GCE MARKING SCHEME

SUMMER 2017

GEOLOGY GL5 - THEME 2
1215/02

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 2

GEOLOGY OF NATURAL RESOURCES

SUMMER 2107 MARK SCHEME

1 (a) (i) placer deposit (1) [1]

(ii)

	maximum	minimum	range
sand	159	14	145
gravel	• **2780**	• **244** (1)	• **2536** (1)

[2]

(iii) hardness – resists physical breakdown (1)
poor cleavage – resists physical breakdown (1)
relative density – deposited in concentration (1)
insolubility – doesn't get reduced by dissolving mineral into water (1)
(max 2 marks) [2]

(b) (i) 3.2/4 + 4.3/6.6 (1) = 1.45 (accept 1.35-1.55) (1) correctly plotted (1) [3]

(ii) concentration increases with coefficient of sorting (1)
non-linear/exponential relationship (1) [2]

(c) higher energy flow transports coarse sand grains and finer ore grains (1)
rapid deposition of sediment (1) as flow slows down (1) denser ore mineral trapped between coarser sand grains (1) same energy conditions as coarser quartz (1)

credit other reasonable explanations (e.g. bed roughness).
(max 3 marks) [3]

(d) Named problem:
large hole
large quantity of waste material
unstable waste tips
leached metal from waste tips
acid mine drainage

Credit relevant planning control marks
bunding/banks built around site (1) shields from view (1)
uses waste material/overburden (1) shields from view (1)
use waste rock as an aggregate (1) reduces volume of waste tips (1)
vegetate waste tips (1) to bind loose material (1)
treat run-off water (1) to reduce contamination of ground/surface water (1)
seal waste tips (1) to prevent leaching (1)

Credit other reasonable answers
Planning control MUST relate to the problem named for credit.
(max 2 marks) [2]

Total 15 marks

2. "Economically viable hydrocarbon resources can only be located using geophysical prospecting techniques."
Evaluate this statement. [25]

Can use them to search a wide area often remotely (gravity and magnetic).
Can find deposits that don't have a surface outcrop/deeply buried.
Can narrow areas for further investigation.
Very useful for finding geological structures that may contain viable quantities of petroleum (seismic survey).
May be used to find salt domes that can create petroleum traps (gravity survey)
Can be used to determine structure and extent of structure.
Only finds deposits where there is a physical contrast with surrounding rocks.
Cannot prove the occurrence of oil or gas, only structures in which it may have accumulated. Well log data is important once a hole has been drilled.
Cannot be used to determine quantity of the resource – more detailed work such as mapping and drilling required.

Total 25 marks

3. (a) Explain how igneous processes can form economically valuable mineral resources.

(b) Evaluate the significance of Bowen's Reaction Series in forming ore minerals. [25]

(a) Magmatic segregation: separating minerals by their crystallisation temperature and density e.g. chromite and magnetite.
Magma immiscibility: Sulphide melts are immiscible with silicate melts and may separate and sink below the silicate-rich part of the intrusion or be injected into the rock surrounding it, e.g. sulphide ores containing copper, nickel or platinum.
Pegmatites: Pegmatites formed by the crystallisation of late stage aqueous magmas. Very coarse grained.
Hydrothermal veins: The movement of heated waters within the crust, often as a consequence of magma intrusion or tectonic activity. Sources of hydrothermal solutions include seawater and groundwater circulating through fractured rock.

Credit other processes e.g. copper porphyry deposits

(b) Bowen's Reaction Series relates to rock forming minerals, the ideas can apply to ores.
Formation of minerals at different temperatures is very important for magma segregation/fractional crystallisation e.g. chromite and magnetite. It is less important for the other processes.
Position on Bowen's Reaction Series can influence the vulnerability of a mineral to chemical weathering during sedimentary ore forming processes.

Total 25 marks

4. (a) Describe the processes of formation of:

1.china clay

and

2.fluorite **or** barite (baryte)

(b) Evaluate the application and limitations of prospecting using mapping and satellite remote sensing techniques. [25]

(a) **China Clay**

In situ weathering of feldspar to form kaolinite. Mostly plagioclase feldspar. Sodium-rich feldspar (Albite) is most susceptible and is transformed into pure kaolinite. Potassium rich feldspar (Orthoclase) is less susceptible and is altered to a mixture of kaolinite and mica.

Muscovite and lithium-rich granites are those that form the best quality china clay deposits. These granties do not contain much iron so do not stain the china clay following chemical breakdown.

Water from groundwater in tropics and/or radiogenically heated groundwater is main agent of kaolinisation.

Example: SW England

Fluorite

Hydrothermal fluids containing dissolved fluorine and other elements/compounds are injected along weaknesses in rocks surrounding plutons.

When this solution reaches calcium-rich, limestone bedrock, fluorite crystals can precipitate along the walls of fractures and voids in the rock.

Flat layers of fluorite can form parallel to the limestone beds, replacing the host rock.

Often occurs as part of a suite of hydrothermal minerals with copper, zinc and lead ores.

Example: North Pennine Orefield

OR

Barite

Barite occurs in a variety of depositional environments, by a large number of processes including biogenic, hydrothermal, and evaporation.

Most barite can be formed in sedimentary rock which was deposited when barite precipitated onto the ocean floor.

Barite commonly occurs in lead-zinc veins in limestones where barium sulphate precipitated from hydrothermal solutions. It is often associated with the minerals galena, fluorite and haematite.

Example: North Pennine Orefield

(b) **Geological mapping**

Fieldwork based – direct observation using trained geologists.
Applications:
High level of accuracy to pinpoint resources at the surface prior to exploitation.
Can be very detailed – good to assess the problems of exploitation and viability of resource.
Samples can be collected for accurate analysis.
Limitations:
Labour intensive and time-consuming.
Structural trends obscured on small scale.
Accuracy depends upon sample points and interpretation.
Possible problems of access in remote areas and lack of outcrops.

Satellite remote sensing

Radiation is absorbed and reflected in different ways by different materials.
Materials emit different types of radiation depending upon temperature and molecular structure.
Emitted and reflected radiation can be monitored, analysed and displayed as a visual image. Suitable for major metalliferous deposits (e.g. copper, iron)
Applications:
Provides a large-scale image relatively cheaply without need for fieldwork.
Inaccessible areas studied easily.
Large-scale structures show up which might be missed in the field.
Satellites are generally in place – only need to buy image required.
Limitations:
Used for only basic reconnaissance.
Does not provide stereo images.
Colours can be misleading.

Total 25 marks