

Geology

Advanced GCE F794

Environmental Geology

Mark Scheme for June 2010

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Question	Expected Answers	Marks	Additional Guidance
1			
a	porosity is the percentage / volume / amount of <u>pore space</u> in a rock (1) permeability is the rate at which a fluid flows through a rock / is the ability of a rock to transmit fluids (1)	1 1	Must use correct technical terms
b	confined aquifer diagram –impermeable rocks above and below / overlain by impermeable rocks (1) unconfined aquifer diagram –open to the atmosphere / not overlain by impermeable rock (1) correct labels of aquifer and impermeable rocks / aquiclude (1)	1 1 1	synclinal structure for aquifers or aquifers in dipping beds or horizontal bed labels must be on both diagrams accept correctly named rocks of sandstone for aquifer and clay as impermeable
c	i QWC mark for correct use and spelling of artesian as the technical term	1	
	ii water will rise up the well / water will flow out onto surface / water flows up naturally / water rises with no need for pumping (initially) (1) water is under (high hydrostatic) pressure / water is confined under impermeable rocks / water table is higher than the well / pressure is released (1)	1 1	One mark for description and one for explanation. Description must match the explanation.
d	position of lowered water table in vicinity of well drawn and labelled (1) label of : cone of depression / draw down / height difference between level of water table and water in well / hydraulic gradient / water flowing in towards well / reduction in hydrostatic pressure in vicinity of well (1)	1 1	
e	(rain) water enters the aquifer at recharge zones / water infiltrates (downwards) through the soil / water percolates (downwards) through the pore space / rocks water pumped back into the aquifer / artificial recharge schemes	any 2	One mark for general statement of idea of rainwater moving through the rocks to the aquifer

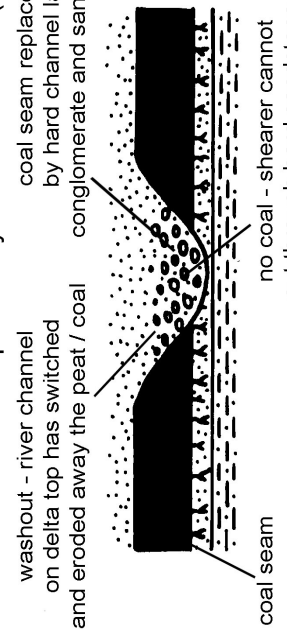
	ii	<p>nitrites / pesticides from agricultural run off sewage / effluent from sewage farm or flooding hydrocarbons / solvents / benzenes / dioxins / chemical spill from petrol stations or factories toxic fluids / leachate from landfill / waste disposal acid mine drainage water from coal / metal mines salts / seawater from sea</p>	any 1	Source must be identified
	iii	<p>unconfined aquifers are open to the atmosphere / pollutants can only enter confined aquifers at recharge zones / the area of a confined aquifer open to the atmosphere is restricted no impermeable rock above so leakage of toxins is easier</p>	any 1	allow correct opposite argument
		Total	14	

Question	Expected Answers	Marks	Additional Guidance
2			
a	<p>i granite is competent / has high load bearing strength / strong (1) granite is impermeable / made of interlocking crystals / crystalline / resistant to (physical or chemical) weathering / chemically unreactive (1) granite is attractive or can be polished / tends to be of uniform composition (1)</p>	any 2	accept RA that granite is unsuitable as high concentration of radioactive mine hard to cut (1)
	<p>ii overburden is removed first (1) blasting / explosive techniques may be used (1) joints form ready made blocks aiding the quarrying process (1) sides of open cut must be at stable angle / stepped / benches / ground improvement strategies such as rock bolts may be used in places (1)</p>	any 2	
	<p>iii noise or dust generated by machinery or blasting / visual pollution / landscape degradation from holes left in ground / deforestation / removal of vegetation / loss of habitat for plants and animals / surface water pollution</p>	any 1	
	<p>iv crushed rock chippings / crushed rock used in construction / crushed rock of sand size and above / unconsolidated sand and gravel / unconsolidated construction materials of sand size and above</p>	1	do not allow mixture of rocks or just crushed rock
	<p>b main ingredient is clay (+/- mudstone / shale) (1) most British bricks are made from Oxford Clay (1) a high carbon content (7%) acts as an internal fuel during firing / reduces energy costs / self-firing (1) lime is added (1) a lot of energy / fuel / coal / oil / natural gas is needed to fire the bricks (1) sand is used for facing bricks (1) thick beds / constant composition is required to give consistent product (1)</p>	any 2	

Question	Expected Answers	Marks	Additional Guidance
2 c	<p>site B is suitable as underlain by impermeable silt and clay (1) site B is suitable as the beds are horizontal (1)</p> <p>site A is unsuitable as underlain by permeable glacial sand and gravel (1) site A is unsuitable as the beds are dipping allowing down dip migration of leachate (1)</p> <p>site B is suitable as water table below B is inaccessible to pollutants ORA / site B may be unsuitable as sides could suffer landslips (1)</p>	any 3	<p>no mark for stating which site is best – must give reasons</p> <p>for full marks, both sites must be evaluated i.e. max. 2 for only one site evaluated</p>
d i	leachate is the fluid generated by water dissolving / mixing / reacting with landfill waste.	1	concept of rainwater reacting with waste is essential allow leachate produced from mines / mining waste
ii	<p>either grouting to make the quarry floor <u>impermeable</u> / <u>impervious</u> (1) (holes are drilled and) <u>liquid</u> cement pumped into ground (1) or clay / geotextile / geomembrane / plastic lining (1) is <u>impermeable</u> / <u>impervious</u> and will prevent leakage of toxic fluids / leachate (1) or drainage and collection of toxic fluid (1) toxic fluid can then be treated / processed / stored safely (1)</p>	1 + 1	<p>description must match named method</p> <p>material used must be stated</p>
	Total	14	

Question	Expected Answers	Marks	Additional Guidance
3 a	<p>QWC mark for correct use and spelling of hydrothermal as the technical term (1)</p> <p>hot fluids / water contain soluble minerals / volatiles and incompatible elements / metals that do not fit in silicate minerals collect to form late stage hydrothermal / watery / residual fluids (1)</p> <p>fluid moves out from intrusion / cools and precipitates minerals along faults / joints / bedding planes / through permeable / reactive / suitable named country rock (1)</p> <p>high temperature / least soluble minerals precipitate first closest to intrusion / low temperature / most soluble minerals precipitate last furthest from intrusion (1)</p>	1	do not allow magma instead of fluid
b i	<p>1 = calcite 2 = cassiterite 3 = quartz 4 = sphalerite</p>	1	
ii	<p>the fluid cools against the cold country rock / crystals grow from outside inwards (1)</p> <p>the first minerals will precipitate at the edge of the vein or close to country rock / the last minerals will precipitate in the centre or furthest from country rock (1)</p> <p>a symmetrical pattern results (1)</p> <p>repeated pulses of hydrothermal fluids will have moved along the vein (1)</p> <p>high temperature / least soluble minerals precipitate first closest to edge / low temperature / most soluble minerals precipitate last in centre of vein (1)</p>	any 2	only allow solubility if not credited in 3a
iii	<p>gangue minerals are low value / worthless / waste minerals / uneconomic to extract</p>	1	

	<p>c</p> <p>i down stream of confluence (1) on inside of either meander bend (1)</p>	2	allow on banks of river if 3 areas marked and 1 incorrect then max 1
	<p>ii</p> <p>mineral veins at surface undergo weathering / erosion (1) ore minerals are separated from gangue minerals into individual grains (1) ore minerals are transported down slope / downstream (1) the current velocity / flow slackens at the sites of deposition (1)</p>	any 2	
3	<p>d</p> <p>i</p> <p>cassiterite 7.0, 6.5 galena 7.5, 2.5 gold 19.3, 3.0 sphalerite 4.1, 3.5</p>	2	3 or 2 points plotted correctly = 1 mark all 4 points plotted correctly = 2 marks max 1 for line graph
	<p>ii</p> <p>cassiterite would be found as it is dense and hard / has no cleavage (1) gold would be found as it is very or exceptionally dense / dense and has no cleavage (1) galena would not be found as it is too soft and has three cleavages (1) sphalerite would not be found as it is too soft, has 6 cleavages / is not dense enough (1)</p>	3	4 correct = 3 marks 3 correct = 2 marks 1 or 2 correct = 1 mark max 1 if correct pairs of minerals but insufficient reasons must give statement or whether it is found in the placer deposit
	Total	16	

Question	Expected Answers	Marks	Additional Guidance
<p>4 a i</p>	<p>location 1 – fault has displaced coal seam / allows water to flood in (1) location 2 – seam splitting where a thick seam has split into thin / uneconomic / unworkable seams (1) location 3 – dip of seam has become too steep for (mechanised) mining / dip angle exceeds five degrees / seam has become too deep to work (1)</p>	<p>3</p>	<p>max 1 for list with no description</p>
<p>ii</p>	<p>suitable diagram showing river channel / washout cutting into labelled coal seam (1) suitable labels / text: coal seam and river channel / wash out labelled / river sediments / channel lag / sandstone / conglomerate / sands / gravels shown in washout / coal seam is replaced by river sediments (1)</p> 	<p>1 1</p>	<p>mark labels as text</p>
<p>b</p>	<p>(two) horizontal roadways / tunnels are driven out from the shaft / through the coal seam (1) a coalface is established up to 400m long / the coal is cut with a mechanical cutter/shearer and falls onto a conveyor belt (1) the roof is supported by steel / hydraulic rams / chocks / supports and the mined-out area is allowed to collapse (1) mining takes places backwards / retreating towards shaft (so that geological conditions can be assessed in advance) (1)</p>	<p>any 2</p>	

<p>C</p>	<p>danger of tunnel collapse / cave-ins / subsidence of overlying rocks danger of explosions from build up of methane gas / coal dust possibility of pockets of foul air / carbon monoxide or methane build up / poor ventilation / lack of oxygen danger of flooding rescue of trapped mine workers is difficult and dangerous</p>	<p>any 1</p>	<p>must describe</p>
<p>Total</p>		<p>8</p>	

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