OCR
RECOGNISING ACHIEVEMENT

GCE

Geology

Advanced GCE **A2 7884**

Advanced Subsidiary GCE **AS 3884**

Mark Schemes for the Units

June 2007

3884/7884/MS/R/07

Oxford Cambridge and RSA Examinations

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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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CONTENTS

Advanced GCE Geology (7884)

Advanced Subsidiary GCE Geology (3884)

MARK SCHEMES FOR THE UNITS

Mark Scheme 2831
June 2007

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the final version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

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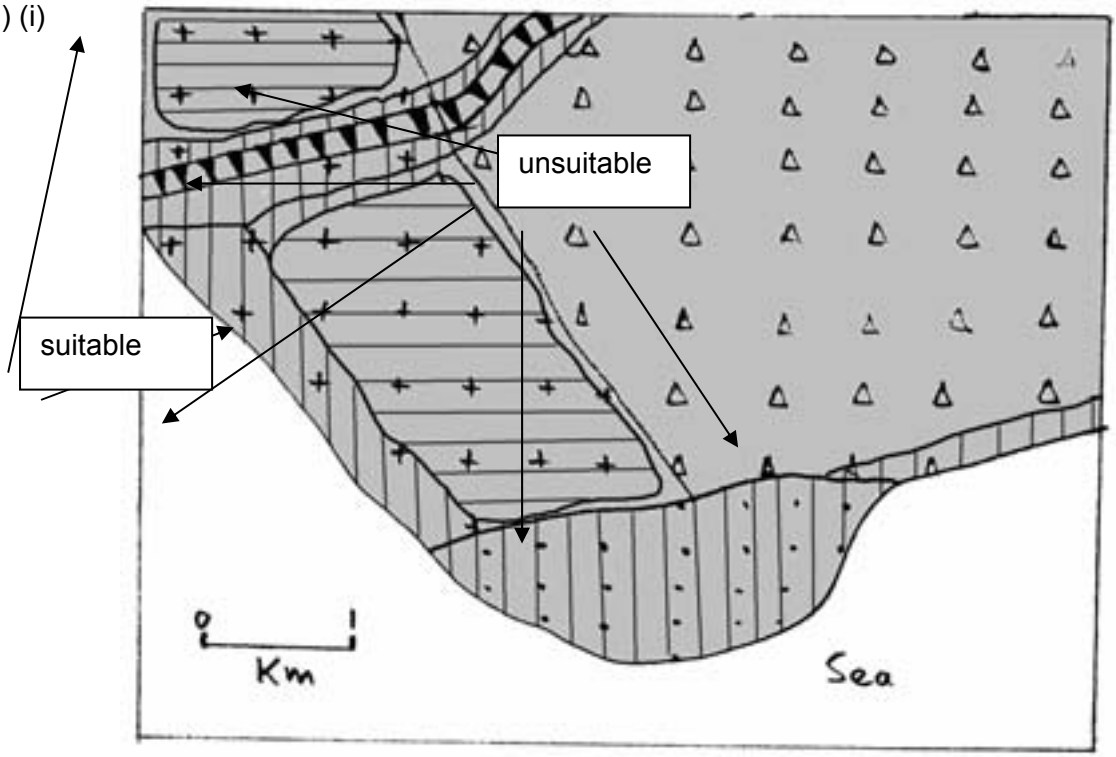
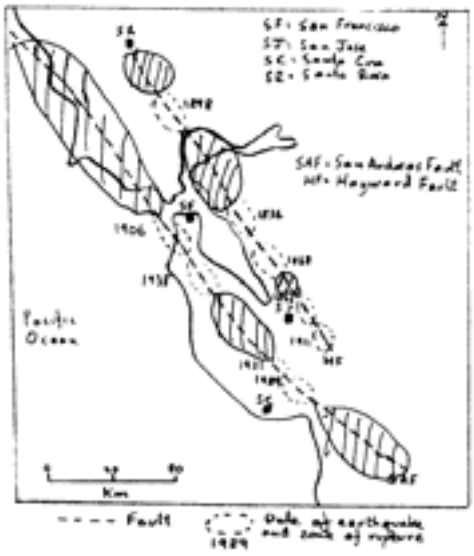
Question	Expected Answers	Marks
1 (a) (i)		
	An **X** in the suitable region	1
1 (a) (ii)	Not likely to collapse/better foundations/most stable area seismically/solid/consolidated ground not affected by liquefaction not affected by landslides near cliff away from coastline/reduced tsunami impact	Any 2
1 (a) (iii)	A **Y** in the unsuitable area	1
1 (b) (i)	**Social:** People evacuate Saves lives Possible looting or riots Road chaos during evacuation	Any 1
	Economic: Value of houses drops May not get house insurance Industry/businesses may close Less money for local infrastructure Buildings will be better prepared so less damage Better organised emergency services	Any 1

1 (b) (ii) **Cross-bracing/bird caging**
flexible steel structure/steel girders at 90°/to strengthen building/prevent twisting/flexing
Weight on roof
To raise the centre of gravity/reduce swaying
Pyramid like structure
more stable/wider base to increase surface area in contact with ground
Building on a solid concrete raft/deeper foundations
to strengthen building
Base isolation/Rubber/Teflon/rollers/springs in foundations/(stilts in LEDC)
to absorb ground vibrations/less movement
restricted building height
less likely to collapse/domino effect
Name = 1 mark
Description = 1 mark
Mark diagram as text
Max 2 for each method 4

1 (c) (i) Conservative plate margin 1

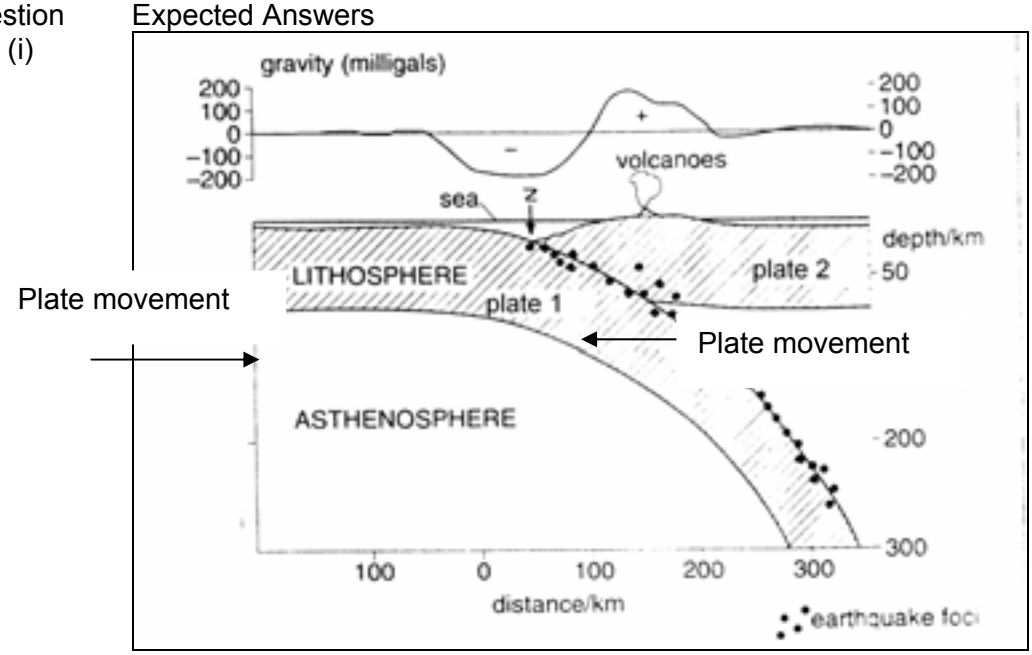
1 (c) (ii)



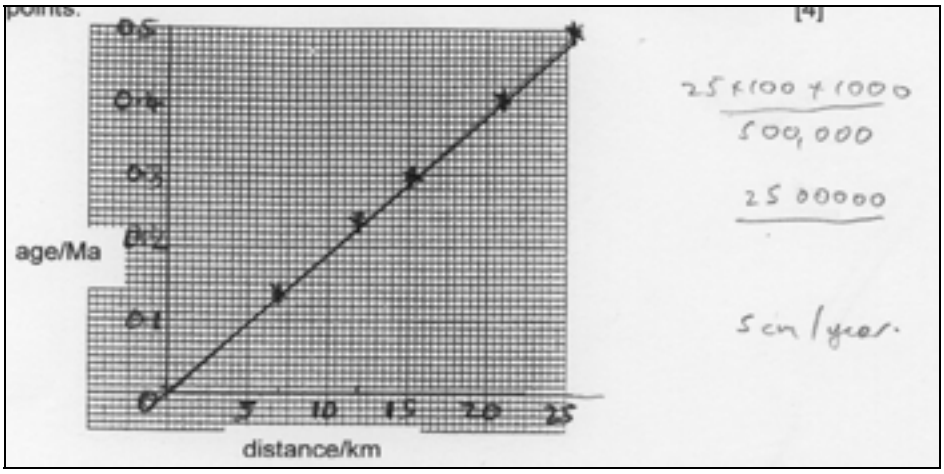
Any of the 3 shaded areas on the San Andreas Fault 1
Any of the 3 shaded areas on the Hayward Fault 1

1 (c) (iii) Seismic gap
Area where fault has not moved
So stress/force/pressure has built up
Stress moves along the fault progressively and so the next earthquake is further along Any 2

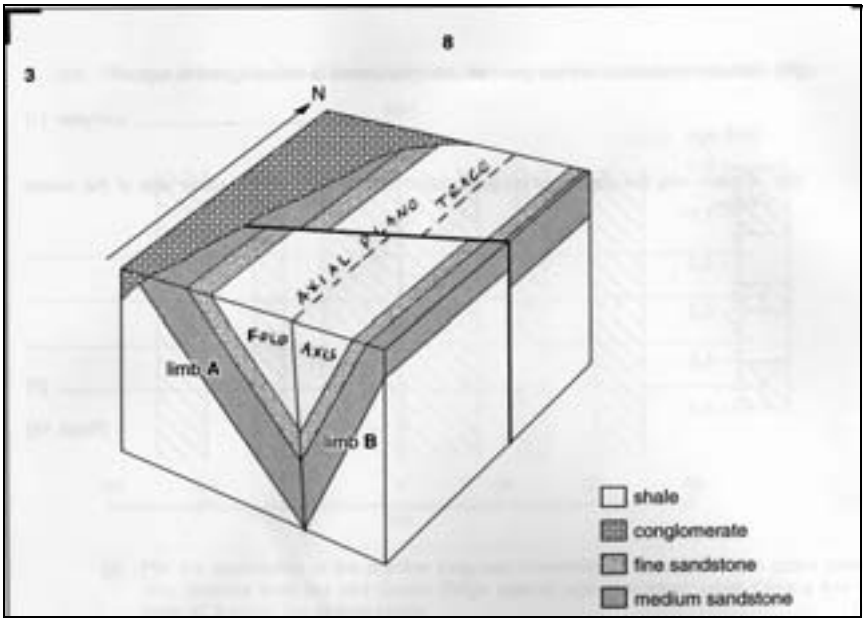
1 (c) (iv)	Strange animal behaviour (or example) Tiltmeters/lasers/satellites/GPS measure ground movement/train gauges show change/gravity change (Radon) gas levels increase/change Foreshocks increase Rise in water table/changing water table P wave velocities change Electrical resistivity changes Release/increase of electricity/earthquake lights/change in local magnetic field If just a list max 1	Any 2
		Total: 17

Question	Expected Answers	Marks
2(a) (i)		
	1 mark for each correct (labelled) arrow	2
2 (a) (ii)	(ocean) trench	1
2 (a) (iii)	Destructive/ocean v ocean collision/convergent/(ocean v continental collision)	1
2 (a) (iv)	Caribbean/Montserrat/Japan/Aleutian islands/any appropriate answer (accept ocean v continental examples)	1
2 (b) (i)	Increasing depth of foci/at the top of the subducting plate	1
	Friction/irregular movements/stuck/build up of stress/pressure/force/elastic rebound If only described max 1	1
2 (b) (ii)	Low over the trench as there is less mass/trench filled with less dense water	1
	Positive over island arc/volcano/mountains as the crust is thicker If only described max 1	1

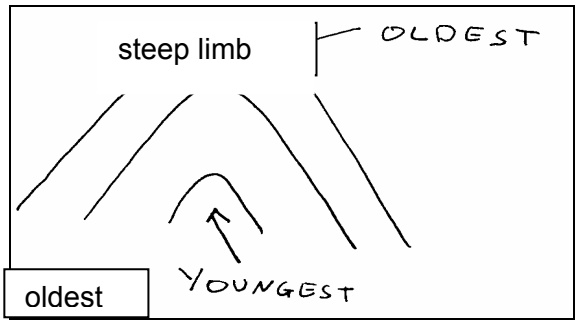
2 (c) (i)



	1-2 points correct = 1 3 –6 points correct =2 correct axes (needs a 0 at origin) = 1 best fit line (through origin and straight) = 1	4
2 (c) (ii)	Correct working shown = 1 5cm/year +/- 0.2 cm/year ecf	1 1
2 (c) (iii)	10 cm/year +/- 0.4 cm/year ecf	1
2 (c) (iv)	Due to sea floor spreading Spreading rate equal on both sides New crust created at the ocean ridge then moves apart	any 2 Total: 18

Question	Expected Answers	Marks
3 (a) (i)	**Synform/syncline** **Asymmetrical/fold striking N-S/limbs dipping W and E/closed/angular**	any 2
3 (a) (ii)	 Both correct but no label = 1 max	2
3 (a) (iii)	Limb **A** angle of dip 35° - 55° Direction of dip East Limb **B** angle of dip 60° - 85° Direction of dip West Any 2 correct = 1 All 4 correct = 2	1 1
3 (a) (iv)	On conglomerate (anywhere on the bed) must be labelled	1
3 (b)	Fold older than the fault and unconformity Fault older than the unconformity but younger than the fold Unconformity younger than the fold and fault All 3 in correct order = 2 2 correct = 1	3
3 (c)	technical term — description mylonite — Fine-grained rock with fractured crystal fragments in a streaky, very fine-grained matrix. slickensides — Parallel scratches and grooves produced by fault movement fault breccia — Angular fragments of rock set in a finer-grained matrix produced by grinding of rock against rock. 1 or 2 correct = 1 mark 3 correct = 2 marks	2

3 (d) (i)

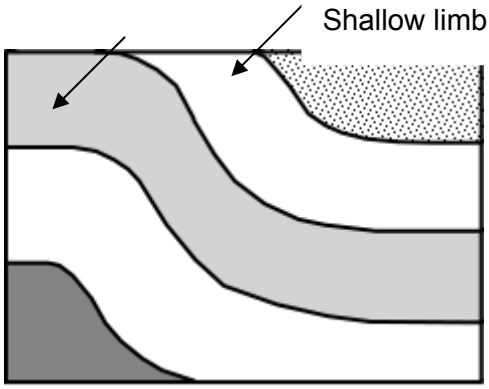


Shape = antiform = 1 mark
oldest in core (or correct way up shown/younging direction) = 1 mark

2

(ii)

Shallow limb



Steep limb = 1
2 shallow limbs = 1
Recumbent fold = 0

2

Total: 15

Question	Expected Answers	Marks
4	**composition**	
	outer core – iron, nickel and sulphur/ inner core – iron - nickel	1
	Earth's magnetic field generated by iron	1
	Iron/metallic/iron - nickel meteorites same as core	1
	Whole Earth density (5.5) compared to crust/mantle	1
	Suggests very dense core of iron	1
		max 5
	Physical state	
	Outer core = liquid/Inner core = solid	1
	Convection currents create magnetic field	1
	S waves are stopped at the outer core/	1
	S wave shadow zone	1
	P waves are slowed down	1
	P waves are refracted	1
	P wave shadow zone	1
	Arrival of P waves faster than expected/speed up in inner core	1
	S waves exist in the inner core	1
	Lehman/outer – inner core discontinuity	1
		max 5
	Mark labelled diagrams as text	Total: 8
	Quality of Written Communication	
	2 marks Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.	
	1 mark There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.	
	0 marks There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar, which makes the candidate's meaning uncertain.	
	[quality of written communication max 2]	Total: 10

Mark Scheme 2832
June 2007

Question	Expected answers	Marks
1 (a) (i)	(repeated sequence of) processes that link all three major rock groups/ the interlinked formation of the three different rock groups.	1
(ii)	correct order, clockwise starting on left of diagram is igneous, sedimentary, metamorphic	
	two or three correct=	2
	one correct=	1
(iii)	X below the igneous box / between igneous and metamorphic box	1
	Y above the sedimentary box but below the ground surface	1
(iv)	partial melting	
	magma accumulation/upward movement of magma/stoping/making space for the intrusion	
	cooling of magma/cooling of melt/cooling of molten rock	
	differentiation/assimilation/crystallisation/solidification	
	minor intrusives at shallow depth cooling fairly slowly/ major intrusives at depth cooling very slowly	any 2
(v)	lava (any named basic/intermediate/acid)	
	pyroclasts (bombs/blocks/lapilli/ash/tephra/ignimbrite/tuff/agglomerate/ nuee ardente/pyrocastic flow	
	extrusive rocks max1	
	gas /SO_2 /other correct named volcanic gas	any 2
(b)	igneous= C E	
	sedimentary= A F G	
	metamorphic= B D H	
	no mark for letters used in more than one box	
	7-8 correct=	4
	5-6 correct=	3
	3-4 correct=	2
	1-2 correct=	1
(c) (i)	geological column/geological time scale/geological time line/ stratigraphic column	1
(ii)	system/period immediately beneath K (Quaternary) shaded	1
(iii)	J = era	1
	K = system/period	1

17

Question	Expected answers	Marks
2 (a) (i)	L is the parent of O	1
	N is the parent of M	1
(ii)	rolling of a pellet/oolith/rock fragment/shell fragment /sand grain in carbonate mud /concentric layers of $CaCO_3$ sea water saturated in calcium carbonate/ high rates of evaporation/ $CaCO_3$ precipitated tidal/wave action/ high /medium energy conditions	any 2
(iii)	under water/ oscillating currents/bi-directional currents/flow direction oscillates/AW;	1
	beach/inter-tidal/sea floor/large lake/affected by wave action/wave action caused by winds	1
(iv)	symmetrical shape/pointed crests and rounded troughs/gradient <37^o	1
	scale showing ripple marks up to 20cm in height NOT scale bar without recognisable diagram	1
(b) (i)	water freezes in cracks / joints / bedding planes water expands (9%) on freezing / exerts pressure which forces rock apart (frost shattering/ freeze thaw) continual process If named only max 1	any 2
(ii)	angular	1
(iii)	gravity/mass movement/mass wasting/falling/rolling/solifluction landslide	any 1
(iv)	rainwater containing dissolved CO_2 becomes carbonic acid acid water reacts with/dissolves carbonates/limestone forms soluble hydrogen carbonates/ $CaCO_3 + H^+ + HCO_3^- \rightarrow Ca^{++} + 2HCO_3^-$ If carbonation only max 1	any 2
(c)	reference to high energy conditions/ fragments of organic origin in carbonate mud matrix burial/compaction/growth of calcite crystals to form micrite/sparite cement/become lithified	any 2

16

Question	Expected answers	Marks
3 (a) (i)	From top to bottom on diagram volcanic hypabyssal plutonic two or three correct= 2 one correct= 1	
(ii)	horizontal structure on left of diagram	1
(b) (i)	P= fine / <1mm	1
	Q= coarse / 6-15mm	1
(ii)	gas bubbles in the magma/gas dissolved in magma/trapped in rock/exsolving rock cools quickly leaving oval/ellipsoid holes/rapid cooling of lava	any 2
(iii)	at depth crystals have longer time to grow /cool slowly = coarse grained/AW at surface crystals have short time to grow /cool quickly = fine grained/AW hypabyssal / intermediate depths conditions are intermediate between volcanic and plutonic/surface and great depth = medium grained /AW very rapid cooling under water/at surface = glassy	any3
(c) (i)	island arc/destructive plate boundary/subduction/adjacent to ocean trench/oceanic oceanic boundary;	1
	(partial) melting/formation of magma/melting point lowered by release of water/heat produced by friction/conduction/rising diapirs	1
(ii)	2 ÷ 12 x 100 / 100÷12x2 = 16.66% / 16.6% / 16.7% working= 1 answer= 1	
(iii)	there was a major eruption in 1815 /preceding year/Tambora eruption/ global extent of the cooling depends on the force of the eruption;	1
	ash in the atmosphere/volcanic gases are thought to be responsible for global cooling amount of particular gases emitted/sulphur dioxide molecules remain in upper atmosphere for years/they absorb solar radiation/reflect solar radiation into space/block sunlight location of the volcano with respect to the Earth 's global atmospheric circulation patterns.	any 2
		17

Question	Expected answers		Marks
4	mass of overlying sediment/hydrostatic pressure/load pressure /compression		1
	squeezes fluids from pore spaces		1
	porosity reduced/no pore spaces		1
	close packing of grains/ volume reduction/density increase		1
	grain contact solution eliminates porosity		1
	primarily affects clays		1
	fluids pass through pore spaces		1
	minerals carried in solution		1
	minerals precipitate in pore spaces/named minerals/crystallise out /deposited in pore spaces		1
	porosity reduced further		1
	reduced permeability		1
	pressure welding/pressure solution		1
	primarily affects quartz/sand grains		1
	compaction and cementation/are diagenetic processes/both affect sediments/lead to lithification of sediments/ lithification is process by which sediment becomes rock		1
	diagrams marked as text		1
	diagram for compaction		1
	diagram for cementation		1
	If only one described(including diagram)	max 6	
	If no diagrams	max 6	
			8

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quality of written communication max 2

Question total 10

Mark Scheme 2833
June 2007

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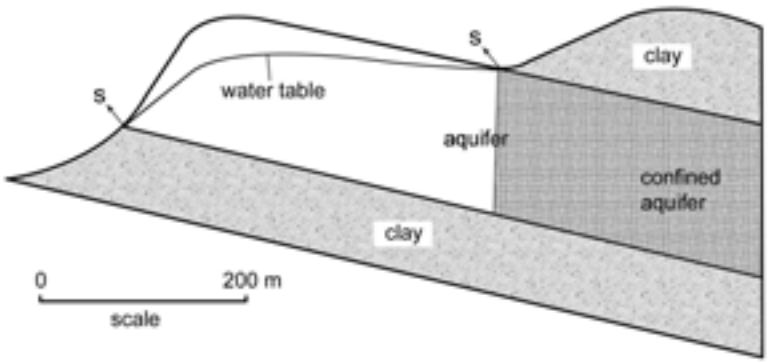
Question 1	Expected Answers			Marks
(a)	high porosity/porous/rock in which water can be stored; high permeability/permeable/rock in which water can flow/good interconnections between the pores/jointed; well rounded, well sorted grains; little or no cementation/poorly consolidated/unlithified			any 2
(b)	water table – line draw from intersection of contact of upper clay and the aquifer with the topographic surface to intersection of contact of lower clay and the aquifer with the topographic surface; spring – marked at intersection of contact of aquifer and either clay layer with the topographic surface; confined aquifer – area in aquifer shaded to the right of and below the contact of the upper clay and the aquifer  			1 1 1
(c) (i)	water will rise up the well/water will flow out onto surface; water is under (high hydrostatic) pressure/water is confined under impermeable rocks/water table is higher than the well/pressure is released			1 any 1
(ii)	artesian			1
(iii)	level of water table falls/well becomes dry/cone of depression forms/hydrostatic/water pressure drops so water no longer flows up/subsidence at surface/salt water encroachment (if near coast)			any 1

(d)	hydrostatic pressure – water pressure at a point in a body of water/pressure caused by the weight of overlying column of water/hydraulic head; hydraulic gradient – slope down which the water moves/slope of the water table/difference in hydrostatic pressure/hydraulic head between two points (divided by the distance between them)/water moves from high pressure to low pressure/water moves down the pressure gradient (accept alternative wording)	1 1
(e)	rocks act as natural filter/purifies water/water does not require treatment/chlorination/dissolved minerals give health benefits/ no loss of water through evaporation/less seasonal/ no requirement to build expensive/unsightly/environmentally damaging dams and reservoirs (must qualify economics with discussion) (accept reverse argument; do not accept less likely to be polluted)	any 1
		Total: 12

Mark Scheme Page 2 of 4	Unit Code 2833/01	Session May	Year 2007	Version Final
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Question 2	Expected Answers			Marks
(a)	oil coal sedimentary environment deep marine deltaic/delta top/swamp/marsh/bog/floodplain type of organic matter plankton/micro-organisms/sapropel terrestrial vegetation oxygen conditions anoxic sea bed conditions low oxygen / reducing/anoxic/anaerobic/stagnant rate of sedimentation slow fast/rapid			1 1 1 1
(b) (i)	Kimmeridge Clay accept: Speeton Clay/Brent Group shales/clay/Jurassic shales/mudstones/clays			1
(ii)	the source rock did not contain plankton/was not suitable for oil formation/there is no Kimmeridge Clay in this area/the conditions were different/different source rock/the source rock is the Carboniferous coal measures/origin was from terrestrial vegetation/methane/gas/volatiles escaped from the coal as it formed/the gas has been trapped under cap/impermeable rocks/the gas has not escaped / temperatures and pressures were high enough for gas to be produced/suitable/named traps are present			any 2

(c)	(i)	horizontal shading in the top of the limestone unit at the crest of the anticline (accept if source rock has been shaded as well)	1
	(ii)	the limestone is a suitable reservoir rock/is porous and permeable; the oil rises to the top of the reservoir rock due to low density; the shale is a suitable cap rock/is impermeable/there is a cap rock above; the anticline/fold is a suitable trap/concentrates the oil in one place/at the top of the anticline;	any 2
	(iii)	the shale and limestone with 5% organic carbon is a suitable source rock oil may have been destroyed by metamorphism; oil may have been destroyed by heat from the igneous intrusion/an igneous intrusion is present;	any 2
	(iv)	oil may have escaped up/along the fault (do not accept down the fault); oil may have escaped through the limestone/there is no cap rock over part of the limestone a (production) well/borehole is drilled into the reservoir rock/limestone; directional/deviation/slant drilling techniques can be used to withdraw oil from a large area; the well needs to be capped off to prevent oil escaping/spills; the oil comes to the surface under natural pressure/forms a gusher/release of pressure causes oil to rise; the pressure is the result of gases coming out of solution/expansion of the gas above/water pushing up from under the oil; typically 20-30% of the oil can be recovered in this way/70-80% of oil is left in the reservoir rock	any 2
			Total: 14

Mark Scheme Page 3 of 4	Unit Code 2833/01	Session May	Year 2007	Version Final
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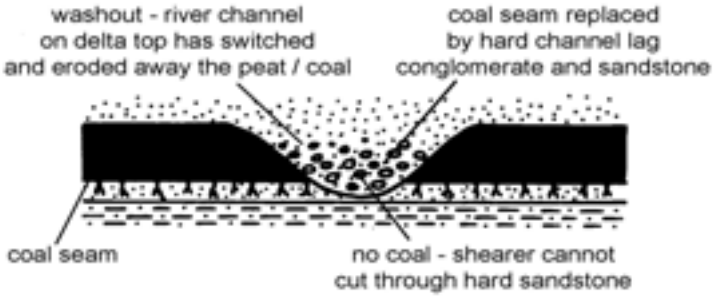
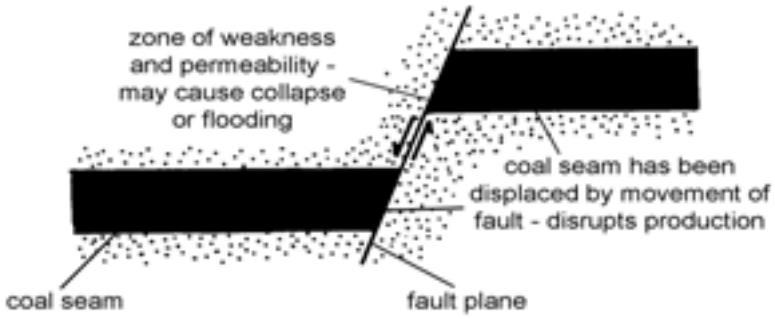
Question 3	Expected Answers			Marks
(a)	longwall (retreat) mining; (two) roadways/tunnels are driven out from the shaft/ a (100-200m) long/longwall/coalface is established/ the coal is cut with a mechanical cutter/shearer/ coal falls onto a conveyor belt/ the roof is supported by (mobile) steel/hydraulic chocks/rams/supports/ the mined area is allowed to collapse/ mining takes places backwards/retreating towards shaft OR pillar and stall/pillar and stope/room and pillar mining (accept pillar mining); coal seams are mined from the rooms/drilling and blasting techniques may be used/pillars of rock are left to support the roof/typically a maximum of 60% of the coal is extracted/maximum safe depth is 200-300m (named mining method must match description)			1 any 2 OR 1 any 2

(b)	(i)	suitable diagram showing river channel/wash out cutting into coal seam; 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/mechanical cutter/shearer cannot cut through hard sandstone (mark labels as text)  	any 2
	(ii)	suitable diagram showing fault displacing coal seam; suitable labels/text: coal seam and fault with direction of movement labelled/coal seam is displaced/offset disrupting production/faults are zones of weakness/permeability/may cause collapse (mark labels as text)  	any 2

Mark Scheme Page 4 of 4	Unit Code 2833/01	Session May	Year 2007	Version Final
Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument			
Question 3	Expected Answers			Marks
(c)	opencast mining is cheaper because it is more efficient/accessible/requires less man power/wages are lower/has lower set up costs / requires less high tech equipment/has no requirement for pumping/ventilation/thinner/ smaller seams can be mined profitably (must qualify economics with discussion) opencast mining is safer because there are no dangers of collapse/ flooding/(methane) gas build up (must qualify safety with discussion)			any 1
(d) (i)	sandstone is permeable/water table is close to the surface/there is permeable rock between the surface and the water table/water can percolate/pass through the sandstone (do not accept sandstone is porous)			1
(ii)	(5x100/10) = 50 days			1
(iii)	make the quarry floor impermeable/impervious / grouting – (holes are drilled and) liquid cement pumped into ground/ clay/geotextile/plastic lining – is impermeable/impervious/ will prevent leakage of toxic fluids / drainage and collection of toxic fluid / toxic fluid can then be treated			any 2

(e)	igneous intrusion is acid/granite/a batholith; description of relationship of veins to batholith (expect diagram); hydrothermal processes occur during final crystallisation/are late stage processes; water/volatiles/incompatible elements/metals do not fit in silicate minerals/residual fluids collect to form hydrothermal fluid/is concentration method; hydrothermal fluid is a hot, watery/aqueous fluid with metals in solution; igneous intrusion is the source of heat; source of water can be igneous intrusion/surrounding groundwater; hydrothermal fluid moves out into country rock; hydrothermal fluid exploits joints/bedding planes/fractures/requires permeable/reactive/suitable named country rock; metals/ore minerals precipitate/crystallise out as fluid cools/encounters (chemically) reactive country rock; veins are formed when precipitation/crystallisation occurs in joints/bedding planes/fractures; disseminated ore/disseminations may occur when precipitation/crystallisation occurs in pore space; metals/ore minerals crystallise out in order of temperature/solubility/often show a zonation/within veins early formed ore minerals will be at edges and later formed ore minerals will be in centre; a + b cassiterite/tin (ore)/tin oxide/is high temperature (~500°C)/least soluble/precipitates first/is found closest to/inside intrusion; a + b galena/lead (ore)/lead sulphide/(and) sphalerite/zinc (ore)/zinc sulphide/are low temperature (~200-300°C)/most soluble/precipitate last/are found furthest from intrusion (mark labelled diagrams as text)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 + 1 1 + 1 total max = 7
		Total: 19

Mark Scheme 2834
June 2007

Question	Expected answers			Marks
1 (a) (i)		phylum	group	
	A	Brachiopoda/Brachiopod	Articulate	
	B	Mollusca/Mollusc	Ammonite/Ammonoid/cephalopod	
	C	Mollusca/Mollusc	Belemnite/Coleoid/cephalopod	
	D	Arthropoda/Arthropod	Trilobita/Trilobite	
	1 mark per row			
				Max 4
(ii)	1. Brachial valve/dorsal valve			1
	2. Protoconch			1
	3. Free cheek			1
	4. Pygidium/pleura			1
(iii)	A = sessile/benthonic			1
	B = nektonic			1
	C = nektonic			1
	D = benthonic			1
(b) (i)	Strong valves/rolled around and not broken up; Hard shells resist erosion; Muscles hold valves together on death; Shells remain articulated; Quickly covered in sediments, may be found whole; Lived in low energy environment			Any 2
(ii)	Sink to bottom of ocean on death; Aligned by currents on landing; Streamlined/elongate shell; May be at right angles or parallel with current (or both); May be rolled around for a long time after death before burial; Often transported and concentrated by currents (winnowing); Strong guard resists erosion			Any 2
(iii)	Trilobites undergo ecdysis/moulting; Cephalon or pygidium resistant to change/does not break up easily/fused segments; Larger or denser parts left/lighter fragments taken away in currents; Death assemblages; Thoracic segments/segmented pleura disarticulate; Muscles or soft tissue holding skeleton together has decayed; Maybe scavenged			Any 2
				18

Question	Expected answers	Marks
2 (a) (i)	Irregular/*Micraster*	1
(ii)	petaloid ambulacra – line to stellate structure on the top of echinoid; anterior groove– line to the anterior depression;	Max 2
(iii)	labrum on underside of organism/adjoining mouth/AW projecting lip to protect mouth/aid feeding	1 1
	plastron on underside of organism/AW; area of attachment for spines/for digging burrows	1 1
(b) (i)	Petaloid ambulacra get longer/more distinct; More tube feet for efficient gas exchange/improves respiration;	1 1
	Anterior groove deepens/development of heart shape; Easier channelling of food towards mouth/more efficient feeding;	1 1
	Increase in size of test/streamlined; suggestions as improved burrowing efficiency	1 1 Max 4
(ii)	F = youngest G E = oldest 2 correct = 1 mark; 3 correct = 2 marks	Max 2
(c) (i)	Differences Regular v irregular/discussion of symmetry; H has large tubercles, E does not/H had large spines, E did not; H has a central anus, E does not; H does not have an anterior groove, E does; H has apical system in centre, E has apical system away from ambs; H lacks petaloid ambs/anterior groove, E possesses them	Any 2
(ii)	H = rocky shore dweller/high energy/vagrant/benthonic/epifaunal	1
	Scavenger/graze on algae/spines allow movement (by rotation)/tube feet for attachment, respiration or feeding	1
		17

Question	Expected answers	Marks
3 (a) (i)	trace fossil description palaeoenvironment	
	M graptoloid/graptolite (fragment); two uniserial stipes/ pendant/or accurate description energy = low water = deep marine	
	N trilobite; walking/resting trace/running/or accurate description energy = low water = shallow marine	
	O crinoid; stem sections/ossicle/broken after soft tissue decayed/or accurate description energy = medium water = shallow marine/deep marine	
	1 mark for possible organism; 1 mark for description;	Max 6
(ii)	5 or 6 correct points = 3 marks 3 or 4 correct points = 2 marks 1 or 2 correct points = 1 mark	3
(b)	Evidence for activity of animals; Animals living in environment; Evidence of diet; Evidence for plants (seeds and fragments); Plants/animals may give information about climate; Evidence of land areas; Large masses = large animals (ora) Complete coprolites means low energy levels; any one point in detail = 2 marks	Any 2
(c) (i)	Silicification Fluids percolate through rocks or sediments; dissolution (pressure solution)/hydrothermal/meteoric waters; Voids filled by crystallising silica/silica stable in voids ; Replacement of shelly material	Max 2
	Carbonisation organic matter trapped in sediments; Increased pressure and temperature; volatiles driven off as gasses (eg CH_4, H_2O, CO_2 etc); material becomes enriched in carbon/depleted in volatiles; Leaves thin film	s Max 2
(ii)	Aragonite has unstable bonds/needs to recrystallise to become stable or more dense/polymorphs/burial increase in heat ora	1
		16

Question	Expected answers	Marks
4 (a) (i)	Emission of particles over time/loss of correct particles; Parent atoms decay to daughter atoms; from an unstable nucleus/isotope; to form stable products; Measured in half lives	Any 2
(ii)	points plotted correctly two or three points plotted = 1 marks four / five points plotted = 2 marks correct curve = 1 mark	Max 3
(iii)	particles emitted at a faster rate from X/parent atoms more quickly change to daughter atoms/short half lives qualified/shorter half lives/X decays faster	Any 1
(iv)	235U = 38% X = 9 - 11 %. ecf from graph	1
(v)	Loss of daughter products, such as argon; Resetting of geological clock, by metamorphism; Chemical weathering or erosion (idea of removal or addition); Dates age of clasts in sedimentary rock; Contamination qualified; Inaccurate equipment/methodology has large range of error; Inaccurate half lives; Lack of suitable minerals to use for dating; Measures cooling rather than formation ages/ora	Any 3
(b) (i)	40Ar	1
(ii)	1 260 Ma Accept 1 160 Ma to 1 360 Ma	1
(iii)	Muscovite mica/biotite mica/hornblende/glauconite/orthoclase	1
(iv)	Slate/igneous rocks/some sedimentary rocks containing glauconite ecf	1
		14

5 (a)	Adaptations of burrowers	
	Elongate valves/smooth valves;	1
	Easy movement though sediment/allows burrowing;	1
	Large foot/strong muscle;	1
	Allows burrowing/pulls organism into sediment;	1
	Long siphons/large pallial sinus;	1
	Allows gas exchange and/feeding to occur out of the burrow;	1
	Gapes present;	1
	Allows extension of foot and siphons for burrowing;	1
	Thin shells or valves;	1
	Light to move through sediment/thick shells not needed (protection)	1
	Suitable diagram of form eg *Solen* or *Cardium*	1
		Max 4
	Adaptations for swimming forms	
	Thin/light shells or valves;	1
	To allow 'swimming'/flapping of shells;	1
	Corrugated or ribbed shells;	1
	High strength;	1
	Monomyarian/single strong muscle;	1
	Control rapid flapping of valves;	1
	Ears or wings;	1
	To direct currents to control direction of movement;	1
	Large surface area to weight ratio;	1
	Efficient displacement of water when swimming;	1
	Hydrodynamic shape;	1
	Suitable diagram of form eg *Pecten*	1
		Max 4
	Adaptations of attached forms	
	Byssus (to attach to rocks);	
	For attachment to substrate;	1
	Streamlined/unornamented shells;	1
	Lessens damage due to impact living in groups/hydrodynamic;	1
	Shells equivalve;	1
	Suitable example of form eg *Mytilus*	1
	May have thick or heavy shells	1
	Strong growth lines;	1
	Cemented to substrate;	1
	Suitable diagram of form eg *Ostrea*	1
		1
		Max 4
	Adaptations for free lying forms	
	Thick or heavy shelled forms;	1
	Protection from high energy conditions;	1
	Inequivalve;	1
	Centre of gravity is lower and so more stable/not moved by currents;	1
	Curved lower surface/snowshoe shaped;	1
	Prevents sinking in soft sediment/stability in high energy;	1
	Strong growth lines;	1
	Grips the sediment;	1
	Suitable diagram of form eg *Ostrea* or *Gryphaea*	1
		Max 4
	Diagrams marked as text	
	No diagrams Max 8	
		Max 12

5 (b)	Similarities	
	Both extinct	1
	Both can be colonial	1
	Both Palaeozoic	1
	Both made of corallites	1
	Both have tabulae	1
	Both have calcium carbonate skeletons	1
	Both live in same conditions/similar environment/found in same rock	1
	Differences	
	Tabulate - tabulae well developed	1
	Rugose – tabulae always present	1
	Tabulate – no dissepiments/sometimes present but reduced	1
	Rugose – dissepiments sometimes present	1
	Tabulate - radial symmetry	1
	Rugose – bilateral symmetry	1
	Tabulate - no axial complex/columella	1
	Rugose – always has axial complex/columella	1
	Tabulate – septa sometimes/reduced/poorly developed	1
	Rugose – present/well developed	1
	Tabulate – always colonial	1
	Rugose – colonial or solitary	1
	Tabulate – small corallites	1
	Rugose – larger corallites	1
	Tabulate – have mural pores	1
	Rugose – don't have mural pores	1
	Tabulate – ranges Cambrian to Permian	1
	Rugose – ranges Ordovician to Permian	1
	Suitable labelled diagram of tabulate form	1
	Suitable labelled diagram of rugose form	1
		Max 11

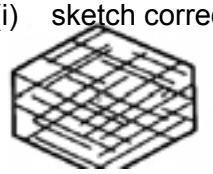
2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, use a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

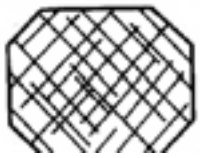
quality of written communication max 2

Question total 25

Mark Scheme 2835
June 2007

Question	Expected answers		Marks
1 (a) (i)	A	rhyolite	1
	B	obsidian/volcanic glass	1
	C	diorite	1
(ii)	bands contorted dark and light bands/minerals separated into layers/minerals aligned banding shown on diagram		any 2
(iii)	no time for crystals to form/very rapid cooling/quenching in water/supercooling		1
(iv)	a series of parallel semi circular lines along which the rock has broken/a fracture pattern similar to that seen in broken glass/shell shaped fracture (allow sketch to assist definition)		1
(b) (i)	sketch correct shape		





hornblende 6 sides / hexagonal	augite 8 sides	
cleavage drawn 2 sets	cleavage drawn 2 sets	
at 120°	at 90°	any 2
crystals are elongate	crystals are roughly equidimensional	

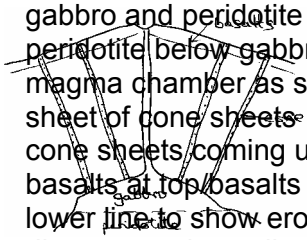
Any correct description for 1 mark but must be a comparison

(ii)	lamellar or repeated twinning/twin planes/simple twins/schillerisation hardness 6 – 6.5/can be scratched by steel triclinic crystals	any 2
(c) (i)	D olivine E potash feldspar/K feldspar/orthoclase F muscovite G quartz 4 or 3 correct = 3, 2 = 2, 1 = 1	max 3
(ii)	olivine and Ca-rich plagioclase are high temp/>1600° quartz/G is lower temp 800° general statement of down diagram is lower temperature = 1 second mark for specific temps or for detail of reactions such as olivine reacts with liquid as temp drops to form lower temperature mineral	1 1
(iii)	ring left part of diagram/D to biotite	1
(d) (i)	100% anorthite/just anorthite/pure anorthite	1
(ii)	1490° +/- 10	1
(iii)	1274° +/- 10	1
		20

Total 20 marks

Question	Expected answers		Marks
2 (a) (i)	Cubic/cuboid/cube		1
(ii)	H	fluorite/fluorspar	1
	J	galena	1
	K	pyrite/fools gold	1
(b) (i)	pyrite (K) ecf		1
	large crystal that grows in metamorphic rocks/large crystal embedded in a finer grained groundmass/forms after the finer crystals		1
(ii)	galena (J) ecf		1
	a mineral that contains an economic metal/named economic metal/a mineral from which a useful metal may be extracted		1
(c) (i)	L due to different hardness of minerals/coarse grain size wearing differently so skid resistant / minerals plucked out/ differential wear so surface stays rough OR allow N		any 2 OR
	N due to different hardness of minerals/fine grain size wearing differently so skid resistant/minerals plucked out / If general statement on roadstone characteristics Max 1		any 2
(ii)	gabbro if answer L OR dolerite/basalt if answer N		1
(d)	high crushing strength/load bearing strength strong/hard non reactive chemically resistant to weathering		any 2
			13
			Total 13 marks

Question	Expected answers	Marks
3 (a) (i)	dolerite dykes are radial/radiating along fractures circular pattern/concentric pattern of cone sheets due to intrusion of magma cone sheets are perpendicular to the radial dykes	any 2
(ii)	relationship of cone sheets and gabbro and peridotite to volcano gabbro and peridotite in magma chamber/deepest in crust peridotite below gabbro magma chamber as source of cone sheets sheet of cone sheets cone sheets coming up from magma basalts at top/basalts in volcano lower line to show erosion of basalts diagram to show all	any 4



(b) (i)	P	equigranular/equicrystalline	1
	Q	amygdaloidal (allow vesicular or corona)	1
	R	porphyritic (allow poikilitic)	1
(ii)	10 mm +/- 1		1
(iii)	gas bubbles created holes vesicles infilled by minerals groundwaters deposited mineral calcite/quartz in vesicles		any 2
	OR vesicular ecf trapped gas bubbles/exsolving/exsolution rapidly cooling groundmass		OR any 2
	OR corona ecf Early formed minerals (olivine) Partially replaced by later mineral(s), (pyroxene and amphibole)		OR any 2
(iv)	two stages of cooling phenocrysts or larger crystals formed first/cooled slowly groundmass formed last/cooled more rapidly		any 2
	OR poikilitic ecf early formed mineral (enclosed mineral) totally enclosed by later formed mineral (enclosing mineral)		OR 1 1

14

Total 14 marks

Question	Expected answers	Marks
4 (a) (i)	erosion on outside of a bend	1
	deposition on inside of a bend	1
(b) (i)	fining up sequence/cyclothem/ migration of meandering river system	1
(ii)	flood plain covered in water only when river floods/overbank deposit finest material deposited as clay/swampy area where plants grow/low energy area between channels	any 2
(iii)	gravels and sand deposited in the river/stream channel/as channel lag deposits sands on inside bend of meander point bar deposits/braiding/sand bars and banks	any 2
(c)	energy level high when sands and gravels deposited energy level lower for muds vertical sequence shows one place from channel to floodplain decrease in energy from bottom to top of sequence	any 2
(d)	channel migrates laterally over time/previous channel positions sediment builds up over time so vertical change sand in (lens shaped formed) channel/river bed clay layers on flood plain and eroded by channel/floods asymmetrical shape of channel/sand lens due to erosion on bends	any 2
(e) (i)	saltation	1
(ii)	finest/<0.02mm or <1/16mm/mud/clay/argillaceous	1
(iii)	(bed load) traction/rolling/sliding	1
(f) (i)	cross bedding on point bar at edge of channel/sand laid down on slope of edge of river OR ripple marks/cross lamination sand on sand bars or channel floor/asymmetrical formed by unidirectional current OR imbricate structure formed in high energy conditions with pebbles parallel to current/in gravels where pebbles line up parallel to current	1 1 OR 1 1 OR 1 1
(ii)	roots in anaerobic conditions so preserved/roots not weathered or eroded stem and leaves and other fossils decay aerobically/eaten/weathered or eroded as exposed few organisms live in the river compared to the sea/sediment too course/no rapid burial	any 2
		18

Total 18 marks

Question	Expected answers	Marks
5 (a)	mechanically formed those deposited by wind, sea, river, ice	1
	chemically formed precipitated from sea water	1
	biologically formed by organisms skeletons	1
	OR	
	clastic as formed from fragmental material	1
	non clastic formed from chemical or biological materials	1
	grain size used only for clastic sedimentary rocks	
	rudaceous/over >2mm/gravels and boulders - breccia or conglomerate	1
	arenaceous , 2 – 0.02mm/2 – 1/16mm sand size sediment - sandstones	1
	argillaceous/< 0.02mm//16mm – mudstone, clay or shale	1
	grain shape used only for clastic sedimentary rocks	1
	shape of fragments controlled by length of transport	1
	angular fragments = little transport/breccia	1
	rounded fragments = more transport/sandstone/conglomerate	1
	mineral composition	
	sandstones subdivided by composition into	
	quartzite/orthoquartzite/quartz arenite >90% quartz	1
	arkose > 25% (orthoclase) feldspar	1
	greywacke high proportion of rock fragments/>15% matrix	1
	micaceous sandstone contains mica	1
	desert sandstones pure quartz and iron staining	1
	evaporites of sequence of salts	1
	detail of halite, gypsum, anhydrite, calcite	1
	limestones made of calcium carbonate/calcite	1
	oolites and micrites formed by precipitation	1
	coals made of carbon	1
		max 5
	fossil content	
	coals made of plants	1
	lignite, bituminous and anthracite	1
	limestones subdivided by fossils into	
	bioclastic made of fossil fragments	1
	reef limestone rich in corals/crinoidal limestone rich in crinoids	1
	chalk made of coccoliths/calacareous ooze	1
	oolites few fossil fragments	1
	micrites rare fossils	1
		max 5
	Mark diagrams as text	12

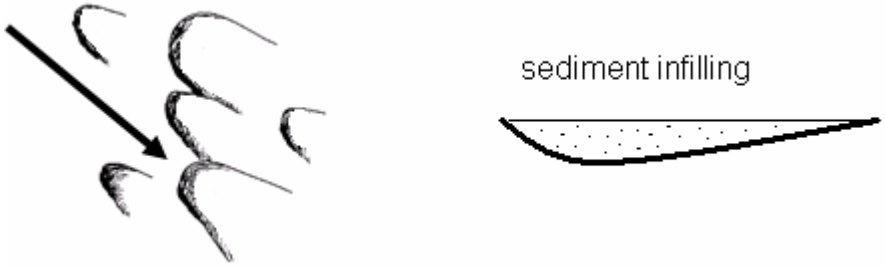
Question	Expected answers	Marks
5 (b)	shale as (parent rock) made of clay minerals	1
	regional metamorphism needs both temperature and pressure	1
	description of Barrovian zones/index minerals listed	1
	sequence of regional metamorphism - slate > phyllite >schist >gneiss	1
	low grade regional metamorphism – low temperatures and pressures	1
	slate is a fine grained rock	1
	index minerals chlorite and mica formed by recrystallisation	1
	formation of slaty cleavage	1
	minerals aligned at 90° to pressure	1
	relict features preserved	1
	phyllite is a fine/medium grained rock	1
	have higher T/P conditions	1
	more mica/less clay minerals/chlorite	1
	crenulation cleavage/phyllitic texture	1
	medium grade regional metamorphism – medium temperatures and pressures	1
	schist is a medium grained rock	1
	schistose texture, foliation	1
	index mineral biotite / garnet minerals grow	1
	(porphyroblasts of) garnet	1
	index mineral kyanite (as Al2 SiO5 polymorph)	
	high grade regional metamorphism –high temperatures and pressures	1
	gneiss is a medium / coarse grained rock	1
	rich in quartz, biotite and K feldspar	1
	gneissose banding (with light and dark bands)	1
	light bands felsic minerals, dark bands mafic minerals	1
	index mineral sillimanite (as Al_2SiO_5 polymorph)	1
	Diagrams to show textures as text	
		11

QWC

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

Total 25

Mark Scheme 2836
June 2007

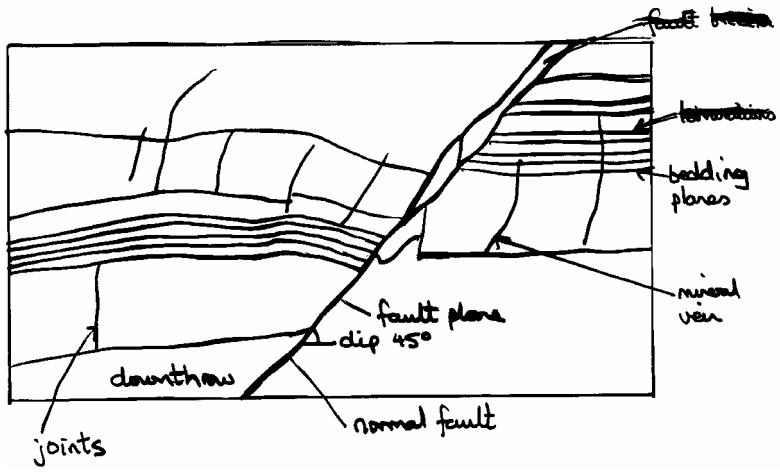
Question	Expected answers	Marks
1 (a) (i)	Grain size medium/arenaceous/sand sized/varied / graded coarse to fine/size within range 0.02 – 2mm	1
	Grain shape sub angular/angular	1
	Composition rock fragments, quartz, (sand grains), feldspar, clay (mud) (must have 2 min)	1
	Sorting poor/unsorted/description of grading and sorting	1
(ii)	Made of clay minerals/platey clay (Very) fine grained/argillaceous Black/dark colour Thinly bedded/laminated/fissile	Any 2
(iii)	Graptolite/monograptus type/single stipe type/specific named Silurian trilobite	1
(b) (i)	Load cast	1
(ii)	Denser/heavier sand/greywacke/light coloured layer pushing down lighter/lower density clay/into darker coloured/softer/shale layer/mud injected	1
	up as flame structure ecf	1
(iii)	Calcite will react with dilute HCl and quartz will not Calcite has hardness 3 so can be scratched by a copper coin while quartz is harder (7) scratches glass Calcite has cleavage/quartz has none Quartz has conchoidal fracture calcite does not Quartz has hexagonal crystals calcite has rhombs If 2 correct statements but no comparison = 1	Any 2
(c) (i)	Flute casts/sole structures	1
(ii)	Current scouring out hollows Sediment infilling the hollow Diagram/s showing deep to shallow hollow in direction of current or U shape narrower part of flute upcurrent	Any 2 1
	 direction drawn correctly Cannot get full marks without a diagram ecf	
(d)	Deep sea/abyssal plain/turbidity currents/foot of continental slope	1
		Total 17 marks

Question	Expected answers	Marks
2 (a)	Symmetrical syncline/synform	1
	Axis/axial plane trace trends SW to NE/limbs dipping SE and NW	1
(b)	Shale and sandstone beds laid down Beds folded Beds faulted by vertical faults allow normal or reverse Granite (batholith) intruded / causes thermal metamorphism Porphyry dykes along faults Erosion and limestone laid down unconformably Tilting 10˚ to NE Dolerite sill/concordant intrudes limestone (could be before tilting) Erosion and unconformity and grit laid down Grit horizontal If reverse order or list max 4	Any 8
	QWC	1
(c) (i)	Dolerite is basic/dark colour/equigranular/mafic minerals porphyry is acid/light colour/porphyritic/quartz	1
(ii)	Similarity is same composition/both acid/both felsic/mineral content same/both contain quartz/both light coloured/both leucratic	1
	Difference granite coarse (>5 mm) (plutonic) and porphyry medium (1 – 5mm) crystals (hypabyssal)	1
(iii)	Spotted rock/slate – fine grained, spots of iron or biotite Andalusite rock/slate - porphyroblasts of andalusite Hornfels - equigranular/granoblastic/medium/coarse crystals/hard crystalline max 1 for list of names	Any 2
		Total 16

QWC

1 mark	The candidate is able to communicate knowledge and ideas adequately, specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

Question	Expected answers		Marks
3	Normal fault		
	Fault breccia		
	Fault plane/upthrow/downthrow		
	Mineral veins/tension gashes		
	Laminations/thin bedding/bedding planes		
	joints		max 3
	Dip of fault at 45˚ (+/- 5)		
	throw measured at 30 cm (+/- 5)		
	measured bed thickness	max 2 for measurements	1



label lines must connect to feature Total 4

Question	Expected answers	Marks
4 (a) (i)	F is coral	1
(ii)	E/brachiopod	1
(iii)	D is involute	1
(b)	Marine environment as all fossils live in the sea Low energy as ammonites are delicate and these are whole coral / brachiopod sessile/live on sea floor ammonites die and sink to the sea floor ammonites are nektonic/swimming in the sea water depth likely to be continental shelf as brachiopods are fixed water depth likely to be continental shelf as corals prefer shallow water cannot be a life assemblage as they live in different environments is a death assemblage as fossils are brought together after death good preservation means low energy reasoned answer making case for derived fossil =1	Any 5
	QWC	1
		Total 9

QWC

1 mark The candidate is able to communicate knowledge and ideas adequately, specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.

0 marks There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

Question	Expected answers		Marks
5 (a)	Lithostratigraphic/lithological correlation		1
	The sequence/pattern of beds/rock types are matched up		1
(b) (i)	Leakage could occur along the fault line Movement could occur along the fault The fluvial sand and gravel or sandstone if uncemented would allow leakage Shale has a low compressive strength/weak foundations unconsolidated sand and gravel so weak foundation Landslides due to steep slope collapsing/due to inwards dip		Any 3
(ii)	Boreholes are metres apart may miss feature eg fault/geophysical survey gives continuous data better data coverage		1
(c)	G	basalt	1
	H	quartzite (meta or ortho)	1
	I	schist	1
(d) (i)	Imbricate structure/imbrication		1
(ii)	Pebbles are aligned by strong current/tops point downstream Long axes parallel to direction of current (possible arrow on diagram) Moved by traction/bed load for transportation		any 2
(e)	Crystalline limestone/granite/other igneous rock/well cemented grit/sandstone/quartzite		1
	High compressive stress so very strong/resistant to weathering so strong/massive so strong/impermeable so no leakage		1
			Total 14

Advanced GCE (Subject) (Aggregation Code(s))
January 2007 Assessment Series

Unit Threshold Marks

	Unit	Maximum Mark	a	b	c	d	e	u
2831	Raw	60	44	39	34	29	25	0
	UMS	90	72	63	54	45	36	0
2832	Raw	60	47	42	37	32	28	0
	UMS	90	72	63	54	45	36	0
2833	Raw	120	92	81	70	59	49	0
	UMS	120	96	84	72	60	48	0
2834	Raw	90	66	58	50	43	36	0
	UMS	90	72	63	54	45	36	0
2835	Raw	90	55	48	41	34	27	0
	UMS	90	72	63	54	45	36	0
2836	Raw	120	89	79	69	59	50	0
	UMS	120	96	84	72	60	48	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3884	300	240	210	180	150	120	0
7884	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3884	17.9	37.9	59.1	77.8	90.3	100.0	1247
7884	24.6	50.0	70.0	89.2	97.2	100.0	856

2103 candidates aggregated this series

For a description of how UMS marks are calculated see;
http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication

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