

**GCE**

**Geology**

Unit **F791**: Global Tectonics

Advanced Subsidiary GCE

**Mark Scheme for June 2018**

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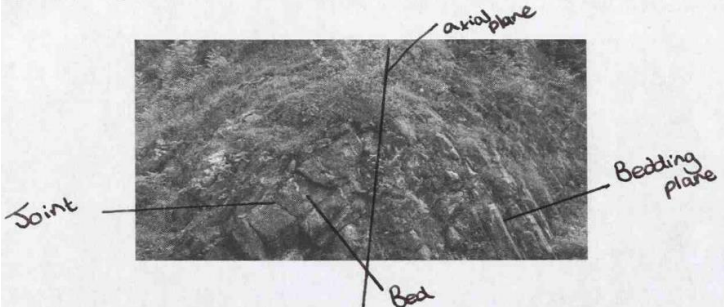
All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

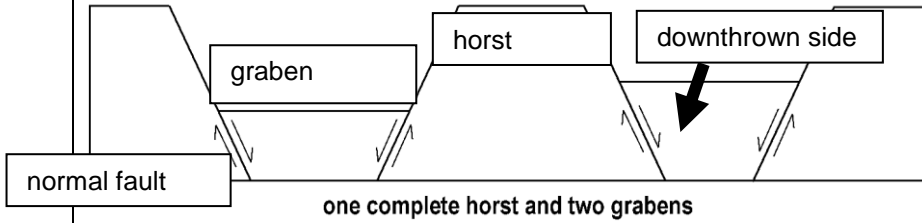
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

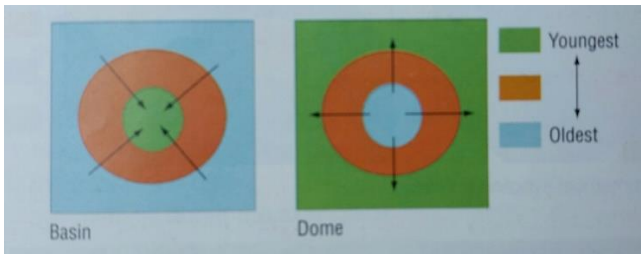
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## Annotations

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

Question			Answer	Mark	Guidance
1	(a)	(i)	Bedding plane, joint and bed correctly labelled 	3	Joint label must end on a fracture at 90° to bedding  Bed needs to be bracketed or have a clear label to the middle of a bed.  Bedding plane must clearly divide separate beds
		(ii)	axial plane labelled	1	Axial plane should dip steeply to left <b>ALLOW</b> vertical axial plane <b>DO NOT ALLOW</b> axial plane dipping to right
			name: anticline	1	<b>ALLOW</b> antiform (spelled correctly)
		(iii)	description: <ul style="list-style-type: none"> <li>• asymmetrical</li> <li>• axial plane dipping (steeply) to left / near vertical</li> <li>• interlimb angle dipping at 70-95° degrees / open / closed</li> <li>• left limb dipping at 30-45° / right limb dipping at 55-65°</li> <li>• beds similar thickness</li> </ul>	any 1	<b>DO NOT ALLOW</b> vertical axial plane  <b>ALLOW:</b> open or closed antiform
		(iv)	compression / compressional / compressive	1	

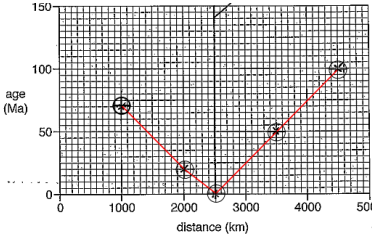
Question	Answer	Mark	Guidance
(b)	<p>Ooliths were originally spherical / circular in shape <b>AND</b> after deformation they become ellipsoid / elongated / oval;</p> <p>Undeformed fossils / ooliths are used to establish original shape and then the amount of and direction of deformation can be analysed;</p>	1 1	<p><b>Max 1</b> if only ooliths or fossils discussed  <b>ALLOW</b> diagrams marked as text  <b>ALLOW</b> Fossils / ooliths elongated perpendicular to maximum compression                      Accepted fossil references include trilobites, belemnites, 'Delabole butterfly' (<i>Cyrtospirifer verneuili</i>) etc.</p>
(c)	 <p style="text-align: center;">one complete horst and two grabens</p>	2	<p>Diagram must be labelled</p> <p>All 4 correct labels = 2                      1-3 correct labels = 1</p> <p>Downthrow must be labelled on correct side of fault plane</p> <p>Normal fault must have marker bed or two relative movement arrows (on fault plane or on blocks)</p>

Question	(d)	Answer	Mark	Guidance
		 <ul style="list-style-type: none"> <li>• Domes have beds that dip outwards in all directions;</li> <li>• If the top of the dome is eroded away the result will be a series of concentric strata with the oldest rocks in the middle;</li> <li>• Dome is an anticline;</li>   <li>• Basin has beds which dip inwards in all directions;</li> <li>• In a basin the youngest rocks are in the centre;</li> <li>• basin is a syncline;</li> </ul> <p><b>explanation:</b> compressional forces (are acting inwards towards the core from all sides)</p>	<p>Any 1</p> <p>Any 1</p> <p>1</p>	<p><b>Maximum 1</b> if diagrams only</p> <p>Minimum of 3 dip arrows needed</p> <p><b>Max 1</b> for dip arrows correct on dome <b>AND</b> basin</p> <p><b>Max 1</b> for dip ages correct on dome <b>AND</b> basin</p> <p><b>ALLOW</b> labelled compressional arrows drawn on both diagrams (minimum 3).</p>
		<b>TOTAL</b>	<b>14</b>	

Question			Answer	Mark	Guidance
2	(a)	(i)	Spacecraft / satellite / probes / fly-by missions have discovered / observed / measured / photographed / thermally imaged volcanic activity on Io;	1	<b>ALLOW</b> Reference to lava flows / pyroclastic deposits / eruption columns / detection of <u>high</u> heat flow
	(b)	(i)	radiometric dating;	1	<b>DO NOT ALLOW</b> reference to metamorphism <b>DO NOT ALLOW</b> crust is renewed / replaced as alternative to re-cycled <b>ALLOW</b> crust being destroyed <b>AND</b> created / produced as alternative to re-cycled
		(ii)	Earth surface was initially molten; original surface / original crust / original rocks destroyed by crustal processes of erosion / re-cycling;	2	
	(c)		Mercury Mars Saturn Venus Uranus	2	4-5 correct = 2 marks 1-3 correct = 1 mark
(d)	(i)		2	Must have all three correct for 2 marks  1-2 correct = 1 mark  <b>ACCEPT</b> Gutenberg discontinuity drawn at 2900km	
	(ii)	It is a phase boundary between materials of the same composition but in different states; It is a zone of about 100km where the material changes from all liquid (in the outer core) through a liquid-solid mix to all solid (in the inner core);	max 1		

Question		Answer	Mark	Guidance
	(e)	1-5% of rock is melted; incomplete melting of rock (in crust / upper mantle); some of the minerals melt to form magma; where a proportion of the minerals (will have a lower melting point, allowing them to) melt while the rest remain solid;	1	<b>ALLOW</b> up to 10% melted
	(f)	(i) lithosphere	1	<b>DO NOT ALLOW</b> semi-molten
		(ii) solid / rigid / brittle	1	
		(iii) (1-10%) partially molten / rheid / plastic / solid that flows / ductile	1	
	(g)	(i) 7.5°C/km	1	$\frac{750}{100} = 7.5$
		(ii) 2.2°C/km	1	$\frac{1400 - 750}{400 - 100} = \frac{650}{300} = 2.166666$
		(iii) The mantle is heated by radioactive decay in the core; The heated mantle rock moves up towards the crust away from the core (as it is less dense); The cooler mantle rock near the crust sinks towards the core (as it is more dense); convection currents / convection cells cause the movement of (mantle) material, to transfer heat;	max 2	<b>ACCEPT</b> 2.17 / 2.167 °C/km <b>DO NOT ACCEPT</b> 2.1 °C/km <b>DO NOT ACCEPT</b> 2.16 °C/km without recurring symbol! <b>ALLOW</b> reference to mantle plumes <b>ALLOW</b> slab-pull v ridge push (max 1) <b>DO NOT ALLOW</b> magma instead of mantle (material)
<b>TOTAL</b>			<b>17</b>	



Question			Answer	Mark	Guidance
3	(a)	(i)	5 points plotted correctly; 	2	<b>IGNORE</b> best fit line, if drawn  5 points plotted correctly = 2 marks 3 – 4 points plotted correctly = 1 mark
		(ii)	Mid Ocean Ridge marked on graph	1	Point / line indicated on the graph
		(iii)	50Ma	1	70Ma – 20Ma = 50Ma
	(b)		2cm/yr	1	$3,800,000,000\text{mm}/190,000,000\text{yr} = 20\text{mm/yr}$ $3800\text{km}/190\text{Ma} = 3800\text{mm}/190\text{yr} = 20\text{mm/yr} = 2\text{cm/yr}$
	(c)		labels to include: continental crust <b>OR</b> plate <b>OR</b> lithosphere; oceanic crust <b>OR</b> plate <b>OR</b> lithosphere; asthenosphere; (deep ocean / deep sea) trench subduction zone / Benioff zone rising magma volcanoes partial melting batholith fold mountains ophiolites / accretionary prism / accretionary wedge direction of plate movement	max 3	6 correct labels = 3 marks 4-5 correct labels = 2 marks 2-3 correct labels = 1 mark  At least half of earthquake foci must be on top edge of subducting plate  Two arrows needed

Question		Answer	Mark	Guidance
	(d)	hot springs / hydrothermal vents / high speed jets of very hot solutions; can reach 350°C; rich in sulphur / copper / iron / zinc / gold; bacteria can aid formation of ore minerals; metals / metal sulphides / ore minerals can precipitate; resultant structure is called a chimney; situated along MORs / hotspots;	max 1	any 2 for 1 mark  <b>ACCEPT</b> any correct named ore mineral (e.g. Chalcopyrite)
	(e)	oceanic crust is destroyed / subducted; subduction along the Pacific rim / subduction at deep ocean trenches; ocean crust / lithosphere / plate is more dense than continental crust lithosphere / plate and so it subducts; complete cycle is called a "Wilson Cycle"	max 2	<b>ALLOW</b> convergent plate margin as AW for Pacific Rim  <b>ALLOW</b> ridge push <b>OR</b> slab pull as AW <b>ALLOW</b> continental crust is less dense and so does not subduct
	(f)	no <b>subduction OR</b> plate(s) not <b>subducting OR</b> plate(s) not <b>subducted</b> ;  continental plates are of similar density continental crust increases in thickness (>35km); viscous / silicic magma generated; granite batholiths formed;	1  Any 1	Must be spelled correctly  <b>ALLOW</b> the base of the crust does melt but the main obstacles are the great depth and high viscosity of that silicic magma
<b>TOTAL</b>			<b>13</b>	

Question		Answer	Mark	Guidance
4	(a)	continental shelf major rift valley (and rift system) deep sea trench seamount	3	all 4 correct = 3 marks 2-3 correct = 2 marks 1 correct = 1 mark
	(b)	Continental shelf exposed when sea levels fall <b>ORA</b>  sea level change due to isostatic re-adjustment <b>OR</b> climate change  sea level rise due to melting ice / glaciers <b>OR</b> increased MOR activity <b>OR</b> increased sediment input  sea level fall due to formation of glaciers / ice sheets <b>OR</b> decreased MOR activity	2	<b>Max 1</b> for discussion of sea level rise and sea level fall  <b>Max 1</b> for general comment about deposition increasing the amount of dry land exposed on the continental shelf <b>OR</b> erosion decreasing the amount of dry land exposed on the continental shelf  <b>ALLOW</b> reference to continental break up as alternative to increased MOR activity.
	(c)	heat flow anomalies; <u>chains</u> of volcanoes / island arcs; (deep ocean) trenches; rift valleys; gravity anomalies; fold mountains / fold mountain belts / fold mountain chains;	max 3	
<b>TOTAL</b>			<b>8</b>	

Question		Answer	Mark	Guidance
5	(a)	<p>none of the techniques are reliable / accurate <b>OR</b>                      a combination of techniques needed <b>OR</b> very little prior warning possible</p> <p><b>seismic gap theory</b>  <b>description:</b></p> <ul style="list-style-type: none"> <li>• map earthquakes along a fault / measure timing of historical earthquakes</li> <li>• a gap between active areas along a fault line</li> </ul> <p><b>explanation:</b></p> <ul style="list-style-type: none"> <li>• fault is locked and stress increases <b>ORA</b></li> <li>• areas with no earthquakes will have stored stress</li> <li>• earthquake is more likely in a locked zone</li> </ul> <p><b>changes in ground levels</b>  <b>description:</b></p> <ul style="list-style-type: none"> <li>• the area around the earthquake focus may tilt / distances between two points may change</li> <li>• deformation / strain recorded by tilt meters / lasers / stress meters / strain gauges</li> </ul> <p><b>explanation:</b></p> <ul style="list-style-type: none"> <li>• due to stress in the ground / strain in rocks / deformation</li> <li>• ground swelling due to microcracks</li> </ul> <p><b>measuring radon gas emissions</b>  <b>description:</b></p> <ul style="list-style-type: none"> <li>• radon levels increase (prior to earthquake)</li> </ul> <p><b>explanation:</b></p> <ul style="list-style-type: none"> <li>• radon percolates up through microcracks</li> <li>• as a heavy gas radon accumulates in water wells</li> <li>• new pathways are opening up for the gas</li> </ul>	<p>1</p> <p>Max 3</p> <p>Max 3</p> <p>Max 3</p>	<p>Max 1</p> <p>Any correctly named method = 1 mark</p> <p>At least three methods to be discussed</p> <p>Answers must include description <b>and</b> explanation to achieve 3 marks</p> <p><b>ALLOW</b> energy / stress is transferred along fault line (e.g. North Anatolian Fault)</p> <p>maximum 3 marks if only one method discussed</p> <p>maximum 6 marks if only two methods discussed</p>





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