GCE MARKING SCHEME

GEOLOGY
AS/Advanced

JANUARY 2013

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 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.

GCE Geology GL1 Mark Scheme

January 2013

Q.1	(a)	(i)	Convergent	[1]
		(ii)	Partial melting (1) **R** mafic (1) subducted (1) ocean lithosphere/ocean crust/Pacific Plate (1) contamination (1) 3 max	[3]
	(b)	(i)	Arrows showing dextral movement ie to E on N side and to W on S side	[1]
		(ii)	Erosion (1) a detail of erosion (1) at same rate as or faster than uplift (1) 2 max	[2]
	(c)	(i)	Foci in zone dipping towards the West from the trench (1) Maximum depth 700 km (1)	[2]
		(ii)	Subduction or Benioff Zone (1) **R** towards the West/Pacific plate beneath Australian plate (1) plate moves against another plate (1) friction/stress release(1) 2 max	[2]
		(iii)	Plate too ductile/partially melted to allow brittle failure (1) **R** lack of friction/stress build up (1)	[2]
		(iv)	Description: foci line will dip to East at D/deeper to the East/ on East side of plate boundary (1) Explanation: plate is subducting to the East at D (1) Evidence: trench is on other side (West) of plate boundary (1)	[3]

16 marks

Q.2	(a)	(i)	Normal (1) Hanging wall has moved down (1) or footwall has moved up or fault plane dips to the downthrow side or crustal lengthening	[2]
		(ii)	drawn through synform to south of granite	[1]
		(iii)	folding related to intrusion of the granite (1) xenoliths of "shale" in granite (1) metamorphism/heating of surrounding rocks (1) granite cuts across the surrounding rocks (1) 3 max	[3]
	(b)	(i)	600 500	[1]
		(ii)	Area in sandstone shading only (1) Area fills all of zone greater than 500 °C (1)	[2]
	(c)	(i)	Random orientation/not aligned (1) Porphyroblasts/porphyroblastic (1) Length of chiastolites (up to 1.2 cm) (1) Fine groundmass (coarse crystals in fine crystals) (1) 3 max	[3]
		(ii)	Contact metamorphism (1) Low/intermediate grade (1) of shale (1) 550 °C (or alternative temperature to fit in with the values inserted for their isotherms) (1) Heat from granite intrusion (1) Low directed pressure (1) Recrystallising (of clay minerals) (1) 4 max	[4]

16 marks

Q.3 (a) (i) To the East/to the right (1)
Current/cross bedding dips to the East/right (1) [2]

(ii) Fluvial rather than Aeolian because .....
Continue to credit only if stated as Fluvial
Moderate poorly sorted (Aeolian would be well sorted) (1)
Sub angular shape (Aeolian would be well rounded) (1)
Small scale of cross-bedding (Aeolian would be bigger) (1) [2]
2 max

(b) (i) Calcite [1]

(ii) Suture line [1]

(ii) Ammonite (1)
Highly folded/ammonitic/complex suture line (1)
or only one alive in Jurassic [2]

(c) (i) Gaseous exchange between living organism and atmosphere [1]

(ii) Decrease in the amount of ^{14}C (1)
^{14}C decays radioactively (1)
^{14}C decays to ^{14}N (1)
^{14}C not replenished from the atmosphere (1) **R** [3]
3 max

(iii) ¼ is two half-lives elapsed or 2 x 5730 yrs (1)
11,460 yrs (1) [2]

(iv)

	Suitable for dating by ^{14}C method. Yes/No	Reason(s)
The unfossiliferous Quaternary sand and gravel layers	No	does not contain fossils (1)
fossil **G** in Jurassic shale	No	too old/ all ^{14}C decayed/ no original C preserved (1)

[2]

16 marks

Q.4 (a) dyke [1]

(b) (i) Gneiss is older because
Precambrian is older than Tertiary [1]

(ii) **correct cross-cutting statement** (1)
e.g. a rock which cuts another rock is the younger
or
e.g. Dolerite (dykes) cut any of other 4 rocks
e.g. Silicic pluton cuts mafic pluton
e.g. plutons cut lavas

correct age relationship from the map (1)
e.g. Dolerite (dykes) younger than any of other 4 rocks
e.g. Silicic pluton younger than mafic pluton
e.g. Both plutons younger than the lavas [2]

(c) (i) Crystalline or interlocking (1)
Coarse (1)
6-8 mm (1)
Equigranular (1)
Random (1)
Subhedral/anhedral (1) [3]
3 max

(ii) Plagioclase feldspar [1]

(d) Mafic pluton (1) **R**

Rock **H** is coarse (1)
Slow cooling (1)
Occurs in a Pluton (1)
2 max

Contains augite (1)
Mafic mineralogy (1)

If answer **dolerite/dyke** or **mafic lava** then credit:
Contains augite (1)
Mafic mineralogy (1)

If answer **silicic pluton** then credit :
Coarse (1)
Slow cooling (1)
Occurs in a Pluton (1) [4]

No credit for gneiss or 'other rocks'

12 marks

GCE Geology GL3 Mark Scheme

January 2013

Q.1 (a) (i) rock removed (1) unable to support weight of overlying rock (1)

tunnel collapses (1) [2]

(ii) 7.5 (1)

7.5/2 = 3.75 (1) [2]

(b) Description: greater amount of subsidence along **B**-**B′** (1)

double the rate of subsidence (1)

quote data (1)

Explanation: coal extracted below **B**-**B′** is at a shallower depth (1)

less support from overlying rock (1)

fault movement has increased subsidence (1)

- holistic [3]

(c) fracturing of rock as it subsides (1)

fault reactivation (1)

not related to large tectonic stresses that built up over long periods of time (1)

- max 2 [2]

(d) acid mine drainage

sulphate / pyrite (1) oxidation / weathering (1) suspended solids (1)

change in groundwater levels (1) acidic (1) examples credited

- holistic max 3 [3]

Q.2 (a) (i) upper surface of saturated zone [1]

(ii) outcrop at pond (1) and spring (1) [2]

(iii) as water table rises FoS decreases [1]

(iv) Water table **P** +1m (accept >0.1m)

Water table **Q** +3m (accept 2.1-3m) [1]

(v) increases pore pressure (1)

reduces friction (1)

decreases strength of material / cohesion (1)

lubricates slip planes (1)

increases driving force (1)

- max 2 [2]

(b) sandstone above shale (1)

greater mass in sandstone (1)

shale weaker (1)

increased pore pressure to overcome friction (1)

increased driving force (1)

- max 2 [2]

(c) Drains

remove water from deep within slope (1)

decreases pore pressure (1) increases strength of material (1)

- max 2

Concrete barrier

act as retaining wall (1)

supporting upper parts of slope (1)

stops water (1)

- max 2

[4]

Q.3 *(a)* *Describe, giving reasons, the geological factors that need to be investigated to assess the suitability of a site for the disposal of highly toxic/radioactive 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

- 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
- toxic – confinement in hard crystalline (also evaporates / clay) stable rock – deep
- hydrological regime – dry site – above water table is preferred – (pore pressure); gradient and rate of groundwater flow; proximity to groundwater extraction

- holistic max 10 [10]

(b) *Explain how the problems associated with domestic waste disposal can be controlled by good geological site selection.*

holistic – depends upon site
case studies credited, e.g., local landfill site
examples of suitable – lithologies, clay or rock – permeability
groundwater / site characteristics
engineering practice despite poor site:
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 15 (max 12 if no case study) [15]

Q.4 *(a)* *Describe the properties of aquifers that allow the storage and movement of groundwater.*

aquifer defined
high permeability, porosity (specific yield)

gaps between grains large / interconnected
well rounded grains
well sorted grains
non-cemented pore spaces
interconnected joints, faults, fractures, solution cavities
examples – limestone, sandstone, fractured/jointed igneous and metamorphic rock

primary and secondary porosity depends upon
- packing of grains – cubic v rhombic
- shape / orientation of grains – angular v rounded
- sorting of grains – small fit in between larger
- cementation

permeability depends upon
- connectivity of pores
- size of pores
- joints and fractures

credit structures if related to permeability (artesian basins / confined / unconfined aquifer)
good aquifer depends upon good permeability / specific retention
case studies credited

- max 10 [10]

(b) *Explain the geologically related problems that may result from the overuse of aquifers.*

local exhaustion of water table – cones of depression, extraction exceeds recharge
reduction of flow from springs / wells – dry wells and valleys – domestic supply in arid region
loss of artesian effect
reduction in pore pressure causing surface subsidence
contamination as pollutants are drawn in – pollutants identified
sea water contamination in coastal areas
examples and diagrams credited

- max 15 [15]

Q.5 *(a)* *Describe, with reference to one or more case studies, how the destructive effects of volcanoes may be managed and controlled.*

discussed using examples

ultimately little management / control if people choose to live near volcanoes

case studies – Iceland, Etna etc. (max 7 if no case study)

evacuation, hazard mapping, diversion / blocks, dropping-spraying with water, explosion of flow margin, prediction devices

[10]

(b) *Explain how **two** of the following techniques may be used to predict a volcanic eruption:*

(i) *ground deformation*
(ii) *gas emissions*
(iii) *seismic activity*

Two from:

(i) *ground deformation*

as stress increases with filling of magma chamber, strain causes deformation of volcanic cone leading to increasing slope angles and increased distances across the vent / height of vent

changes in slope angle measured by tiltmeters; description of their mechanism

changes in distance – EDM (electronic distance measurements) from known fixed points, laser reflections etc.

example(s) credited - holistic max 7 plus 1

(ii) *gas emissions*

changes in gas emissions – SO_2 etc., degassing of vent during pressure release as magma moves to surface, decrease in gas – vent blocked = explosion (COSPEC)

example(s) credited - holistic max 7 plus 1

(iii) *seismic activity*

variations in the rate of seismic activity

seismic “fingerprint” showing magma chamber

harmonic tremors, Mount St Helen’s / Galeras

example(s) credited - holistic max 7 plus 1

[15]

MARK BAND CRITERIA FOR AS 2013 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.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk