## 2012 Geology

## Intermediate 2

## Finalised Marking Instructions

## © Scottish Qualifications Authority 2012

The information in this publication may be reproduced to support SQA qualifications only on a non-commercial basis. If it is to be used for any other purposes written permission must be obtained from SQA's NQ Delivery: Exam Operations.

Where the publication includes materials from sources other than SQA (secondary copyright), this material should only be reproduced for the purposes of examination or assessment. If it needs to be reproduced for any other purpose it is the centre's responsibility to obtain the necessary copyright clearance. SQA's NQ Delivery: Exam Operations may be able to direct you to the secondary sources.

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments. This publication must not be reproduced for commercial or trade purposes.

## 2012 Geology Intermediate 2

1. (a) Use eight of the mineral names from the word box to complete the table below.
```
amphibole : barite : cassiterite : chalcopyrite : fluorite : galena :
haematite : olivine : sphalerite : talc
```

| Mineral properties | Name of mineral |
| :--- | :---: |
| Grey colour. Metallic lustre. Ore of lead. | galena |
| Glassy green colour. No cleavage. Hardness $61 / 2$. | olivine |
| Brassy yellow colour often with multi-coloured <br> tarnish. Ore of copper. | chalcopyrite |
| Black or green-black colour. Two planes of <br> cleavage at $60^{\circ}$. Hardness $51 / 2$. | amphibole |
| White or pale colour. One perfect cleavage. <br> Hardness 1. | talc |
| White or pale colour. Three planes of cleavage. <br> Feels very heavy in the hand - relative density <br> $41 ⁄ 2$. | barite |
| Red-brown colour. Streak red-brown. Often <br> forms kidney-shaped or rounded lumpy masses. <br> Ore of iron. | haematite |
| Brown glassy mineral. Six planes of cleavage. <br> Ore of zinc. | sphalerite |

All 8 correct $=4$ marks, $6-7$ correct $=3,4-5$ correct $=2,2-3$ correct $=1$
(b) Use eight of the rock names from the word box to complete the key below.
agglomerate : andesite : flint : greywacke: limestone : marble : metaquartzite : mylonite : rhyolite : slate


All 8 correct $=4$ marks, $6-7$ correct $=3,4-5$ correct $=2,2-3$ correct $=1$
2. The map and table below show information about ash that fell when Askja volcano erupted in Iceland in 1975.


50km $\xrightarrow{-1}$

| Distance from volcano <br> along line A-B (km) | Thickness of ash <br> $(\mathrm{cm})$ | Maximum diameter of <br> ash particles $(\mathrm{cm})$ |
| :---: | :---: | :---: |
| 10 | 100 | 40 |
| 25 | 25 | 13 |
| 60 | 10 | 0.3 |
| 100 | 4 | 0.1 |
| 150 | 1 | 0.001 |

(a) Explain why the area of ash fall has a long narrow shape.

Blown/carried by wind (from W)
(b) Using the information in the table draw a line graph to show how thickness of ash changes with distance from the volcano. Use appropriate scales to fill most of the graph paper.


Labelling axes $=1$ mark
Both scales correct and $>$ half graph paper $=1$ mark
Plotting points correctly + drawing line = 1 mark - line must go through points but can be drawn with a ruler or freehand
(c) Describe two features of the relationship between the thickness of ash and distance from the volcano.

As distance increases the thickness of ash decreases = 1 mark Any statement that suggests exponential decrease/rapid decrease then slowing down = 1 mark
Any statement that quotes figures to support description = 1 mark
(d) Which two of the following statements are correct?

A All the ash fell on Iceland.
B The largest fragment thrown out by the volcano had a diameter of 40 cm .
C The thickest ash fall was more than 100 cm thick.
D At any distance from the volcano the particles are all the same size.
E The smaller the ash particles the greater the area they covered.
F The rate of change in size of particle from west to east is the same as that from north to south.

Give only the letters: $\mathbf{C}$ and $\mathbf{E}$
3. Diagram 1 below shows part of a sand quarry visited during a field trip. The sediment was deposited over many years by meltwater flowing from a glacier.

## Diagram 1


(a) Describe four safety precautions you would take when visiting this quarry.

Stay safe distance from cliff face where it appears unstable/wear hard hats/ do not interfere with machinery/wear appropriate clothing for the weather/ suitable footwear/have first aid kit/have mobile phone/or any other reasonable answer
(b) Name the sedimentary structure Q.
cross bedding or graded bedding
(c) Name the sedimentary structure R.
river bed/river channel
Stay safe distance from cliff face where it appears unstable/wear hard hats/
do not interfere with machinery/wear appropriate clothing for the weather/
suitable footwear/have first aid kit/have mobile phone/or any other
reasonable answer
(d) How can you tell that the strength of the melt-water flow has changed over time?
mud, silt and sand particles are of different size and are deposited at different flow speeds/the big boulders in sedimentary structure $\mathbf{R}$ could only have been transported by fast flowing water.
(e) Explain how you can tell that the direction of the meltwater flow has changed over time.

The cross bedding changes direction/the river channel cuts through earlier bedding.
(f) Diagram 2 below shows a melting glacier.

Diagram 2


Use the information in diagram 2 above to account for the presence of the large boulder (labelled P) found in the sand quarry shown on Diagram 1.

The boulder was carried on floating ice from a melting glacier and dropped when the ice block melted.
4. Study the block diagram below.

(a) Complete the blank face of the block diagram.

Each line correctly drawn $\boldsymbol{+}$ symbols $\boldsymbol{=} 1$ mark
Accept arcing of thinner volcanic ash layer
(b) What types of fault are F1 and F2?

## F1: normal

F2: tear
(c) What type of fold is formed by the limestone and shale?
anticline
(d) Place the following geological events in the correct order from oldest to youngest.

A Deposition of limestone
B Formation of unconformity
C Movement on fault $F_{1}$
D Movement on fault $F_{2}$
E Intrusion of dyke
F Folding of shale
Give only the letters: $\mathrm{A} \rightarrow \mathrm{F} \rightarrow \mathrm{B} \rightarrow \mathrm{C} \rightarrow \mathrm{E} \rightarrow \mathrm{D}$
oldest youngest
All 6 in correct order $=3$ marks
4 or 5 in correct order = 2 marks
3 in correct order = 1 mark
(e) Which one of the following statements is correct?

A Columnar joints are formed when an igneous rock heats up and expands.
B Sheet joints are formed when the weight of rock above a batholith is reduced allowing the batholith to expand and crack.
C Mud cracks are a honeycombed pattern of cracks produced when mud dries out and expands.
D Vertical cracks (joints) within limestone beds are a result of frost shattering.

Give only the letter:
5. The sketch below shows a variety of depositional environments.

(a) Match the sedimentary rock in the table below with its likely environment of deposition. Choose from environments $\mathrm{P}, \mathrm{Q}, \mathrm{R}, \mathrm{S}$ or T .

| Sedimentary Rock | Environment of Deposition |
| :--- | :---: |
| Salt deposits | $\mathbf{Q}$ |
| Mudstone | $\mathbf{T}$ |
| Coral limestone | $\mathbf{R}$ |
| Coal | $\mathbf{S}$ |
| Sandstone | $\mathbf{P}$ |

$\mathbf{5}$ correct = $\mathbf{2}$ marks, $\mathbf{3}$ or $\mathbf{4}$ correct = $\mathbf{1}$ mark
(b) Which diagram below shows the type of sand grain formed in a desert environment?


Give only the letter: A
(c) Describe the process by which a coral atoll is formed. Diagrams must be used in your answer.

Volcano grows on seabed and rises above sea level.
Coral grows in shallow water around coastline.
Coral needs well-lit warm water to grow.
Due to isostasy or movement away from the ridge into deeper water, the volcano sinks (into the mantle).

Coral's upward growth keeps pace with sinking.
The peak of the volcano sinks below surface forming atoll.
All 6 with suitable diagrams $=3$ marks
$4 / 5=2$ marks
2/3 = 1 mark
(d) The diagram below shows part of a sea floor.

(i) As more sediment is added to the sea floor converting the older sediment to rock, what will happen to the shape of the burrows?

They become squashed
(ii) Explain why the bivalves and sea urchins are more likely to be preserved than worms.

They have hard exoskeletons/outer shells whereas worms are soft bodied
6. Study the geological map given below.

(a) Name the type of fold shown on the map. Give a reason for your answer.

Type of fold: syncline
Reason: The dip symbols show the fold limbs slope towards each other/The dip symbols point towards each other
(b) Use a protractor to measure the strike direction (in degrees) of the mudstone.

Strike of mudstone: $\mathbf{1 2 5}^{\circ}$
or $305^{\circ}\left(+\right.$ or $\left.-1^{\circ}\right)$
(c) On which side of fault $F_{2}$ have the rocks been moved down? Give a reason for your answer.

Side moved down: NW side
Reason: The outcrop of the mudstone is wider on this side indicating less erosion/the older sandstone abuts the younger mudstone.
(d) What type of intrusion is formed by igneous rock $P$ ? batholith or stock
(e) Place the following events in the correct order from oldest to youngest.

A Formation of igneous rock Q
B Deposition of mudstone
C Movement on fault $F_{1}$
D Formation of igneous rock $P$
E Folding of rocks
F Formation of igneous rock $R$
Give only the letters: $\mathrm{B} \rightarrow \mathrm{E} \rightarrow \mathrm{C} \rightarrow \mathrm{D} \rightarrow \mathrm{F} \rightarrow \mathrm{A}$
oldest youngest
All 6 in correct order $=3$ marks
4 or 5 in correct order = 2 marks
3 in correct order = 1 mark
7. The diagram below shows an ocean floor separating two continents $A$ and $B$. The locations of two boreholes are also shown. The borehole data is displayed underneath.

(a) Name the type of valley shown.

## Rift

(b) Name the type of lava shown.

## Pillow/basalt

(c) The continents separated 80 million years ago.

Using the scale, calculate the speed at which continents A and B have moved apart over this time. Give your answer in km per million years.
Space for calculation:

$$
\begin{array}{ll}
4000 \mathrm{~km} \text { in } 80 \text { million years } & 1 \text { mark } \\
4000 / 80=50 & 1 \text { mark }
\end{array}
$$

$50 \mathrm{~km} /$ million years
(d) Using the borehole data, provide evidence that supports the idea that the joined continents drifted from polar to equatorial and then desert latitudes before separating.

Glacial deposits indicate very cold conditions possibly polar - 1
Coal indicates hot wet conditions possibly equatorial - 1
The fresh water fossils followed by salt deposits indicate a possible inland lake/sea that has evaporated or salt deposits indicate a desert - 1
8. (a) Name the parts of the fossils indicated below. Select your answers from the word box.

```
columella : foramen : guard : pro-ostracum : pygidium : spine :
stipe : test : theca : thorax
```



P- foramen : Q - pro-ostracum : R-spine : S-columella : T- stipe : U - thorax
All $6=3$ marks, $4 / 5=2$ marks, $2 / 3=1$ mark
(b) Name the fossils P-U

P Brachiopod
Q Belemnite
R Sea urchin/echinoid
S Coral
T Graptolite
U Trilobite
All 6 = 3 marks, 4/5 = 2 marks, 2/3 = 1 mark
(c) The diagram below shows two species of ammonite.

Species A
Species B

(i) Which species would probably be the faster swimmer?

B
narrowness makes it more streamlined/ smoother surface makes it more streamlined/
(ii) Give two reasons why species A could probably live in deeper water than species B.

Thicker outer walls
Thicker septa
More corrugations in outer wall The shell is stronger

Any two
9. Name the instrument drawn below and explain how it works to make a recording of an earthquake.

(a) Name: seismometer

How it works: During an earthquake the heavy weight (and pen) remain stationary - 1
The rotating drum and base move - 1
(b) What is the focus of an earthquake?

The point underground where the earthquake is triggered
(c) The diagram below shows the P - and S - wave arrival times for an earthquake as recorded at three stations.


Calculate the time interval between the arrival of P -waves and S -waves at station 3.

## Space for calculation: gap = $\mathbf{1 7}$ minutes using the scale above

Answer: 17 minutes
(d) The distance that a recording station is from an epicentre can be calculated using the formula:
$\begin{array}{ll}\text { Distance from epicentre }(\mathrm{km})=8.65 x & \begin{array}{l}\text { Time difference between the arrival of } \\ P \text { - and S- waves }(\text { seconds })\end{array}\end{array}$
Use this formula to complete the blanks in the table below that gives information concerning stations 1 and 2. Round off your answers to the nearest whole number.

| Station | Time Difference (s) | Distance from Epicentre $(\mathrm{km})$ |
| :---: | :---: | :---: |
| 1 | 520 | 4500 |
| 2 | 900 | $\mathbf{7 7 8 5}$ |

(e) During a prospecting survey, dynamite was exploded underground to produce shock waves, some of which were detected by a recording vehicle.


On the diagram continue :
(i) line A-B to show a reflected shock wave.
$A B$ is reflected at $35^{\circ}$ from the normal (plus or minus $5^{\circ}$ )
(ii) line C-D to show a refracted shock wave as the wave enters the lower layer.

CD changes direction upon entering - 1
(f) Which two statements correctly describe the internal structure of the Earth?

A The Earth has a liquid metal inner core.
B The Earth's crust is thicker than the mantle.
C The Earth's crust is made of peridotite.
D The Earth has a molten nickel and iron outer core.
E P-waves and S-waves travel at the same speed through the outer core.
F The Moho is a major discontinuity between the crust and the mantle.
Give only the letters: D and F
10. Study the diagram below which shows the rock cycle.

(a) What is happening to the sediment to change it into sedimentary rock? Compaction/cementation/squashed/compressed/lithified
(b) What is happening at location $Y$ to change the metamorphic rocks into igneous rocks?

Partial melting/melting/the rocks are being heated
(c) What happens to the surface rocks at $Z$ before they are eroded and transported downslope?

Isostasy/plate movements/sea level rising/magma activity/weathering
(d) The table below gives the height of a mountain over a 75 million year period.

| Time <br> (millions of years ago) | Height of mountain <br> $(\mathrm{km})$ |
| :---: | :---: |
| 0 | 0.16 |
| 15 | 0.32 |
| 30 | 0.63 |
| 45 | 1.25 |
| 60 | 2.5 |
| 75 | 5.00 |

(i) Predict the height of the mountain in 30 million years time.

### 0.04 km

(ii) Apart from erosion, name another factor which may affect the rate of height reduction over a long period of time

Isostasy/plate movements/sea level rising/magma activity
(iii) Calculate the percentage change in the height of the mountain between 60 and 30 million years ago.

Space for calculation:
Change $=2.5-0.63=1.87$
$\%$ change $=1.87 / 2.5 \times 100=74.8 \%$
74.8\%
(iv) Express as a simple whole number ratio the height of the mountain at 75, 60 and 45 million years ago.

Space for calculation:
$5.00: 2.50: 1.25$
75 million 4:60 million 2: 45 million 1
11. The diagram below shows minerals found in shale as it undergoes regional metamorphism.

(a) Which mineral appears after the first low grade metamorphic mineral has disappeared?

Garnet
(b) Explain why quartz cannot be used to define a metamorphic grade.

It appears in unaltered shale as well as all grades of metamorphosed shale/because it is not changed by heat or pressure
(c) The diagram below shows zones of metamorphism as found in the Scottish Highlands.


Name the metamorphic mineral that defines the metamorphic grade within each of the zones 2 and 3 .

```
zone 1 = chlorite
zone 2 = biotite
zone 3 = garnet
Two correct = 2 marks; one correct = 1 mark.
Other minerals can be accepted but they must be in the correct order.
```

(d) Which sequence of rock types is formed when shale undergoes increasing grades of regional metamorphism?

A shale $\rightarrow$ gneiss $\rightarrow$ migmatite $\rightarrow$ schist $\rightarrow$ slate
B $\quad$ shale $\rightarrow$ slate $\rightarrow$ gneiss $\rightarrow$ schist $\rightarrow$ migmatite
C $\quad$ shale $\rightarrow$ slate $\rightarrow$ schist $\rightarrow$ gneiss $\rightarrow$ migmatite
D shale $\rightarrow$ migmatite $\rightarrow$ gneiss $\rightarrow$ schist $\rightarrow$ slate

Give only the letter: C
12. Five types of plate boundary, labelled $A, B, C, D$ and $E$, are shown on the world map below.


Complete the table below which is continued onto the next page
Drawing of Plate Boundary
(astructive

## All 9 correct = 5 marks

$7 / 8=4$ marks
$5 / 6=3$ marks
3/4 = 2 marks
2 correct = 1 mark
[END OF MARKING INSTRUCTIONS]

