GCE MARKING SCHEME

SUMMER 2017

GEOLOGY GL5 - THEME 4
1215/04

INTRODUCTION

This marking scheme was used by WJEC for the 2017 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE GEOLOGY GL5 THEME 4

SUMMER 2017 MARK SCHEME.

1. (a) (i) M → marked at boundary between gabbro and solid mantle (1)

(ii) L → marked at boundary between the solid mantle and asthenosphere (1) [2]

(b) (i) heat flow highest above ridge / heat flow lowest on abyssal plain (1)

decrease away from ridge (1)

non-linear (1)

symmetrical pattern about the ridge (1)

use of exemplar values (1)

(max 3 marks) [3]

(ii) asthenosphere nearer to surface beneath ridge (1)

hotter rocks nearer to surface beneath ridge (1)

magma chamber beneath ridge (1)

1300°C isotherm nearer to surface beneath ridge (1)

Higher geothermal gradient beneath ridge (1)

Rocks youngest at ridge - less time to lose heat to oceans (1)

Rocks oldest on ridge flanks - more time to lose heat to oceans (1)

(max 3 marks) [3]

(c) (i) [2]

the depth below sea level of the ocean floor at location X	H_d = 4.7-5.3 km
the depth below sea level of the ocean ridge	H_r = 1.7-2.3 km

(ii) values from c i) appropriately substituted into formula e.g. $T = [(5.0-2.0)/0.35]^2$ = or $T = [3.0/0.35]^2$ (1)

T is consistent with their values; expect answer in range 55-95 Ma (1) [2]

(d) ocean ridge underlain by shallow heat source (1)

oceanic plate/crust/lithosphere in the ridge area expands (1)
and becomes less dense (1)

oceanic plate/crust/lithosphere in the ridge area thus becomes more buoyant (1)

‘rises’ out of underlying asthenosphere - isostatic uplift (1)

alternate approach is acceptable:

as oceanic plate/crust/lithosphere moves away from ridge/ heat source it cools (1)

this leads to oceanic plate/crust/lithosphere contracting (1)

and becoming more dense (1)

oceanic plate/crust/lithosphere becomes less buoyant (1)

‘sinks’ into underlying asthenosphere- isostatic subsidence (1)

Credit exemplar values in either approach (1)

(max 3 marks) [3]

Total 15 marks

SECTION B

2. (a) Describe how the J Tuzo Wilson cycle of ocean growth and destruction is supported by the size, structure and distribution of present day oceans.

(b) Evaluate the evidence for the J Tuzo Wilson cycle being a cyclic process.

[25]

(a) Description.

Ocean Growth.
Stable cratons (e.g. Baltic Shield) → Continental Rift (e.g. East African Rift Valley) → Narrow ocean (e.g. Red Sea) → Mature ocean basin (e.g. northern Atlantic). Symmetric oceans. Size few hundred km growing to several thousand km. Dominated by extension and tensional structures e.g. normal faults.

Ocean destruction.

Subduction initiation (e.g. central and southern Atlantic; islands arcs) → contracting ocean (e.g. Pacific; cordilleran mountain belts) → terminal stage (e.g. Mediterranean) → end stage (e.g. Himalaya). Asymmetric oceans. Size several thousand km diminishing to no ocean remaining. Dominated by compressional structures e.g. reverse faults.

(b) Evaluation.

Do not see a continuous cycle- today's present day oceans only show snapshots of the cycle and certain parts of the cycle may therefore be missing. Idea that the end-stage plate boundary becomes inactive, but the site of the join, or suture, between the two continental masses is a zone of weakness in the lithosphere that has the potential to become the site of a new rift and so the cycle continues. Principal evidence from IAPETUS Ocean between England/Wales and Scotland in the Lower Palaeozoic, closed during the Caledonian Orogeny; with the later opening of the Atlantic in the Cretaceous/Tertiary almost but not in the same place. Present day ocean only 200Ma old therefore difficult to reconstruct the type and positions of oceans in the past. Previous sites of plate convergence may difficult to locate, however apparent polar wandering data from continents may allow for reconstruction of past continent splitting and convergence.

Total 25 marks

3. (a) Describe how the structure of an accretionary prism provides evidence for the process of accretion.

(b) Evaluate the role of accretion in the growth of continental crust.

[25]

(a) Description.

Structure dominated by brittle thrust/reverse faults and ductile folds. Age relationship is discrete thrust slices that young towards the trench.

When two tectonic plates collide subduction occurs with low density sediment on the ocean floor scraped off by the over-riding (usually continental) plate. This results in the formation of a mass of material called an accretionary prism. Volcanic island arcs and/or seamounts may collide with the continent, and as they are of relatively low density they will often be thrust onto the leading edge of the continent, thereby adding to it in a sequential fashion.

(b) Evaluation.

Accretion is an extremely important process in the growth of continents as evidenced by ancient accretionary wedges e.g. Palaeozoic of Southern Uplands of Scotland/ recent Sumatra as well as age distribution of rocks in continents - younger to edge of plate. However, other processes add to volume of continents e.g. obduction of ophiolites and incorporation of the partial melt (intrusives/extrusives) of the subducted plate. Could argue that accretion is mainly recycling eroded continents.

Total 25 marks

4. 'The type of deformation a rock undergoes in the lithosphere is controlled primarily by depth'.
Evaluate this statement.

[25]

Description.

Increasing depth results in increased confining pressures and increased temperatures (except in subduction zones). Consequently brittle deformation (faults) at shallow depths and ductile deformation (folds) at greater depths. Discussion of fault and fold types. Definition of elastic/ plastic/ strain and stress-strain curves to support this discussion.

Evaluation.

Given that increased confining pressures and increased temperatures are major controls on the way in which rocks deform then depth is very important. However other factors can influence the type of deformation a rock suffers including: rock type (competence)/ principal stress orientation/ strain rate/ role of fluids (water).

Total 25 marks