OCR
RECOGNISING ACHIEVEMENT

GCE

Geology

Advanced GCE

Unit **F794:** Environmental Geology

Mark Scheme for June 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

1. **Annotations** available in scoris:

Annotation	Meaning
	Unclear
BOD	Benefit of doubt
CON	Contradiction
	Cross
ECF	Error carried forward
I	Ignore
NBOD	Benefit of doubt not given
PD	Poor diagram
R	Reject
SEEN	Noted but no credit given
	Tick
^	Omission mark
MR	Maximum (marks available for) Response

2. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions):

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Question			Answer	Marks	Guidance
1	(a)	(i)	• (high) porosity has storage space **OR** porous rock in which oil can be stored; • (high) permeability allows flow **OR** permeable rock in which oil can flow **OR** has good interconnections between the pores; • well rounded grains so has (more) pore spaces; • well sorted so has (more) pore spaces; • has little or no matrix **OR** little or no cement **OR** is poorly consolidated **OR** is unlithified so is porous / permeable;	**2**	**ANY 2** **MAX 1** if statement porous **AND** permeable **MUST** relate to the properties of a reservoir rock **ORA** **AW**
		(ii)	**QWC** mark for correct use and spelling of **impermeable / impermeability** as the technical term	**1**	**ALLOW** impervious
		(iii)	evaporites / salt domes produce a negative (gravity) anomaly; evaporites / salt / halite are less dense than the surrounding rocks **OR** density of evaporite / salt / halite is 2.3 / 2.2 g/cm^3	**1** **1**	**MAX 1** for general correct statement of low gravity **AND** low density salt **ORA**
	(b)	**(i)**	**description** oil gushes upwards uncontrolled; **explanation** the blowout preventer / BOP / pressure control system failed **OR** the (cement) cap / plug / lining / casing failed **OR** the oil is under high pressure **OR** drilling causes sudden pressure release **OR** the oil rises due to gases in the oil coming out of solution **OR** the oil rises due to expansion of gas above the oil **OR** the oil rises due to hydrostatic pressure / pressure of water under the oil	**1** **1**	**MUST** have idea of forceful / sudden **ANY 1**

Question			Answer	Marks	Guidance
		(ii)	2 500 x 24 = 60 000 x 86 = 5 160 000 **OR** 5.16 million **OR** 5.16 x 10^6 barrels	1	
		(iii)	800 000 / 5160 000 x 100 = 15.5%	1	**MUST** be to one decimal place **ALLOW ECF** from part **(ii)**
	(c)	(i)	• may be washed ashore and cause pollution **OR** may cause pollution to coastlines **OR** may cause pollution to beaches; • harmful to birds **OR** marine mammals **OR** invertebrates **OR** named invertebrate **OR** kills plankton; • oil is toxic **OR** poisonous **OR** carcinogenic to marine life; • oil is highly flammable **OR** may catch fire **AND** causes atmospheric pollution; • blocks out light reducing photosynthesis;	1	**ANY 1** **MUST** give environmental effect **DO NOT ALLOW** pollution without qualification **ALLOW** oiling of birds
		(ii)	• persists on the seabed for a long time **OR** smothers organisms on seabed **OR** pollutes sea water; • may be washed ashore and cause pollution **OR** may cause pollution to coastlines **OR** may cause pollution to beaches; • causes oiling of birds **OR** damages fish **OR** damages marine ecosystems **OR** enters the marine food chain **OR** may deplete oxygen in the water column; • oil is toxic **OR** poisonous **OR** carcinogenic to marine life;	1	**ANY 1** **DO NOT ALLOW** repetition of answers from part **(i)** **MUST** give environmental effect **DO NOT ALLOW** pollution without qualification
			Total	11	

Question			Answer	Marks	Guidance
2	(a)	(i)	rock **A** = **dolerite**; rock **B** = **oolitic limestone / oolithic limestone / oolite**; rock **C** = **slate**	3	
		(ii)	**use for rock A** = aggregate / roadstone / building stone / work tops / kerb stones **reasons** • made of interlocking crystals **OR** impermeable; • strong / competent **OR** high crushing strength **OR** high impact strength; • roadstone / aggregate – contains more than one mineral of different hardness / does not polish **OR** work top – can be polished; • roadstone / aggregate – bonds well with bitumen; • resistant to abrasion **OR** resistant to weathering **OR** resistant to chemical corrosion; **use for rock B** = building stone / dimension stone / in cement / decorative stone **reasons** • strong / competent **OR** high load bearing strength; • well jointed so easy to extract **OR** soft enough to be sawn into blocks **OR** can be easily worked; • uniform composition; • attractive / decorative appearance / light coloured; • for cement – composed of calcium carbonate / calcite / high purity; • for cement – can be crushed;	**2** **2**	for each rock – use **MUST** match information on thin section diagram if more than one use stated **CONSIDER THE FIRST USE ONLY** **1 MARK** for each correct reason to match correct stated use **ALLOW** any other correct use for dolerite with reason **DO NOT ALLOW** hard with no explanation if more than one use stated **CONSIDER THE FIRST USE ONLY** **1 MARK** for each correct reason to match correct stated use **ALLOW** any other correct use for oolitic limestone with reason

Question			Answer	Marks	Guidance
		(iii)	• is made of interlocking crystals so is impermeable / waterproof **OR** is impermeable – so is waterproof; • has cleavage / foliation – so splits into thin sheets **OR** splits into thin sheets – so is lightweight / does not fracture; • is strong / competent / rigid – so retains shape / rigidity; • resistant to weathering – so is durable / lasts a long time **OR** chemically unreactive – so does not weather;	**2**	**ANY 2** each marking point **MUST** have correct characteristic **AND** explanation **ALLOW** any other sensible explanation
	(b)	**(i)**	• overburden is removed; • (hard) rock is broken up by (drilling and) blasting / explosives; • joints aid extraction **OR** rock picks / large pneumatic drills are used to break up rock **OR** (wire) saws are used to cut soft rocks; • dragline excavators / bucket (wheel) excavators / diggers / bulldozers scoop up material **OR** dump trucks / conveyor belts transport material; • sides of quarry must not be too steep **OR** benches are cut for stability **OR** correct named strategy to make quarrying safe, e.g. water pumping and drainage;	**2**	**ANY 2**
		(ii)	unconsolidated material **OR** sand **OR** gravel **OR** aggregate **OR** placer deposits	**1**	**ALLOW** any correct dredged geological material, e.g. cassiterite **OR** gold **OR** silt

Question	Answer	Marks	Guidance
(c)	• strength of rock – incompetent rock / correct named rock is weak so likely to slip **OR** poorly cemented rock is weak so likely to slip **OR** unlithified / unconsolidated rock is weak so likely to slip; • water in rock – high permeability allows addition of water making slope failure more likely **OR** permeable beds overlie impermeable beds – water enters and adds weight / acts as a lubricant **OR** water increases pore fluid pressure causing landslip; • dip of beds – beds dipping into valley / cutting are unstable **OR** high angle of dip – is unstable; • presence of bedding planes / joints / faults – zones of weakness making failure more likely / unstable / allow rock falls / are zones of permeability; • amount of weathering – weakens rock making failure more likely; • earthquakes / seismic activity – (makes the ground vibrate) trigger landslips;	**2**	**ANY 2** **MUST** explain **ORA**
	Total	**14**	

Question			Answer	Marks	Guidance
3	(a)		**ore mineral** = a mineral containing valuable metal(s) **OR** a naturally occurring compound or element containing valuable metal(s) **OR** a mineral that contains enough metal(s) to make it economically feasible to extract **OR** a mineral that contains metal(s) that can be extracted at a profit; **gangue** = waste **OR** worthless **OR** low value minerals / material	**1** **1**	**DO NOT ALLOW** definition of ore **ALLOW** correct named ore mineral in place of metal(s)
	(b)		**description** • magnetite / ore minerals crystallise early **OR** form at high temperatures **OR** have high melting points; • mafic / ultramafic magma is rich in iron; • magnetite / ore minerals form a cumulate / iron-rich layer at the base of the intrusion; **explanation** • fractional crystallisation / magmatic differentiation / magmatic segregation allows separation of magnetite / ore minerals; • magnetite / ore minerals are dense / heavy and sink / settle down through the magma; • magnetite / ore minerals are concentrated in a smaller volume **OR** form a concentrated layer; • mafic / ultramafic magma is fluid allowing minerals to settle out **OR** mafic / ultramafic magma has low viscosity allowing minerals to settle out;	**3**	**MAX 2** for just description or explanation **ALLOW** precipitate **DO NOT ALLOW** discussion of solubility **MAX 2** if iron is referred to rather than magnetite / ore mineral

Question			Answer	Marks	Guidance
	(c)	(i)	**area where % of copper is < 0.5%** = any where above the water table in the copper vein including the gossan **area where % of copper is > 0.5%** = immediately below and/or above the water table within the copper vein – allow up to 15 mm below the water table and up to 5 mm above the water table	**1**	**ALLOW** < 0.5 % any where in country rock **BOTH** areas **MUST** be correctly labelled for **1 MARK** **ALLOW** points or zones
		(ii)	**processes of oxidation above the water table** (exposed) mineral vein is subjected to chemical weathering in oxidising conditions **OR** water dissolves copper / takes copper into solution (and percolates downwards) in oxidising conditions **OR** copper is leached from rocks in oxidising conditions **OR** in oxidising conditions copper sulfides are converted to (soluble) copper sulfates / carbonates / oxides; **processes of reduction below the water table** copper / ore is (re)precipitated (immediately below the water table) due to reducing / anoxic conditions **OR** in reducing / anoxic conditions copper (sulfates / carbonates / oxides) are converted to insoluble copper sulfides;	**1** **1**	**ALLOW** correct named copper minerals **ALLOW** spelling sulfide **OR** sulphide and sulfate **OR** sulphate **MAX 1** if state oxidising above water table and reducing below

Question			Answer	Marks	Guidance
	(d)		• uranium is taken into solution – because it's soluble in oxidising conditions **OR** uranium is leached / dissolved from rocks – because it's soluble **OR** uranium is dissolved – so it can be carried in solution; • (dissolved) uranium is transported – by groundwater / through aquifers / through fossil river channels / through permeable sandstones; • uranium ore is precipitated – at redox boundaries **OR** where conditions change (from oxidising) to reducing **OR** at / below the water table; • curved / roll-type / roll-front deposits form – at redox boundaries / at / below the water table; • uranium is found in association with wood / organic matter – due to presence of sulfur-reducing / sulphur-fixing bacteria;	**2**	**ANY 2** each marking point **MUST** contain description **AND** explanation
	(e)	**(i)**	geological processes that form uranium / metals / ores are very slow **OR** take millions of years **OR** uranium reserves are finite **OR** uranium decays to lead over time **OR** the radioactivity of uranium declines over time	**1**	**ALLOW AW** **DO NOT ALLOW** can only be used once – **MUST** give explanation **DO NOT ALLOW** description of unsustainable

Question			Answer	Marks	Guidance
		(ii)	• granite is suitable as granite is competent **OR** strong – so an underground repository / large cavities can be excavated to store the nuclear waste **OR** so the underground repository won't collapse **OR** so the underground repository can withstand earthquakes; • granite is suitable as granite is dry **OR** impermeable **OR** crystalline – so radioactive materials won't leak out / water cannot enter / radiation is absorbed; • granite is unsuitable as granite contains (a higher proportion of) minerals / elements / isotopes / metals / uranium / thorium / potassium – that are <u>radioactive</u> **OR** that cause the temperature of the granite to rise; • granite is unsuitable as granite contains joints / fractures – allowing water in **OR** allowing escape of radioactive materials **OR** making the rock permeable;	**2**	**ANY 2** each marking point **MUST** state the suitability **AND** have a correct characteristic **AND** explanation **MAX 1** for **TWO** correct characteristics **AND** explanations with no evaluation of suitability
			Total	**13**	

Question			Answer	Marks	Guidance
4	(a)		lignite colour = **brown;** anthracite appearance = **shiny / glassy / iridescent / high reflectance;** bituminous coal density = **1.1 – 1.4** g/cm^3	**1** **1** **1**	
	(b)	(i)	• line for carbon plotted correctly – peat = 53%, lignite = 71%, bituminous coal = 84%, anthracite = 93%; • line for total volatiles plotted correctly – peat = 47%, lignite = 29%, bituminous coal = 16%, anthracite = 7%	**1** **1**	all four points **MUST** be plotted correctly and joined with a line for **1 MARK** for each **IGNORE** lines from 0 to peat **MAX 1** for all 8 points plotted correctly if lines missing or incorrect **MAX 1** for one correct line with carbon labelled below and total volatiles labelled above
		(ii)	**description** volatiles are squeezed out **AND** carbon content increases **OR** thickness of the seam decreases; **explanation** due to weight of overlying sediment / overburden **OR** due to load pressure **OR** due to compaction **OR** due burial **OR** due to increasing temperature **AND** pressure	**1** **1**	**MUST** describe the process, not just describe the graph **1 MARK** for description and **1 MARK** for explanation
	(c)	(i)	**exposed coalfield** the coal bearing strata / the Coal Measures outcrop at the surface **OR** coalfield / Coal Measures are not covered by overburden; **concealed coalfield** the coal bearing strata / the Coal Measures are beneath younger / cover rock(s) **OR** coalfield / Coal Measures are covered by overburden **OR** coalfield / Coal Measures are beneath other rock layers	**1** **1**	**ALLOW** the coalfield outcrops at the surface **ALLOW** some of the coal is at the surface **DO NOT ALLOW** only the coal is at the surface **DO NOT ALLOW** only the coal is covered by overburden / other rocks **MUST** have more than one rock layer

Question			Answer	Marks	Guidance
		(ii)	**QWC** mark for correct use and spelling of **cyclothem(s)** as the technical term	1	
		(iii)	• correct vertical sequence with minimum of 3 units correct – either names or rock symbols; • synform shape drawn; • syncline / synform / basin labelled;	2	**ANY 2** correct for **1 MARK** **ALL 3** correct for **2 MARKS**
		(iv)	correct diagram showing **reverse** fault displacing coal seam **AND** suitable label: reverse fault **OR** offset coal seam and fault with arrows showing correct direction of movement **OR** offset coal seam with hanging wall (moved up) or footwall correctly labelled **OR** offset coal seam with upthrow or downthrow side correctly labelled; coal seam is displaced (disrupting production) **OR** coal seam is offset (disrupting production) **OR** faults are zones of weakness **OR** faults are zones of permeability **OR** faults may cause collapse **OR** shearer will encounter harder rocks / sandstone on other side of fault	1 1	**1 MARK** for labelled diagram of reverse fault **1 MARK** for how the fault disrupts coal production **MUST** label reason
			Total	14	

Question			Answer	Marks	Guidance
5			**description of geological conditions** • springs form at the intersection of water table and land surface **OR** springs form where groundwater flows out at surface **OR** where an aquifer outcrops at surface; • springs require (high) hydrostatic pressure **OR** groundwater flows in response to pressure **OR** groundwater flows down hydraulic gradient;	**1** **1**	
			descriptions / diagrams of the sites where springs form **spring at fault** labelled diagram – spring at contact between permeable and impermeable rocks at a fault with shape of water table correct; correct description of spring at fault **OR** detailed labels describing a spring at a fault; **spring at unconformity** labelled diagram – spring at contact between permeable rocks above and impermeable rocks below an unconformity with shape of water table correct; correct description of spring at unconformity **OR** detailed labels describing a spring at an unconformity; **spring as a result of lithology** labelled diagram – spring at contact between permeable and impermeable sedimentary rocks **OR** at contact between permeable sedimentary rocks and impermeable igneous intrusion with shape of water table correct; correct description of spring as a result of lithology **OR** detailed labels describing a spring resulting from lithology; **if both fault and unconformity springs drawn** – second labelled diagram of spring as a result of lithology in a different situation;	**1** **1** **1** **1** **1** **1** **1**	**for each site:** **ALLOW** terms aquifer / aquiclude / correct named rock type / correct rock symbol as alternatives to permeable / impermeable **MAX 5** if no diagrams **MAX 6** if all 3 geological conditions (lithology, fault, unconformity) are not described
			Total	**8**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553