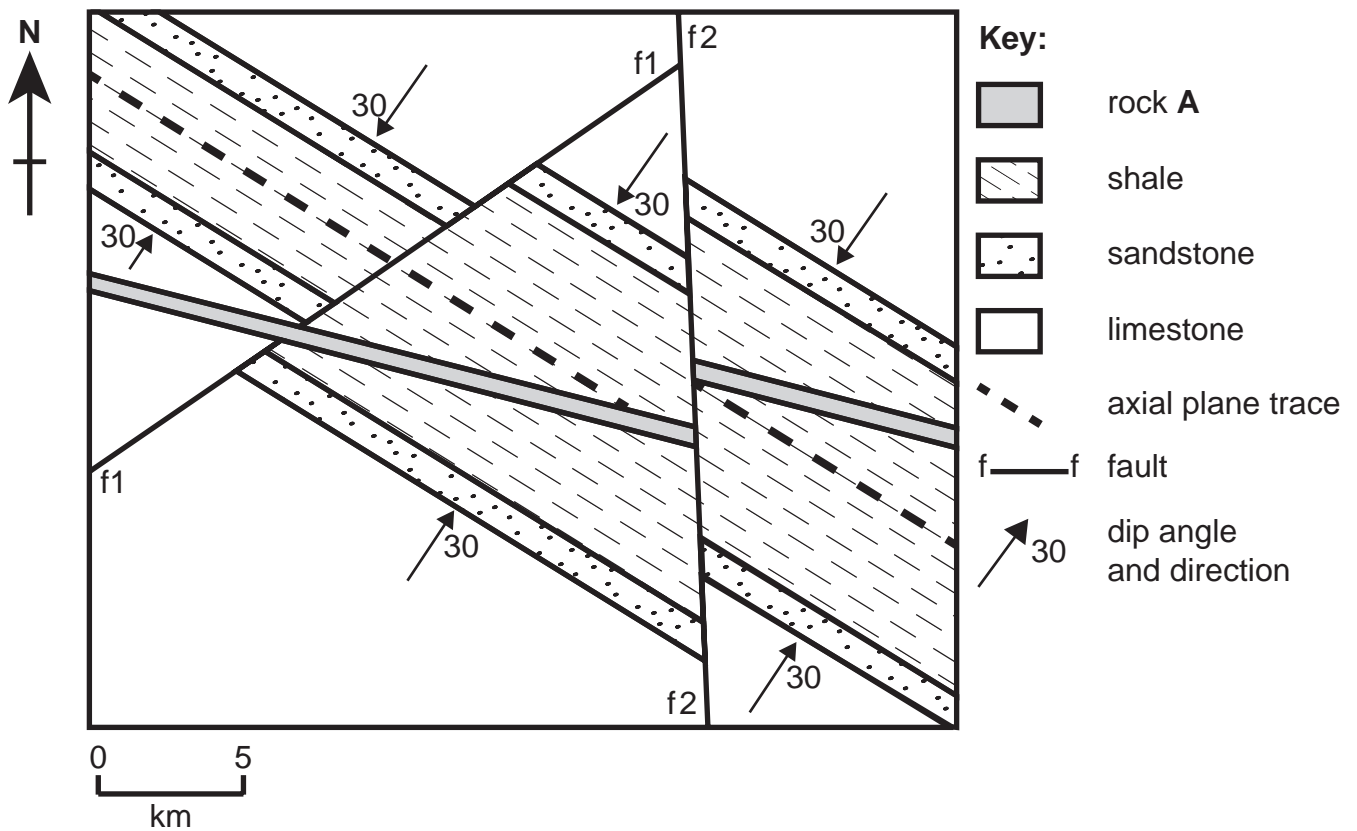


Figure 4

2. Which **two** of the following statements about the map are **correct**? Tick (✓) only **two** boxes.[2]

the fold is an anticline

☐

fault **f1** is a strike-slip fault

☐

the axial plane of the fold is dipping at 30°

☐

the fold limbs have different dip angles

☐

fault **f2** is a dip-slip fault (normal/reverse/thrust)

☐

the axial plane trace has a NW–SE trend

☐

the fold is a syncline

☐

3. Name the type of igneous body formed by **rock A** in **Figure 4**.

[1]

sill	<input type="checkbox"/>
pluton	<input type="checkbox"/>
dyke	<input type="checkbox"/>
lava flow	<input type="checkbox"/>
volcanic central vent	<input type="checkbox"/>

4. List **fault f1**, **fault f2** and **rock A** in **Figure 4** in order of relative age in **Table 1**.

[2]

	youngest
	↑
	oldest

Table 1

5. Name the most appropriate method to determine the relative ages of the faults and igneous **rock A** in **Figure 4**. Tick (✓) only **one** box.

[1]

cross cutting relationships	<input type="checkbox"/>
original horizontality	<input type="checkbox"/>
superposition of strata	<input type="checkbox"/>
lateral continuity	<input type="checkbox"/>
included fragments	<input type="checkbox"/>

Figure 5 is a photograph of a quarry face.

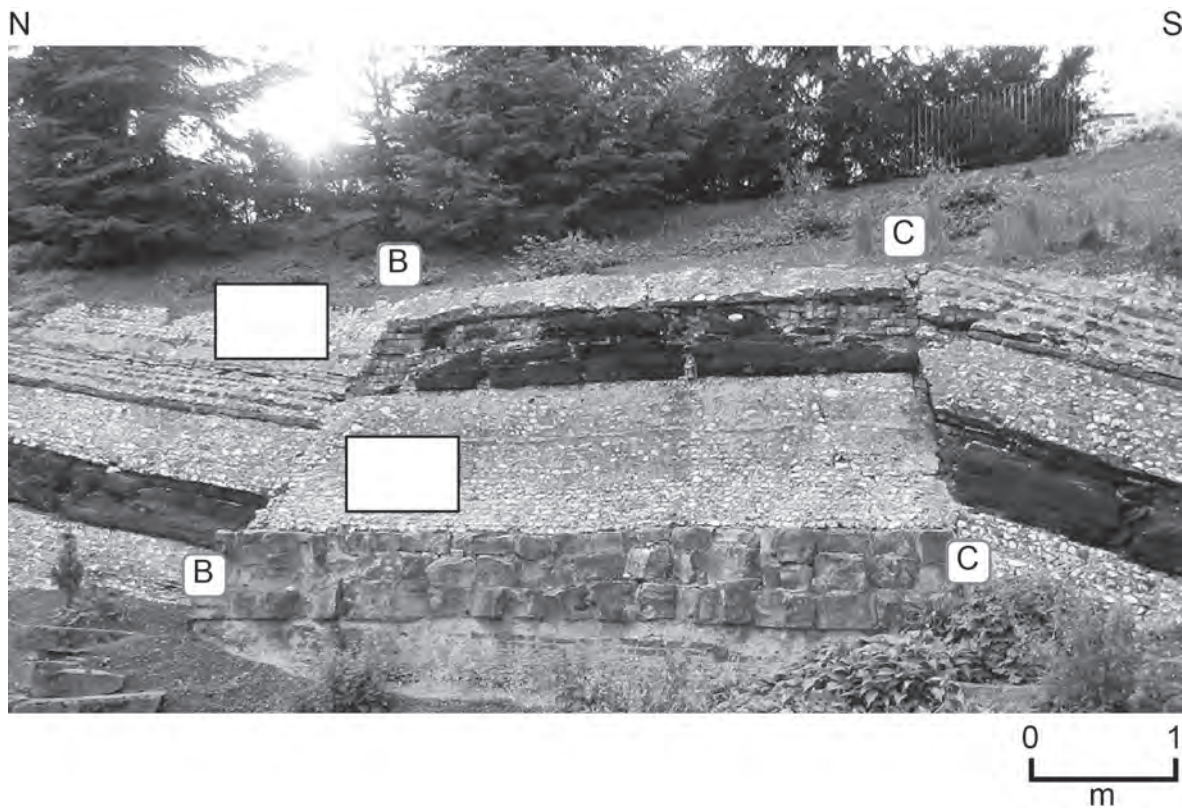


Figure 5

6. Identify the type of faults (**B** and **C**) on **Figure 5**. Tick (✓) only **one** box.

[1]

faults **B** and **C** are both reverse faults

☐

fault **B** is a reverse fault, fault **C** is a normal fault

☐

fault **B** is a normal fault, fault **C** is a reverse fault

☐

faults **B** and **C** are both normal faults

☐

faults **B** and **C** are both thrust faults

☐

7. Which **two** of the following statements about fault **C** are **correct**? Tick (✓) only **two** boxes. [2]

the fault plane is vertical

☐

the downthrow side is to the south

☐

the amount of displacement along the fault is less than fault **B**

☐

the fault plane dips to the north

☐

the foot wall is to the south

☐

the downthrow side is to the north

☐

the fault plane is dipping at a lower angle than the bedding

☐

8. Selecting from the choice below, draw an arrow in each of the empty boxes in **Figure 5** to show the directions of tectonic stress affecting fault **B**. [1]



Figure 6 is a student's field sketch of an igneous body in an exposure just off the map in **Figure 4**.

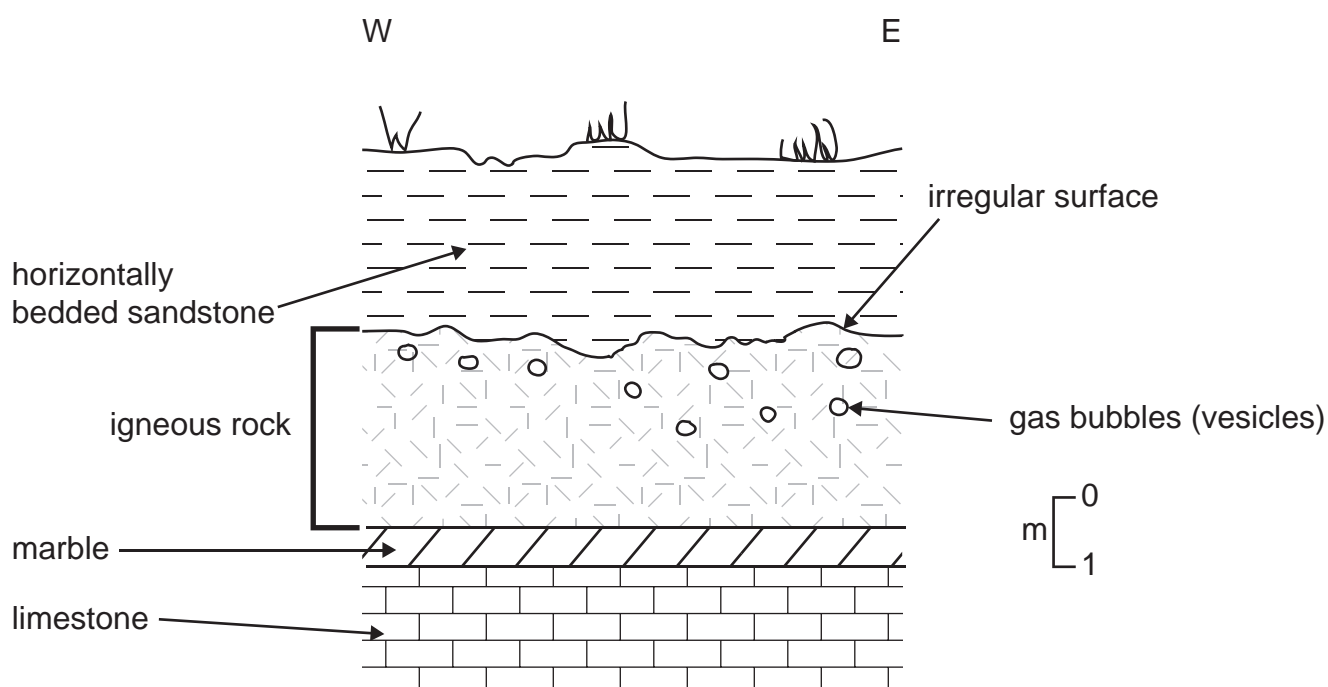


Figure 6

9. The student **incorrectly** identified the igneous body as a **sill**. Give **two** pieces of evidence from **Figure 6** which suggest that it is **not** a sill. [2]

1.
2.

Figure 7 is a microscope view of the rock forming the igneous body in **Figure 6**.

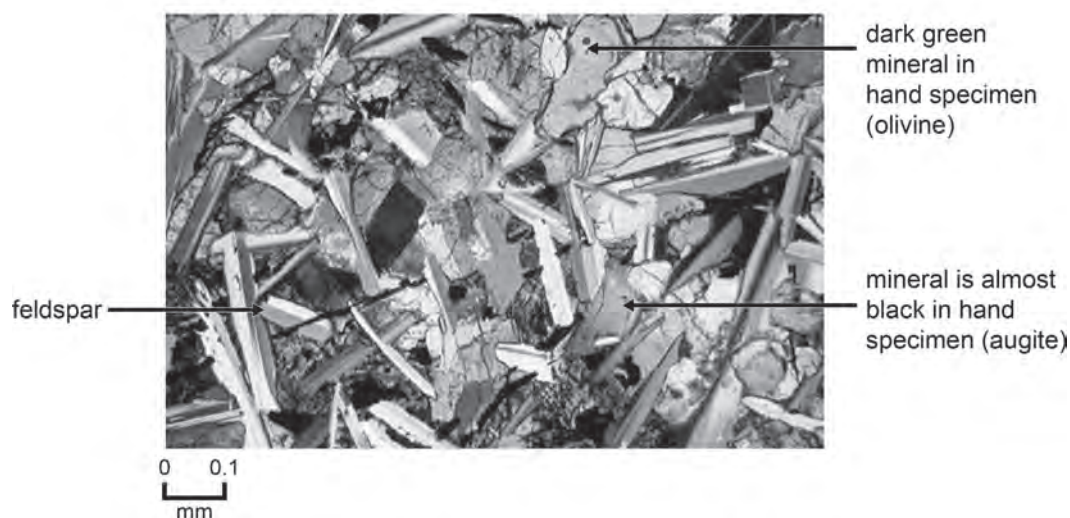


Figure 7

- 10.** Which **two** of the following statements about the rock in **Figure 7** are **correct**? Tick (✓) only **two** boxes. [2]

- | | |
|-----------------------------|--------------------------|
| the rock is gabbro | <input type="checkbox"/> |
| the crystals show alignment | <input type="checkbox"/> |
| the rock is basalt | <input type="checkbox"/> |
| the rock is poorly sorted | <input type="checkbox"/> |
| the crystal size is fine | <input type="checkbox"/> |
| the crystal size is coarse | <input type="checkbox"/> |

- 11.** Explain why the crystal size varies in igneous rocks.

[3]

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Section 3 – answer questions 1-8

Figure 8 is a photograph of an exposure of rock and an enlargement to show the texture of rock **D**. Bed **E** is the location of a sedimentary structure shown in **Figure 9**.

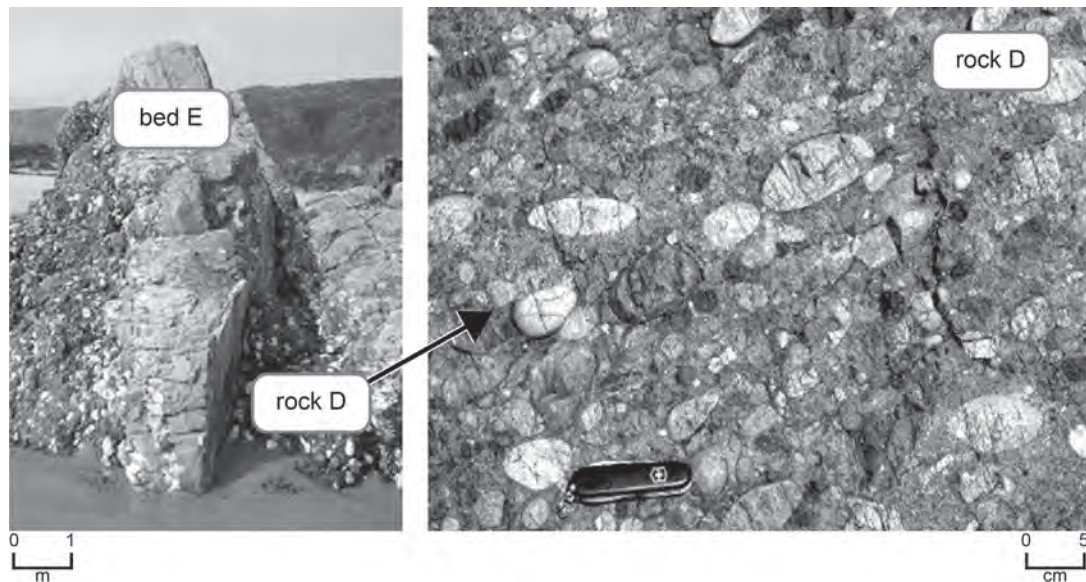


Figure 8

1. Describe the texture of rock **D**. Tick (✓) only **two** boxes.

[2]

- | | |
|---------------------------------|--------------------------|
| crystalline | <input type="checkbox"/> |
| well sorted | <input type="checkbox"/> |
| coarse grained fragments | <input type="checkbox"/> |
| medium grained fragments | <input type="checkbox"/> |
| foliated | <input type="checkbox"/> |
| rounded to subrounded fragments | <input type="checkbox"/> |

2. Name rock **D**. Tick (✓) only **one** box.

[1]

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sandstone

☐

conglomerate

☐

shale

☐

limestone

☐

breccia

☐

Figure 9 shows a sedimentary structure found in bed **E** of the rock exposure in **Figure 8**.

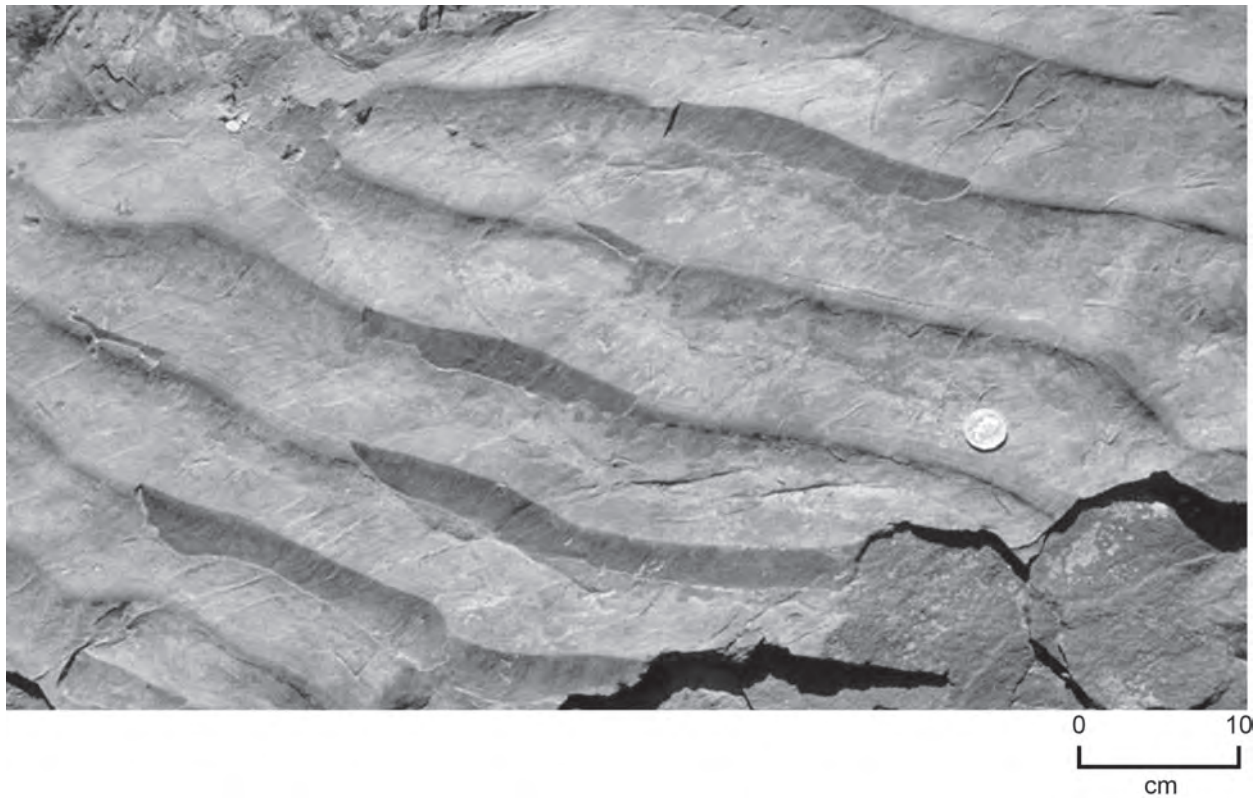


Figure 9

[1]

3. Name the sedimentary structure. Tick (✓) only **one** box.

graded bedding

☐

cross bedding

☐

desiccation cracks

☐

ripple marks

☐

unconformity

☐

4. Using evidence from rock **D** and the sedimentary structure, describe the evidence for the changing energy conditions during the deposition of the rocks shown in **Figure 8**. QWC [4]

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Figure 10 shows two views of an assemblage of fossils on a bedding plane of rock **F**.

Examiner
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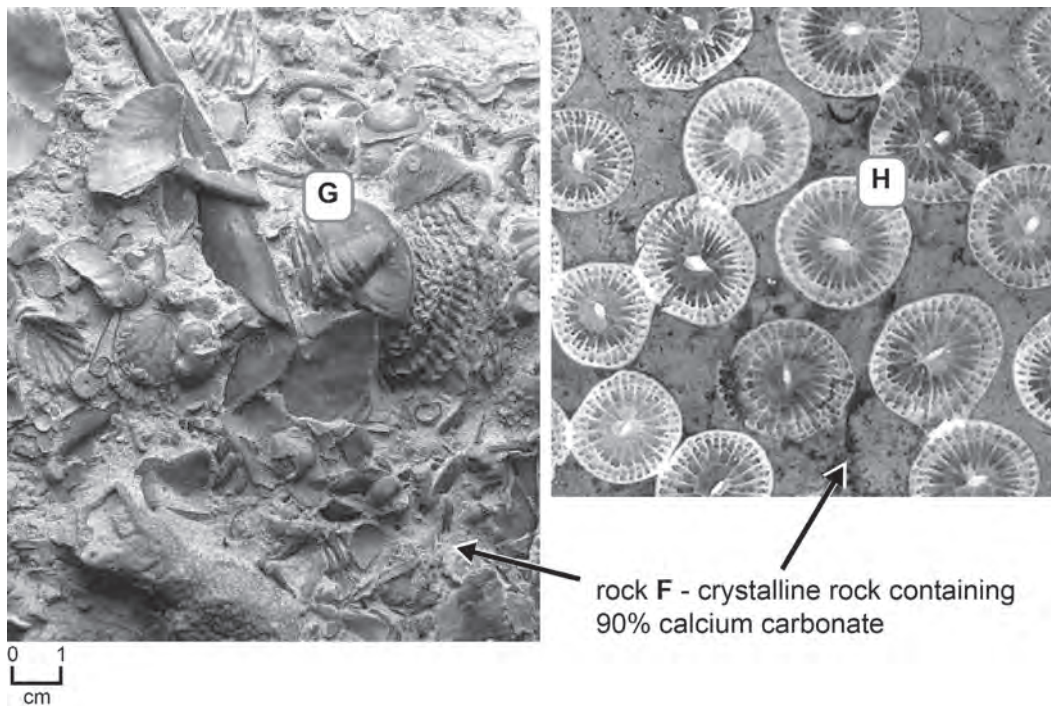


Figure 10

5. Identify the fossils from the fragments **G** and **H** in **Figure 10**. Draw a line from each letter to the correct name. [2]

G

goniatite

graptolite

coral

H

trilobite

ammonite

6. Identify rock **F**. Tick (✓) only **one** box. [1]

sandstone ☐

shale ☐

halite ☐

limestone ☐

coal ☐

7. Using evidence from the **rock** and **both** fossils, describe the most likely environment in which rock **F** was deposited. [3]

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Figure 11 shows the time ranges of three fossil graptolites (**K**, **L** and **M**) which were collected from one bedding plane of shale rock.

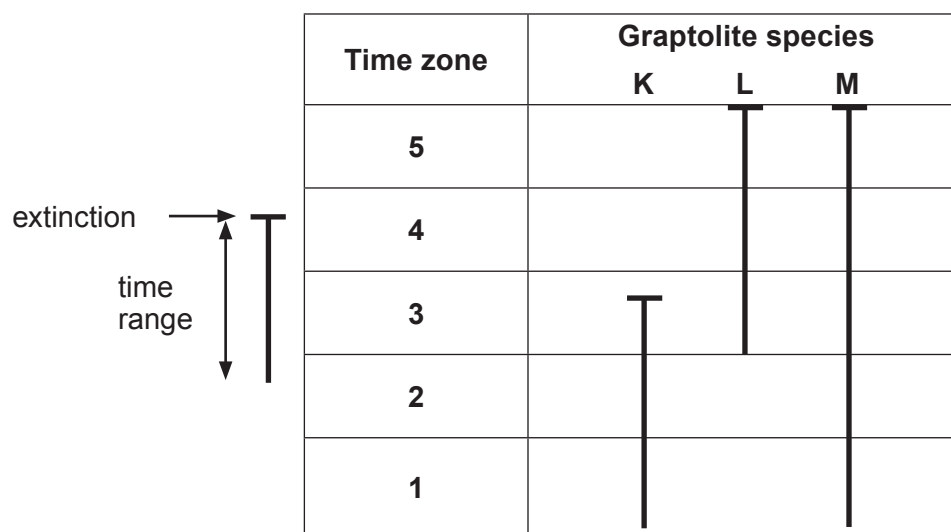


Figure 11

8. During which time zone (1 - 5) was the shale deposited? Tick (✓) only **one** box.

[1]

1	<input type="checkbox"/>
2	<input type="checkbox"/>
3	<input type="checkbox"/>
4	<input type="checkbox"/>
5	<input type="checkbox"/>

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Section 4 – answer questions 1-5

1. Draw a line from each of the following events to the correct geological time.

[2]

	Lower Palaeozoic
	Upper Palaeozoic
opening of the north Atlantic	Carboniferous
Caledonian orogeny	Mesozoic
	Cenozoic
	Pleistocene

2. An exposure of slate can be used as part of the evidence for ancient convergent (destructive) plate margins. Which **one** of the following does **not** provide evidence for plate collision during the Caledonian orogeny? Tick (✓) only **one** box.

[1]

granite intrusion	<input type="checkbox"/>
turbidites	<input type="checkbox"/>
thrust faulting	<input type="checkbox"/>
NE–SW folding	<input type="checkbox"/>
extrusion of flood basalts	<input type="checkbox"/>

Figure 12 is a microscope view of **slate** with the direction of cleavage shown.

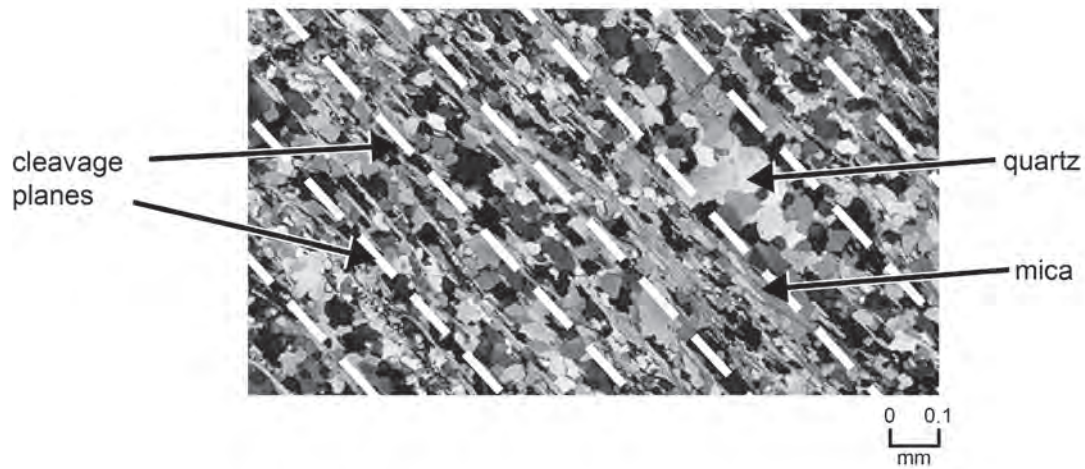


Figure 12

3. Explain why the slate splits along the cleavage planes.

[2]

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4. Which **two** of the following processes in the rock cycle lead to the formation of slate?
Tick (✓) only **two** boxes.

[2]

cooling and crystallisation of magma

☐

recrystallisation of minerals

☐

intrusion and extrusion

☐

magma collects in a chamber

☐

partial melting of the mantle

☐

regional metamorphism

☐

5. The natural landscape can be modified by the extraction of large volumes of material such as slate which is used in the construction industry. Disused quarries and pits are often adapted for leisure purposes or tourism. Describe **one other** way that this land could be used once extraction has finished. [3]

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10

Section 5 – answer questions 1-10

Figure 13 shows the pattern and ages of magnetic stripes in the ocean crust at a mid-ocean ridge.

Key

normal magnetic polarity



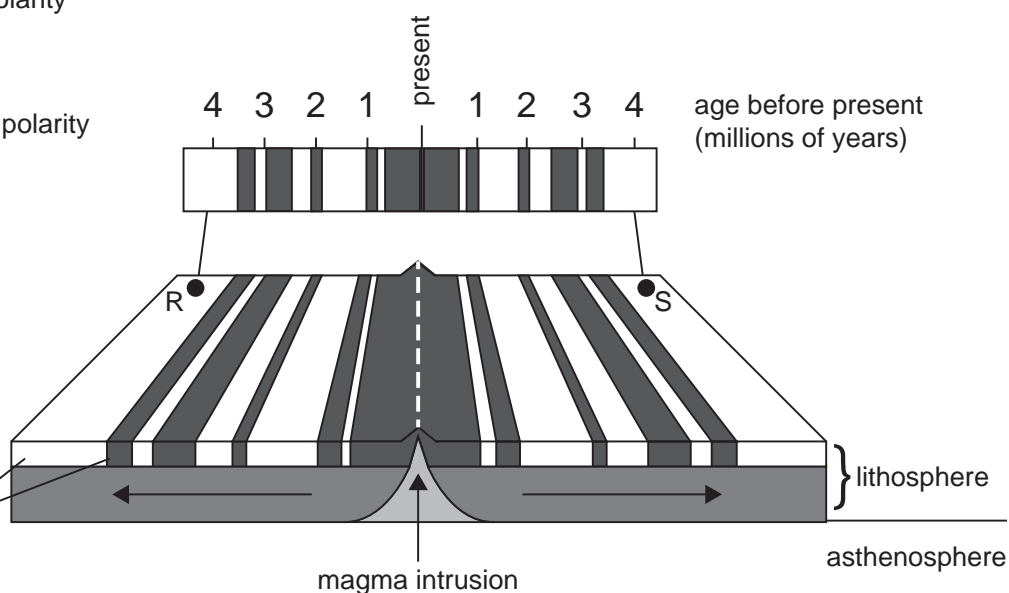
reversed magnetic polarity



mid-ocean ridge



oceanic crust

**Figure 13**

1. Name the type of plate boundary shown in **Figure 13**. Tick (✓) only **one** box.

[1]

convergent (destructive) ocean-ocean

☐

convergent (destructive) ocean-continental

☐

divergent (constructive)

☐

conservative

☐

convergent (destructive) continental-continental

☐

2. Locations **R** and **S** in **Figure 13** are 800km apart on the ocean floor. How fast are **R** and **S** spreading apart from each other? Show your calculation below. Tick (✓) only **one** box. [2]

Calculation

10 cm per year ☐

32 mm per year ☐

100 cm per year ☐

10 mm per year ☐

20 cm per year ☐

3. Which **two** of the following are associated with mid-ocean ridges? Tick (✓) only **two** boxes. [2]

basalt pillow lavas ☐

thrust faults ☐

andesitic lava ☐

high heat flow ☐

deep focus earthquakes ☐

regional metamorphism ☐

4. Name the main feature that is found along the centre of mid-ocean ridges. Tick (✓) only **one** box. [1]

ocean trench ☐

island arc ☐

mountain chain ☐

rift valley ☐

oceanic plateau ☐

5. Explain how the magnetic stripes in **Figure 13** have formed.

QWC [4]

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Figure 14 is a map showing the plate boundaries around Japan and the epicentre of a magnitude 9.0 earthquake which generated a large tsunami in 2011.

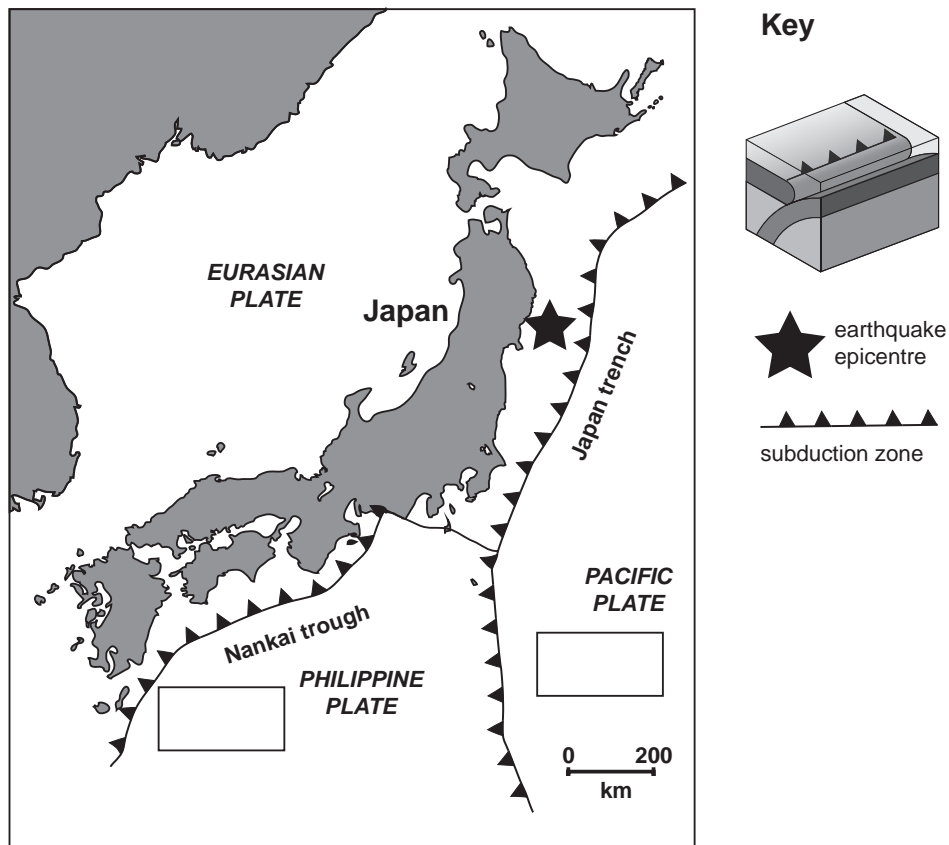


Figure 14

6. Selecting from the choice below, draw an arrow in each of the empty boxes in **Figure 14** to show the direction of plate movement at those locations. [1]



Figure 15 is a record of changes in sea level from two recording stations (**T** and **V**) in the Pacific Ocean near the earthquake shown in **Figure 14**. The earthquake took place at 05.45 on March 11th 2011.

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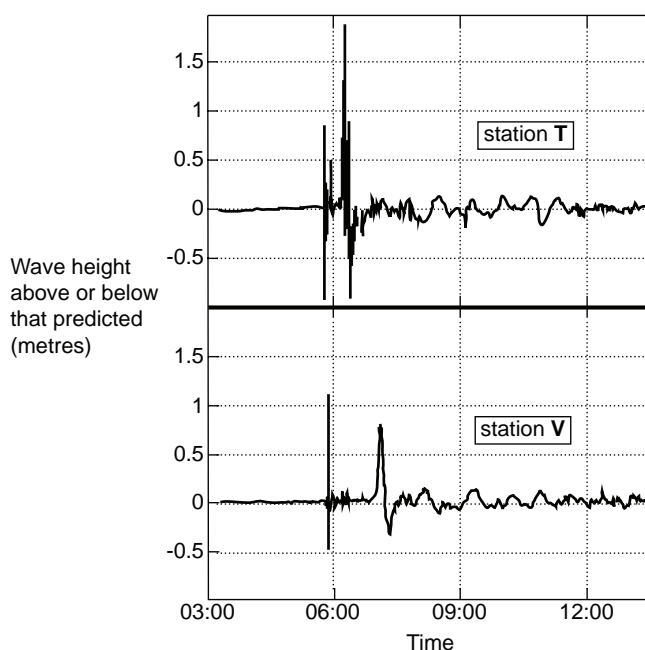


Figure 15

7. Which **one** of the following statements about the tsunami records is **correct**? Tick (✓) only **one** box. [1]

the first wave to arrive is always the biggest

☐

the maximum height of the waves at station **T** is almost 2 metres

☐

it took almost 3 hours for the first wave to reach stations **T** and **V**

☐

station **T** was closer to the epicentre as the wave height is smaller

☐

a tsunami always causes sea level to rise

☐

8. Explain why tsunami wave heights reached up to 40m on mainland Japan.

[3]

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9. Over 15,000 people were killed and more than 127,000 buildings collapsed as a result of the earthquake and tsunami. Three nuclear reactors were damaged. Which **two** of the following are **disadvantages** of using nuclear energy? Tick (✓) only **two** boxes. [2]

suitable geological sites for disposing of radioactive waste are difficult to find

☐

nuclear energy is renewable

☐

nuclear energy adds to the greenhouse effect

☐

nuclear energy depletes the reserves of fossil fuels

☐

reserves of uranium are very low

☐

leakage of radioactive material

☐

the production of energy is not continuous

☐

10. Describe **two** methods that could have been used to reduce the risk from the tsunami and earthquake, taking into account how close the earthquake was to the coast of Japan. [4]

1.

.....

.....

2.

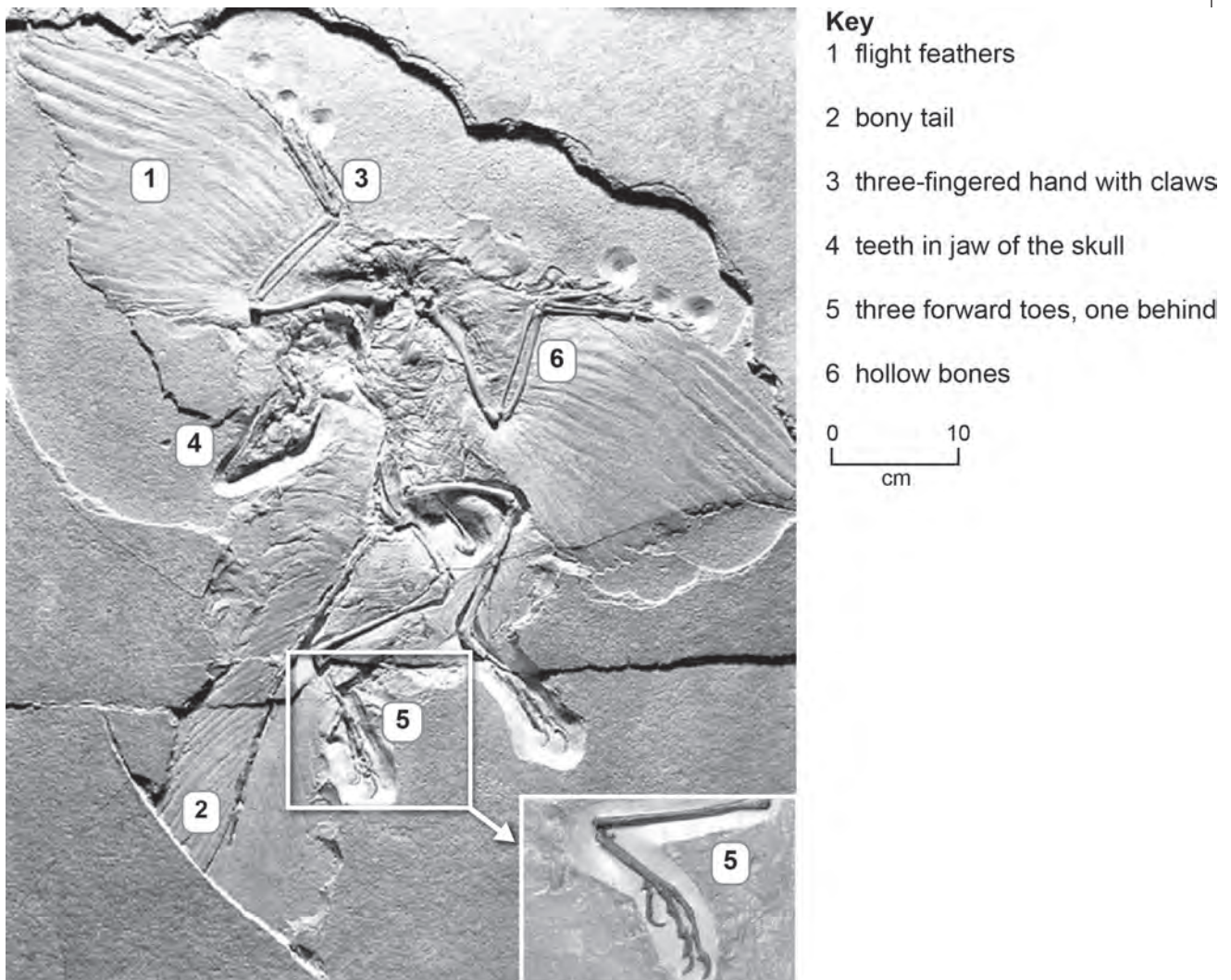
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Section 6 – answer questions 1-9

Figure 16 is a photograph of an exceptionally preserved specimen of *Archaeopteryx* and a short description.



Archaeopteryx lived approximately 150 million years ago. *Archaeopteryx* had small teeth and a long bony tail; features which *Archaeopteryx* shared with other dinosaurs of the time. *Archaeopteryx* also had a number of bird features such as hollow bones, flight feathers, wings, and a partially reversed first toe. Because it displays a number of features common to both birds and dinosaurs, *Archaeopteryx* has often been considered a link between them. It is argued that birds evolved from dinosaurs and *Archaeopteryx* was a critical piece of evidence for this argument.

Figure 16

1. Which **one** of the following statements about *Archaeopteryx* is **correct**? Tick (✓) only **one** box. [1]

Archaeopteryx is evidence for mass extinction

☐

two features of *Archaeopteryx* in common with birds are hollow bones and a long bony tail

☐

Archaeopteryx is evidence for the theory of evolution

☐

two features that *Archaeopteryx* shared with dinosaurs are teeth and a partially reversed first toe

☐

2. Describe the possible conditions which led to the exceptional preservation of *Archaeopteryx*. [2]

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.....

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.....

3. Use the **Data Sheet**. Draw a line from each of the three descriptions of vertebrate evolution to the correct geological time. [3]

reptile, fish and amphibian families were reduced in numbers

Cretaceous-Tertiary (K/T) boundary

Ordovician

bird and mammal families expanded rapidly but reptiles declined

Devonian

first amphibians appeared but declined at the end of the period

Permo-Triassic boundary

Jurassic-Cretaceous boundary

4. Which **two** of the following statements are **incorrect**? Tick only **two** (✓) boxes.

[2]

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trace fossils provide evidence of activities of ancient organisms

☐

trace fossils are preserved in high energy conditions because
low energy conditions would destroy them

☐

trace fossils are much rarer in terrestrial environments due to erosion

☐

trace fossils suggest some dinosaurs ran on two legs on land at speed

☐

dinosaur tracks have been found in Tertiary sandstones

☐

the impression of an ammonite shell in mudstone is not a trace fossil

☐

animal burrows in sandstones suggest shallow water

☐

Figure 17 shows the abundance of the chemical element iridium above and below a clay layer found at the K/T boundary in Italy.

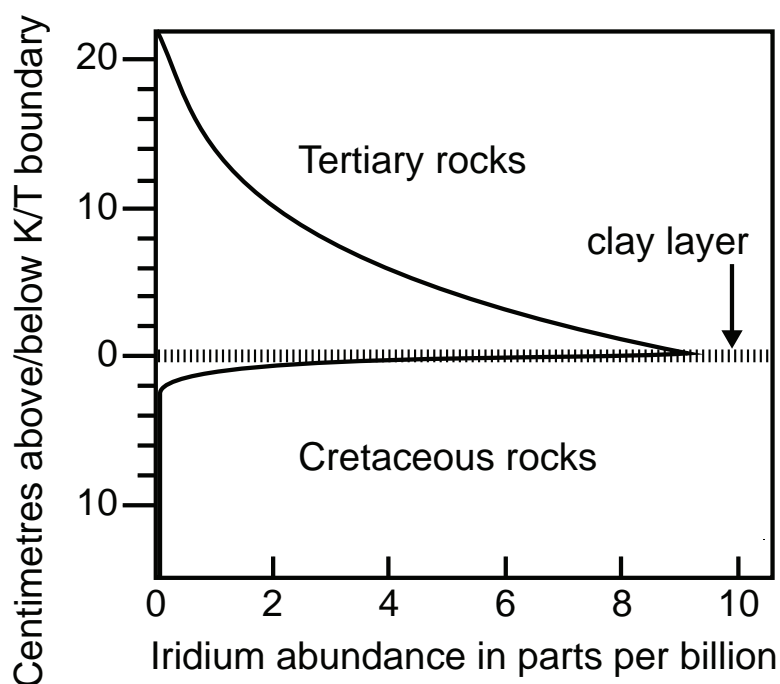


Figure 17

5. Which **one** of the following statements about **Figure 17** and the clay is correct?
Tick (✓) only **one** box.

[1]

the abundance of iridium rises gradually in the clay layer

☐

4 cm below the clay layer the abundance of iridium is virtually zero

☐

4 cm above the clay layer the abundance of iridium is approximately 2 parts per billion

☐

the abundance of iridium reaches a peak of 9 parts per million in the clay layer

☐

the relative age of the clay layer is 65 million years

☐

Figure 18 shows the iridium content in different regions of the Earth and in meteorites.

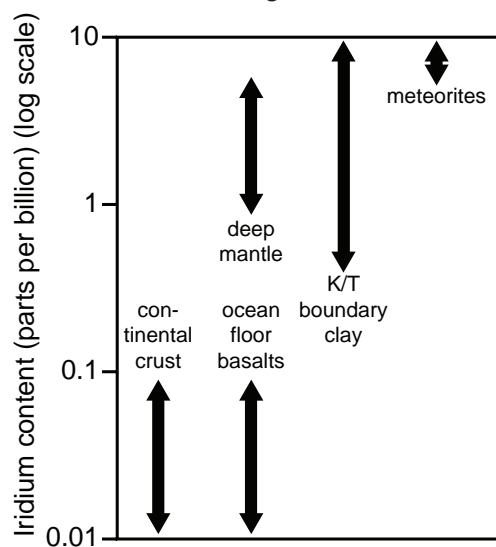


Figure 18

6. Suggest the **two** possible sources of the high levels of iridium in the clay layer in **Figure 17**. Tick (✓) only **two** boxes. [2]

erosion of granitic rocks

☐

there was a sudden addition of extraterrestrial material

☐

eruption of basalt at the ocean ridge due to shallow melting of the upper mantle

☐

turbidite deposits

☐

planktonic fossils that concentrated iridium from sea water

☐

eruption of magma from a source deep in the mantle

☐

7. Explain the link between the clay layer containing iridium and mass extinction at the K/T boundary. [3]

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.....

Figure 19 is a reconstruction of the environment of the Upper Palaeozoic (Carboniferous) in Britain.



Figure 19

8. Which **two** of the following correctly describe the environment in which the plants grew and were preserved? Tick (✓) only **two** boxes. [2]

deltaic environment

☐

arid conditions

☐

high mean annual temperature and low precipitation to encourage growth

☐

aerobic soil conditions to reduce decay

☐

constant supply of sediment and slow burial to reduce decay

☐

swamp environment encouraging coal formation

☐

9. Movement of plates may have contributed to mass extinction. Explain how Upper Palaeozoic (Carboniferous) plant fossils suggest that the British Isles has moved during the geological past. [2]

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Section 7 – answer questions 1-5

1. State why geothermal energy is the main source of energy in Iceland.
Tick (✓) only **one** box.

[1]

there is no wind or hydroelectric energy available

☐

warm oceanic water has heated the land

☐

the area is volcanic so groundwater has a high temperature

☐

global warming has increased global temperature in high latitudes

☐

Iceland is on a destructive plate margin

☐

Figure 20 is a photograph of a hydroelectric power plant at the foot of a dam.



Figure 20

2. Which **one** of the following statements about the generation of hydroelectric power is **correct**?
Tick (✓) only **one** box. [1]

it increases carbon emissions

☐

it can be used in every part of the world

☐

it can increase the albedo effect

☐

it is a renewable source of energy

☐

it pollutes groundwater

☐

3. Which **one** of the following conditions is **not suitable** for the site of a reservoir and dam?
Tick (✓) only **one** box. [1]

the rock underlying the reservoir is impermeable

☐

the rock forming the foundations of the dam
is a well cemented limestone

☐

dip of the beds below the dam and reservoir is horizontal

☐

a lack of seismic activity in the area of the dam and reservoir

☐

the rock beneath the dam is faulted

☐

Figure 21 is a geological map showing the Dol-y-Gaer reservoir and dam site in south Wales.

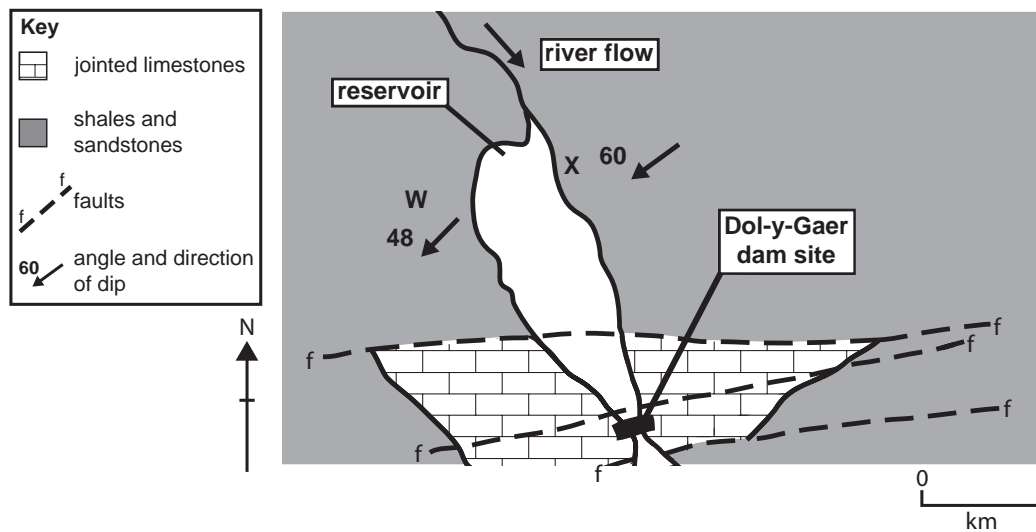


Figure 21

4. Which **two** of the following statements are **correct**? Tick (✓) only **two** boxes.

[2]

landslides into the reservoir are more likely at **W**

☐

a long period of rain decreases the risk of a landslide

☐

a steep angle of dip makes landslides more likely

☐

alternating layers of sandstone and shale make landslides less likely

☐

landslides into the reservoir are more likely at **X**

☐

shale is permeable and sandstone has a low porosity

☐

Figure 22 is a sketch cross section showing the Dol-y-Gaer dam and part of the reservoir in **Figure 21**.

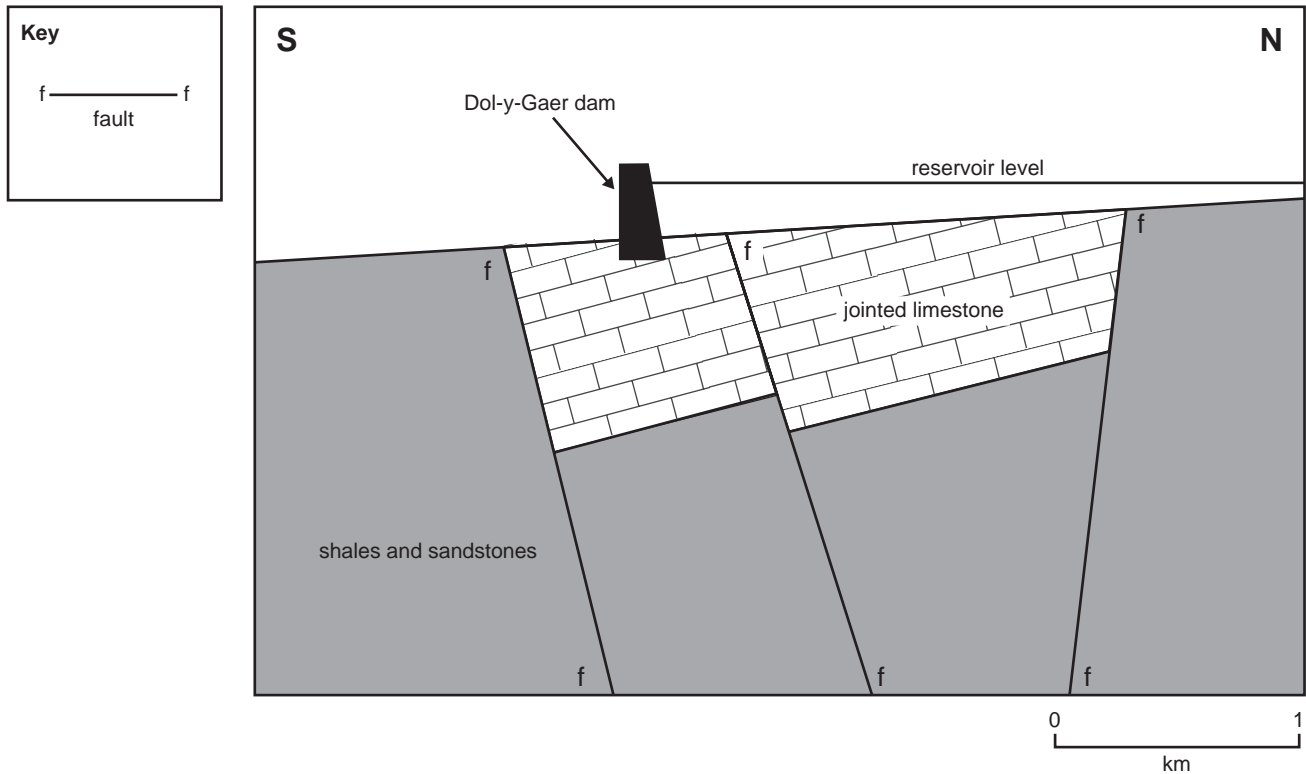


Figure 22

5. After construction, there was considerable leakage from the reservoir. Explain why this may have been predicted. [3]

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**GEOLOGY
DATA SHEET**



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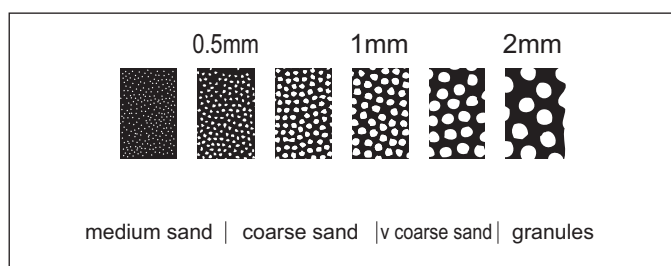
A.M. WEDNESDAY, 20 May 2015

Physical properties of minerals in hand specimen

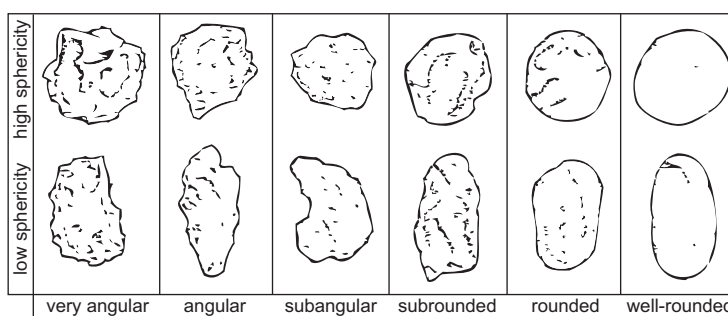
<i>Name</i>	<i>Hardness (Mohs' Scale)</i>	<i>Typical Colour</i>	<i>Streak</i>	<i>Lustre</i>	<i>Cleavage (number of directions)</i>
Quartz	7	colourless or white	scratches streak plate	glassy	none
Feldspar	6	white	scratches streak plate	pearly to glassy	2 good
Mica	2½	silvery or brown	white	pearly to glassy	1 good
Halite	2½	white	white	glassy	3 good
Calcite	3	white	white	glassy	3 good
Haematite	5½	black or red-brown	red-brown	metallic or dull	none
Galena	2½	grey	grey	metallic	3 good
Garnet	7	red	white	glassy	none

Mohs' scale of hardness		
<i>Mineral/ hardness</i>		<i>Common equivalent</i>
Diamond	10	
Corundum	9	
Topaz	8	
Quartz	7	
Orthoclase feldspar	6	← steel pin
Apatite	5	
Fluorite	4	
Calcite	3	← copper coin
Gypsum	2	← finger nail
Talc	1	

Grain size scale



Grain shape and sphericity scale



Geological ranges of vertebrates

