GCE MARKING SCHEME

GEOLOGY
AS/Advanced

JANUARY 2014

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCE GEOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were 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 conferences was to ensure that the marking schemes were 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' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

GL1

Q.1 (a) Concordant or equivalent [1]

(b) (i) Coarser to the centre/finer at edges (1)
0.6-0.8 mm at edge (1)
1.7-1.9 mm at centre (1) (max 2) [2]

(ii) More rapid cooling at edge/slower at centre (1)
Contact with cold country rock or equivalent (1) [2]

(iii) Chilled margin of rock **A** (1)
Against centre of rock **B** (1) [2]

(c) (i) Orthoclase Feldspar [1]

(ii) Crystalline (1)
Medium groundmass or (within 0.5-2 mm) (1)
Larger crystals up to (6-10 mm) (1)
Phenocrysts or Porphyritic or groundmass (1)
Anhedral groundmass or euhedral-subhedral phenocrysts (1)
Random orientation (1) (max 3) [3]

(d) Dolerite (1)
Mafic/black coloured or equivalent (1)
Medium-grained or 1.0-1.3 mm (1) [3]

(e) youngest **A**
B
oldest **C** (1)

Sill intruded **C** so **C** oldest (1)

Fragments of **B** in **A**, so **A** younger
or
A chilled against **B**, so **A** younger (1) [3]

17 marks

Q.2	(a)	P or Primary wave (1) P wave faster than S wave/ fastest wave (1) Surface waves do not travel at depth/only on surface (1)		[3]
	(b)	(i)	Asthenosphere correctly located (within 110-250 km)	[1]
		(ii)	Partially molten (1) Reduction in rigidity or equivalent (1)	[2]
	(c)	(i)	Thicker at **F** Continental crust is thicker than oceanic	[1]
		(ii)	Thicker at **E** **E** is fold mountain location (1) Crust thickened due to ocean-continent convergence, subduction or equivalent (1)	[2]
		(iii)	Thicker at **H** Crust further from ridge is older (1) Sediment added to crust with age (1)	[2]

11 marks

Q.3 (a) (i) Arrow to the west [1]

(ii) Sandstone downfaulted (1)

Sandstone younger (1)
Than the metamorphism (1) (max 2) [2]

(b) (i) Low grade or equivalent (1)
Regional metamorphism (1)
Of shale or equivalent (1)
Heat and pressure (1)
Alignment (1)
At 90 ° to directed pressure (1)
Of clay/mica/chlorite (1)
Axial planar cleavage (1) (max 3) [3]

(ii) **B** (1)
Cleavage found in slates (1)
Chiastolite is a contact metamorphic mineral (1) [3]

(c) Interlocking crystals (1)
Mean size within 1.3-1.7 mm (1) [2]

(d) Evaluation – yes
Marble was limestone (1)
Limestones form in shallow seas (1)
Coral indicates tropical (1)
Coral indicates shallow sea (1) (max 2)

No evidence of lavas (1) **R**
Dyke is later than limestone/marble (1) [3]

14 marks

Q.4	(a)	(i)	Younger bed on downthrow side (1) With example e.g. Quaternary younger than Cambrian / Tertiary younger than Cambrian (1)	[2]
		(ii)	Normal (1) Footwall up / Hanging wall down (1)	[2]
	(b)	(i)	602 m	[1]
		(ii)	Equivalent/marker beds cannot be seen on eastern side, or equivalent	[1]
	(c)	(i)	Base of Quaternary	[1]
		(ii)	1. Boundary **R** cross cuts Jurassic and Permo-Triassic rocks /Jurassic or Permo-Triassic beds get thinner etc. (1) 2. Cretaceous rocks are missing (1) 3. Difference in dip angle between Tertiary and Jurassic & Permo-Triassic beds (1)	[3]
	(d)	(i)	Replacement (1) Atom by atom (1) Of calcite (1) By pyrite/pyritisation (1) From fluids (1) (max 3)	[3]
		(ii)	Ammonite (1) Highly folded/ammonitic suture line (1)	[2]
		(iii)	Not useful because: Derived or included fragment (1) Eroded out of older rock (1) Re-deposited in Quaternary deposit (1) Never lived in the environment of deposition of the Quaternary deposit (1) Large or rounded fragment indicates high energy environment of deposition (1) Credit also to max 1, extinct therefore cannot use uniformitarianism (1)	[3]

18 marks

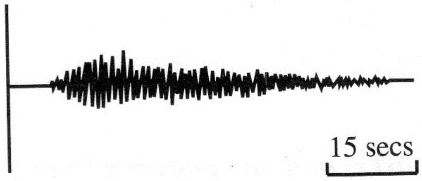
Q.1	(a)	Limestone/sandstone in Carboniferous strata		[1]
	(b)	25 × 3 = 75 °C (1) (1)		[2]
	(c)	(i)	Mendips via lmst/sst to surface via fault and younger permeable strata /fractures	[2]
		(ii)	Holistic: Limestone permeable – joints/fractures, Sandstone permeable – porous/fractures Impermeable strata above and below confined aquifer – artesian water (max 3) Artesian basin conditions/syncline – hydrological head of water – driving force Basin extends deep to where rocks are heated due to geothermal gradient Fault – natural zone of weakness forms fluid pathway channels water to surface (max 3) (total max 5)	[5]
	(d)	Holistic: Dissolution of limestone Forming a cavity Erosion along weakness leading water to surface Collapse into spring pipe		[3]

13 marks

Q.2 (a) (i) Gentle increase (inflation) (1)
followed by sudden decrease (deflation) (1)
Range from 10-30 microradians (1)
Approximately monthly cycle/repeated (1R)
(max 2) [2]

(ii) Longer duration (1)

Lower amplitude (1) [2]



(b) (i) Eruption can be expected
when **short duration** earthquakes peak (1)
near max tilt – full inflation (1)
within weeks if not days (1)
(max 2) [2]

(ii) Holistic:
Short duration quakes indicate intrusion of magma and fracturing around the expanding (inflating) magma chamber
Inflation – increase in tilt

Harmonic tremors indicate turbulent movement of gas and magma through volcano conduits during eruption phase
Release of magma causes deflation and rapid reduction in tilt
(max 4) [4]

(c) Other described – gravity, thermal, gas emissions (COSPEC), EMD
(max 2)

[2]

12 marks

Q.3 (a) Using annotated diagrams, explain how problems of ground stability may be associated with **two** of the following:

(i) *dip of strata;*

Effect of strata dipping "into" and "out of" a rock face (daylighting) at angles less than and greater than the stable slope friction angle. Associated with the type of strata (shale v sandstone). Examples.

(ii) *orientation of rock cleavage, joint and fault patterns;*

Joints/faults/cleavage defined. Increases weathering surface and breaks rock up into discrete sections. Density of joints/faults controls weathering rate. Joint/fault direction patterns. Effect of discontinuity planes "daylighting" at angles greater than stable slope angle. Examples.

(iii) *fluctuations in the water table.*

Water table defined. Water table fluctuations results in reduction and increase in pore pressures (seasonal). Weakens rock. Allows subsidence. Acidic groundwater may help dissolve cement between grains. Increase on water table may allow pore pressure to overcome friction and cause slide. (Water lubrication). Examples.

(max 7 + 1 each; total max 15; where no diagrams max 12) [15]

(b) Describe the methods that may be used to manage and control unstable slopes.

Reprofile to below the stable angle (approx. 35 ° depending on other factors)
Drainage control – drains, pipes etc to remove surface water to improve cohesion
Planting trees – reduces interception, removes water and roots bind the soil
Engineering structures – gabions, retaining walls, shotcrete, rock bolts etc.
Prevention of instability caused by human activity/reduction of erosion at toe
Monitoring techniques – mapping, air photos-satellite imagery, surveying, measurement of creep/strain, groundwater pressures

Credit for examples [10]

25 marks

Q.4 (a) Describe how engineering activity can interfere with the process of longshore drift in coastal areas.

Longshore drift described
A selection from:
Groynes, breakwaters, harbours, seawalls, rip-rap, etc.
Examples credited [10]

(b) Explain the hazardous effects of such interference with the coastal system.

Cliff erosion is slowed by groynes/seawalls/rip-rap etc. which
Protects base of cliff from undercutting preventing release of sediment
Provides stability e.g. toe of landslide etc. – loss of potential sediment source
Increases the size of the beach – reduces energy of waves in engineered area
This results in hazards caused by changes in longshore drift pattern as:
Reduction in amount of sediment available
Reduction in deposition in unprotected parts of the coast
Results in increased marine erosion in unprotected area
Diagrams and examples given credit [15]

25 marks

Q.5 (a) Describe, giving reasons, the geological factors that need to be considered in the disposal of highly toxic and/or radioactive waste compared with the disposal of domestic waste.

Nature of toxic and radioactive waste. Defined. Can do either or both (depth v breadth). Length of time unstable, half-life - millions of years. Degree of hazard/danger to life. Examples of chemicals (e.g. cadmium, mercury, heavy oils, acids) and radioactive waste (e.g. spent uranium rods - low and high level). Needs to be in long term site - often buried.

Nature of domestic waste - can be inert (building rubble) or produce leachate on breaking down. Leachate defined. Disposal in surface landfill site - limited time span - 25 years.

Both require

- Site capable of retaining waste - but for different times
- Free from disturbance (tectonic or subsidence)
- Topography and structure - existing hole/quarry - stable slopes - mainly landfill
- Lithological characteristics - bedrock and surface geology - impermeable rock base to site
  - <u>Domestic</u> - clay with low permeability rates for leachate containment or artificial geomembrane
  - <u>Toxic</u> - confinement in hard crystalline stable rock - deep
- Hydrological regime - dry site - above water table is preferred - (pore pressure) - gradient and rate of groundwater flow - proximity to groundwater extraction
- Careful monitoring of hydrological system - wells outside landfill

Differences

Domestic factors involve - consideration of near future - methane hazards, subsidence of waste, leachate management system

Toxic factors involve - consideration of long future changes - erosion (ice, sea level change), tectonic activity

(Holistic - max 15) [15]

(b) With specific reference to one actual (or potential) landfill or underground site, analyse the suitability of the site for the type of waste disposed.

Holistic - depends upon site and type

Case studies credited e.g. Sellafield or local landfill site

Examples of suitable -

- Lithologies, clay or rock - permeability
- Groundwater/site characteristics
- Engineering practice
  - Clay lining by compaction of clay, plastic/geomembrane
  - Venting of methane gas – boreholes within the landfill
  - Leachate management system – porous pipes for removal/recycling of leachate

(Holistic - max 10) (max 7 if no case study) [10]

25 marks

MARK BAND CRITERIA FOR AS ESSAYS

Summary Description	Mark out of 25	Mark out of 15	Mark out of 10	Criteria
Excellent	21 - 25	13-15	9-10	Not the perfect answer but purposeful, demonstrating a secure grasp of knowledge and understanding and few significant omissions. Well-supported and illustrated with detailed examples selected from named geological situations. Ideas expressed fluently in logical form using appropriate geological terminology. Few errors in grammar, punctuation and spelling.
Good/ Very good	16 - 20	10-12	7-8	Sound answers with relevant material providing evidence of good knowledge and understanding. May be limited in terms of supporting material and breadth of coverage but appropriate examples selected. Ideas expressed with clarity with only occasional errors in grammar, spelling and punctuation.
Modest/ Quite Good	11 - 15	7-9	5-6	A reasonably secure grasp of basics but some deficiencies in knowledge and understanding although use is made of geological terminology. Examples and illustrations may lack detail or may not relate to real geological situations. Reasonable use of language with adequate spelling and punctuation.
Weak/ Minimal	6 - 10	4-6	3-4	Answers show limited basic knowledge and understanding, lacking directness and organisation; tendency to rehash prepared material and answer by inference. Superficial use of examples. Deficiencies in use of language evident; weaknesses in spelling and punctuation apparent.
Very weak	1 - 5	1-3	1-2	Little evidence of knowledge and understanding with erroneous or repeated material evident. Candidate is unable to address the question. Largely irrelevant; possibly too brief. Language skills poor, with spelling, grammar and punctuation errors becoming obtrusive.

Incorporated into this mark scheme is the assessment of candidates on their ability to organise & present information, ideas, descriptions & argument clearly & logically, taking into account their use of spelling, punctuation & grammar.

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