

Mark Scheme for June 2012

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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.

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Annotations

Annotation	Meaning
	Unclear
	Benefit of doubt given
	Contradiction
	Incorrect response
	Error carried forward
	Ignore
	Reject
	Benefit of doubt not given
	Omission mark
	Correct response
	Point has been noted, but no credit has been given
	Poor diagram

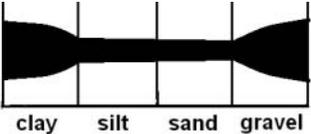
Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

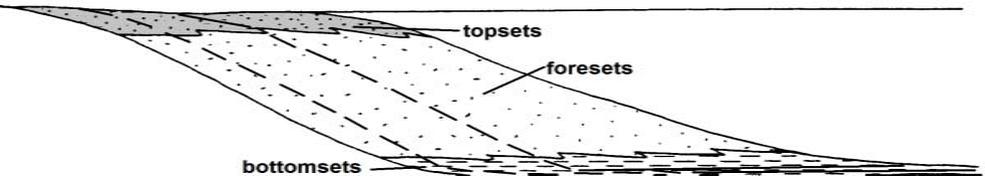
Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording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

Question		Answer				Marks	Additional												
1	(a)		feature	igneous	metamorphic	sedimentary	5 mark by row: 6 or 5 rows correct = 5 4 rows correct = 4 3 rows correct = 3 2 rows correct = 2 1 row correct = 1 DO NOT ALLOW any incorrect ticks per row IGNORE (✓) – not essential for mark												
			(has beds)			(✓)													
			is crystalline	✓	✓														
			the mineral olivine	✓															
			may contain fossils		(✓)	✓													
			the mineral sillimanite		✓														
			amygdaloidal texture	✓															
			may contain phenocrysts	✓															
	(b)	(i)	(flat platy) minerals have a preferred alignment OR minerals are arranged parallel to each other OR mineral alignment due to pressure				1 DO NOT ALLOW general description of layering MUST be definition of foliation – DO NOT ALLOW descriptions of slaty cleavage, schistosity or gneissose banding												
		(ii)	<table border="1"> <thead> <tr> <th></th> <th>name</th> <th>type of metamorphism</th> <th>metamorphic grade</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>schist (1)</td> <td>regional</td> <td>medium</td> </tr> <tr> <td>B</td> <td>gneiss (1)</td> <td>regional</td> <td>high</td> </tr> </tbody> </table> <p>1 MARK for each correct rock identification 1 MARK for correct type of metamorphism and grade for each rock</p>					name	type of metamorphism	metamorphic grade	A	schist (1)	regional	medium	B	gneiss (1)	regional	high	4 ALLOW 1 MARK for both types of metamorphism correct ALLOW 1 MARK for both grades correct ALLOW ECF for type and grade if schist and gneiss wrong way round MUST use correct technical terms
	name	type of metamorphism	metamorphic grade																
A	schist (1)	regional	medium																
B	gneiss (1)	regional	high																

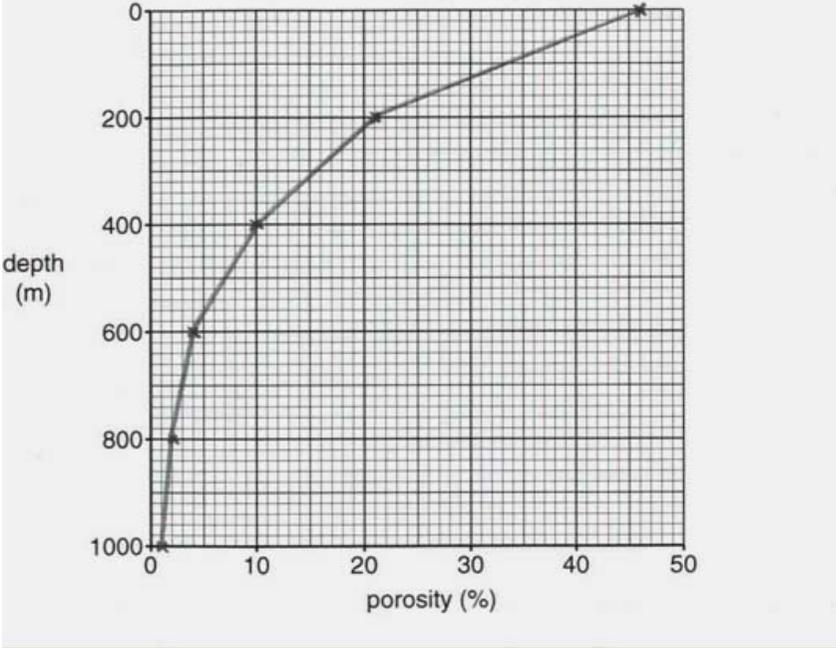
Question		Answer	Marks	Additional	
	(c)	name: marble / (meta)quartzite / spotted rock / andalusite rock / hornfels; texture: description of granoblastic / sugary / equidimensional crystals / random / interlocking mosaic texture MUST match correct named rock	1 1	ALLOW andalusite or spotted slate MUST describe DO NOT ALLOW description of grains / foliated texture ALLOW description of porphyroblastic texture	
	(d)	(i)	convergent / destructive / subduction zone / island arc	1	IGNORE listing of oceanic / continental plates
		(ii)	arrows at 90° to trench, pointing inwards to trench	1	MUST have two arrows pointing inwards
		(iii)	regional	1	ALLOW regional and burial
		(iv)	high pressure low temperature	1	ALLOW low temperature high pressure – must have both parts ALLOW blue schist belt / <u>paired</u> metamorphic belt
		(v)	belt C / high pressure low temperature belt: high pressure due to collision of plates OR close to trench OR (at top of) subduction zone OR scraped up sediments formed belt C OR burial metamorphism occurs at trench OR low heat flow due to subduction of cold oceanic crust OR low heat flow due to cold wet sediments in trench; low pressure and high temperature belt: high temperature due to rising magma OR due to partial melting (of descending plate) OR due to volcanoes OR due to intrusion of batholiths OR low(er) pressure as further from point of collision of plates	1 1	ALLOW explanation for pressure conditions OR explanation for temperature conditions for each belt MAX 1 for general description of processes at convergent margins if it is not clear which belt is being described ALLOW description of blue schist if not given in 1(d)(iv)
			Total	18	

Question			Answer	Marks	Guidance
2	(a)	(i)	D <u>parasitic / secondary / daughter</u> cone / vent; E dyke / pipe / conduit / vent; F crater / vent if not given for E	1 1 1	
		(ii)	steep sided / concave slopes	1	ALLOW slope angle of 30° to 45° ALLOW cone shaped MUST describe
		(iii)	strato-volcano / composite	1	ALLOW strato DO NOT ALLOW strata on its own ALLOW intermediate
		(iv)	gas content: high / any two correct named gases; viscosity of lava: high / medium / viscous / thick / does not flow far; frequency of eruption: rare / infrequent / low / intervals of hundreds or thousands of years between eruptions / <u>many years</u> between eruptions	1 1 1	ALLOW ECF from volcano type in part (iii) for max 2 if all 3 parts correct or max 1 if 2 parts correct ALLOW sticky for viscosity
		(v)	each eruption produces a layer of pyroclastics followed by lava; there is a repeated pattern of pyroclastics and lavas each eruption; lava blocks vent so gas pressure builds up; start of eruption is explosive creating pyroclastics; material from the magma chamber is gas rich at start; material from the magma chamber is (more) silicic at start; erupts from top of magma chamber at start; composition may change during eruption; explanation of wind direction for variation on either side; explanation of coarser / denser pyroclastics fall close to vent for thickness	2	ANY 2 MAX 1 for alternating pyroclastics and lava OR thickness of pyroclastics decreases away from vent OR amount of pyroclastics and lavas differs on either side of vent with no explanation MAX 1 for idea that ash thrown into atmosphere settles on top of lava flow
	(b)	(i)	solid fragment / fragmental material / bomb / block / ash / lapilli produced by (explosive) eruption OR solid fragment / fragmental material / bomb / block / ash / lapilli from a volcano OR lava explosively ejected into the atmosphere	1	ALLOW rock ejected from volcano

Question			Answer	Marks	Guidance
3	(a)	(i)	definition: sorting is the degree to which particles are the same size OR the range of grain sizes in a sediment OR poorly sorted means there is a wide range of grain sizes and well sorted means the grains are all the same size	1	MAX 1 if definition includes shape
			diagrams showing: poorly sorted – mix of grain sizes and well sorted – grains all the same size	1	IGNORE grain shape on diagrams
		(ii)	coefficient of sorting: <u>0.4</u> ; description: well sorted	1 1	ALLOW 0.35 to 0.45 ALLOW ECF for description if incorrect working clearly shown
	(b)	(i)	G river flood plain / deep sea; J aeolian dune / beach	H alluvial fan;	3 1 MARK for each correct environment DO NOT ALLOW contradictions
		(ii)	 <p style="text-align: center;">clay silt sand gravel</p> <p>glacial boulder clay</p> <p>explanation: formed from deposition of all the sediment carried in the ice OR all sizes are transported in ice OR dropped with no sorting as ice melts OR boulders are carried in ice and clay forms by crushing at base of glacier</p>	1 1	diagram should show all grain sizes ALLOW just clay and gravel MUST shade at least 50% of the clay and gravel columns ALLOW AW MUST give explanation of ice transport – not just repeat description of the diagram
	(c)		K orthoquartzite / conglomerate; L greywacke / breccia; M shale	1 1 1	ALLOW mudstone / clay
Total				12	

Question		Answer	Marks	Guidance	
4	(a)	<p>description: a delta is where a river meets the sea / lake OR at the mouth of a river;</p> <p>explanation: deposition occurs due to a loss of energy OR deposition occurs where the energy is low / there is no current OR sediment is not carried away and builds up OR coarsest grains are deposited closest to shore</p>	1 1		
	(b)	(i)	<p>topsets: either coal layer and the seat earth (and coarse sandstone);</p> <p>foresets: cross bedded sandstone (and coarse sandstone);</p> <p>bottomsets: shales with marine fossils only</p>	2	all 3 correct = 2 marks 2 or 1 correct = 1 mark
		(ii)	 <p>topset, foreset and bottomset beds shown in correct order;</p> <p>angle of delta front shown at less than 45°;</p> <p>any correct internal structure shown within delta</p>	1 1 1	MAX 2 if plan view drawn – 1 mark for correct order, 1 mark for correct pattern of distributary channels
	(c)	cyclothem	1		
	(d)	(i)	<p>unidirectional current OR current shown in one direction with arrow / label OR sediment / sand transported downstream;</p> <p>ripple gentle on up current side and steep on down current side OR down current side drawn / labelled at realistic angle (max 37 degrees);</p> <p>sediment / sand moving by saltation OR sediment / sand deposited on down current side OR ripples migrate downstream</p>	2	<p>ANY 2</p> <p>MAX 1 if no label on diagram (an arrow is a label)</p> <p>MAX 1 if ripples drawn with crests overhanging</p> <p>MARK labels as text</p>

Question			Answer	Marks	Guidance
		(ii)	each bedding plane 'U' shaped / concave upwards; beds shown cut off / truncated at the top; scale between 3 and 100 cm per bed	1	ANY 2 correct for 1 mark
			beds shown dipping at less than 37°	1	DO NOT ALLOW very steep dips on diagram MUST have at least 1 label
	(e)		geological column / stratigraphic column; eras; systems / periods	1 1 1	DO NOT ALLOW named eras or systems / periods
Total				15	

Question			Answer	Marks	Guidance
5	(a)	(i)		2	all points plotted correctly = 1 mark; points joined by straight lines or curve = 1 mark DO NOT ALLOW straight line of best fit
		(ii)	as depth increases porosity decreases	1	ORA
		(iii)	pore space is reduced due to compaction (at depth) OR increase in cement fills the pore space (at depth) OR particles move closer together (at depth) OR <u>load / confining pressure</u> increases with depth OR weight of overburden increases with depth	1	
		(iv)	<u>46°C</u>	1	
	(b)	(i)	<u>16</u>	1	ALLOW ratio of <u>16:1</u>
		(ii)	ratio of peat to lignite is 16:5 (16/5) = 3.2:1 so 0.5m lignite requires 3.2 x 0.5 = <u>1.6m</u> of peat	1	

Question		Answer	Marks	Guidance
	(iii)	(compaction / load pressure / weight of overburden causes) <u>thickness to decrease</u> ; water is driven out / volatiles are driven out; carbon increases / ratio of carbon increases / calorific value increases / rank increases; plant fragments no longer recognisable / density increases / colour gets darker / hardness increases / reflectance increases	2	ANY 2 ALLOW any correct named volatile
	(c)	diagenesis is a sedimentary process that operates at low temperatures and pressures OR diagenesis occurs below 150 - 200°C OR diagenesis occurs below 2kb / 200MPa; burial metamorphism occurs at high pressures but low temperatures OR burial metamorphism occurs above 150 - 200°C OR burial metamorphism occurs above 2kb / 200MPa	1 1	MAX 1 for general correct statement comparing the two processes
	(d) (i)	contact / thermal	1	
	(ii)	P <u>spotted</u> rock; Q hornfels; R (meta)quartzite; S marble	1 1 1 1	ALLOW spotted slate
	(iii)	in the east the dip of the contact is shallow / gentle / any angle between 1° and 30° OR in the west the dip of the contact is steep / any angle between 50° and 90° OR the east is shallower than the west	1	ALLOW a correct diagram DO NOT ALLOW discussion of dip of aureole or dip of beds
Total			17	

Question	Answer	Marks	Guidance
6	<p>wadi conglomerate</p> <ul style="list-style-type: none"> • wadi is a steep sided channel / (box) canyon / ephemeral stream / (dry) river channel / has occasional flow / steep gradients / sediment deposited at foot of mountains forms alluvial fans; • high energy water transport / close to source / rapid deposition / flow dried up / flash flood / debris flow; • texture of conglomerate ANY 2 from: coarse grains >2 mm / rounded grains / poorly sorted / fine grained matrix common; • composition of conglomerate: iron oxide (cement) / fragments of mixed composition / immature composition; • grains will be rounded if transported on several occasions / grains transported once will be angular / grains transported once will form breccia / rapid deposition results in poor sorting; • may have imbricate structure – <u>diagram or description</u>; • suitable labelled diagram of wadi OR conglomerate 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>MAX 4 for wadi conglomerates</p> <p>DO NOT ALLOW repetition of text on diagrams MARK labels as text</p>
	<p>dune sandstones</p> <ul style="list-style-type: none"> • dunes are barchan / transverse / seif / longitudinal / stellate / any correct named dune type; • wind transport / aeolian / very high energy / no cushioning between grains / grains affected by attrition / grains affected by abrasion / transport by saltation or suspension; • wind is very effective at sorting grains / wind cannot transport coarse grains; • texture of sandstone ANY 2 from: medium to fine sand 1 to 0.125 mm diameter / very well sorted / very well rounded grains / high sphericity / millet seed sand / frosted grains; • composition of sandstone: iron oxide staining or cement / 100% quartz / mature composition; • deposition on lee side / downwind / sheltered area / where wind velocity reduced / sand grains avalanche down lee slope / forms <u>large scale</u> or <u>dune</u> cross bedding / dunes migrate in wind direction; • suitable labelled diagram of dune OR desert sandstone 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>MAX 4 for dune sandstones</p> <p>DO NOT ALLOW repetition of iron oxide if given for conglomerate DO NOT ALLOW repetition of text on diagrams MARK labels as text</p>

Question	Answer	Marks	Guidance
6	<p>evaporites in playa lakes</p> <ul style="list-style-type: none"> • water flowing into the lakes contains ions in solution / soluble minerals are dissolved as rainwater flows over rocks / chemical weathering occurs; • playa lakes are temporary / ephemeral / low energy / lake dries up / water evaporates; • evaporation of water leads to <u>saturation</u> (of salts) / dissolved ions become more <u>concentrated</u> as water evaporates / a dense brine is formed; • evaporite minerals precipitate in order of insolubility / reverse order of solubility / least soluble minerals precipitate first; • calcite first, gypsum / anhydrite second, halite third, K + Mg salts last OR correct diagram showing plan view; • formation of salt pseudomorphs – <u>diagram or description</u> 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>MAX 4 for evaporites in playa lakes</p> <p>MAX 3 if evaporite sequence is not given</p> <p>ALLOW any 3 in correct sequence</p> <p>ALLOW list in correct order</p> <p>DO NOT ALLOW repetition of text on diagrams</p> <p>MARK labels as text</p>
	Total	10	

Question	Answer	Marks	Guidance
7	<p>major intrusions</p> <ul style="list-style-type: none"> • <u>composed of granite / granodiorite / silicic / intermediate;</u> • batholiths are major / large scale intrusions / have surface area greater than 100km² / are discordant / have chilled margins; • plutonic / intruded at depth / more than 10 km deep / form in fold mountain belts; • the crystal size will be coarse / > 5 mm; • pieces of the country rock may be incorporated as <u>xenoliths</u> / assimilation of country rocks may have occurred / intruded by stoping / intruded as diapirs; • may have hydrothermal activity / pegmatites / veins associated with them; • cross section diagram to show a batholith OR thin section of granite / granodiorite 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>MAX 6 for major intrusions rock type(s) MUST be named for max marks</p> <p>MUST describe batholith ALLOW description of any other correct named major intrusion</p> <p>ALLOW coarse-grained, NOT coarse grains</p> <p>DO NOT ALLOW repetition of text on diagrams</p> <p>MARK labels as text</p>
	<p>minor intrusions</p> <ul style="list-style-type: none"> • sills and dykes are usually composed of <u>dolerite / mafic</u> OR could be <u>silicic / intermediate;</u> • dykes cut across bedding / are discordant / suitable labelled diagram; • sills are parallel to bedding / are concordant / suitable labelled diagram; • transgressive sills are generally concordant but occasionally discordant / suitable labelled diagram; • hypabyssal / intruded close to the surface / less than 1 km deep; • the crystal size will be medium / 1 - 5 mm; • have chilled and baked margins; • description of chilled OR baked margins: margins of the intrusion are chilled / may be fine grained / glassy / composed of basalt OR the (country) rocks are baked / recrystallised next to the contact of the intrusion; • may have <u>cumulate layering</u> / columnar jointing 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>MAX 6 for minor intrusions rock type(s) must be named for max marks</p> <p>ALLOW any correct named hypabyssal rock</p> <p>diagrams MUST show beds in country rock</p> <p>ALLOW description of any other correct named minor intrusion</p> <p>ALLOW medium-grained, NOT medium grains</p> <p>MAX 1 if location of chilled and baked margins is not clear</p> <p>DO NOT ALLOW repetition of text on diagrams</p> <p>MARK labels as text</p>
	Total	10	

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