OCR
Oxford Cambridge and RSA

# GCE

# Geology

Unit **F791:** Global Tectonics

Advanced Subsidiary GCE

# Mark Scheme for June 2016

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

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

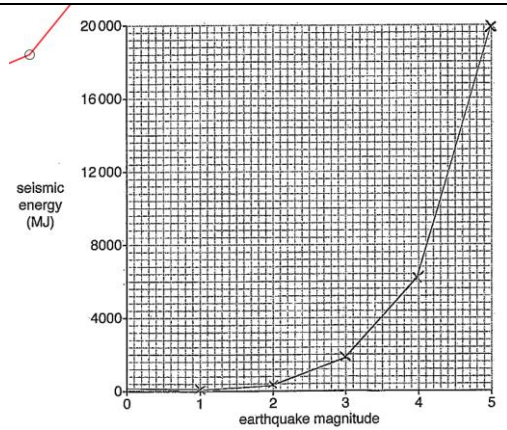
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

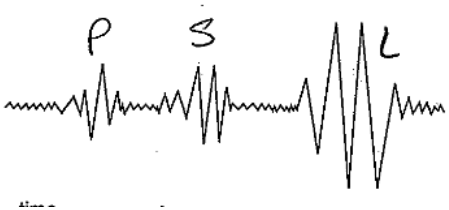
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

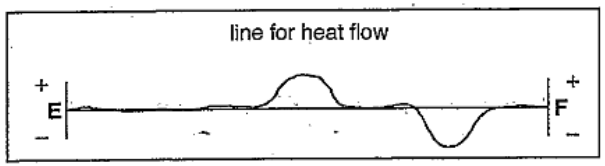
| Annotation | Meaning |
|---|---|
|  | Unclear |
| BOD | Benefit of doubt |
| CON | Contradiction |
|  | Cross |
| ECF | Error carried forward |
| I | Ignore |
| NBOD | Benefit of doubt not given |
| PD | Poor diagram |
| R | Reject |
| SEEN | Noted but no credit given |
|  | Tick |
| ^ | Omission mark |
| MR | Maximum response |

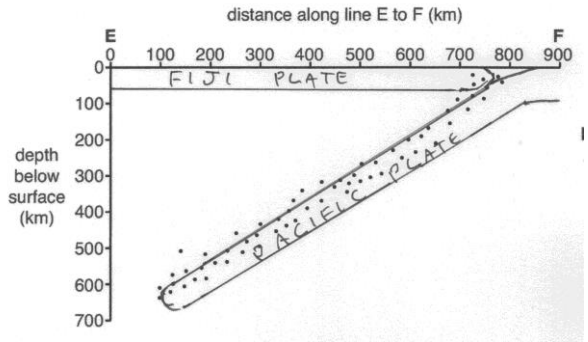
| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 1 | a | i | a rock from space that has landed on / impacted / reached Earth; | 1 | **DO NOT ALLOW** entered Earth's atmosphere without reaching surface<br>**ALLOW** asteroid / debris / stony / metallic mass as alternative to rock |
| | | ii | the asteroid belt **OR** between Jupiter and Mars **OR** area between gas giants and terrestrial planets; | 1 | |
| | b | i | nickel; | 1 | **ACCEPT** Ni |
| | | ii | peridotite **OR** ultramafic **OR** silicate minerals **OR** silicates **OR** any **two** correct named minerals from (augite / pyroxene, plagioclase feldspar, olivine, spinel, garnet, perovskite); | 1 | **ACCEPT** any correct named mineral<br>**ACCEPT** any value 25 – 45% silica<br>**DO NOT ALLOW** silicic |
| | | iii | core;<br>mantle; | 1<br>1 | **ALLOW** either inner core **OR** outer core<br>**ALLOW** asthenosphere as alternative to mantle |
| | c | | any 2 points<br>• circular depression with a raised rim;<br>• inverted layering **OR** inverted strata **OR** overturned strata **OR** tilted strata **OR** reversed layering (around the rim) **OR** ejected material;<br>• shocked quartz in crater **OR** shocked quartz around crater;<br>• tektites **/** spherules **/** brecciated rocks **/** melted quartz in the crater **OR** tektites **/** spherules **/** brecciated rocks **/** melted quartz around crater;<br>• meteorite fragments in the crater **OR** meteorite fragments surrounding the crater;<br>• evidence from tsunami deposits close to crater;<br>• iridium layer surrounding the crater; | 2 | **ALLOW**<br><br>**ACCEPT** impact site **OR** where the meteorite hits as alternative to impact crater<br><br>if a list then 1 mark for 2 or more correct points |
| | d | | abyssal plain;<br>mid-ocean ridge;<br>fold mountains;<br>continental shield; | 3 | 1 or 2 correct = 1<br>3 correct = 2<br>4 correct = 3 |
| | | | **Total** | **11** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 2 | a | i |  <br>points plotted correctly as shown on the graph;<br><br>curve connecting points as shown on the graph; | 3 | point should be accurate to within 1 small square<br><br>**DO NOT ALLOW** as a single straight line<br><br>2/3 correct points = 1<br>4/5 correct points = 2<br>correct line drawn = 1 ecf |
| | | ii | any 1 point<br>• as magnitude increases the seismic energy increases **ORA**;<br>• positive correlation (between (earthquake) magnitude and (seismic) energy);<br>• an exponential curve (between (earthquake) magnitude and (seismic) energy); | 1 | **ACCEPT** specific correct numeric values for the increase in seismic energy<br><br>**ACCEPT** shows a logarithmic relationship ecf |
| | | iii | not enough (strain) energy will build up in the rock **OR** not enough (strain) energy can be released from the rock **OR** no rocks strong enough to store enough (strain) energy; | 1 | **AW**<br>**ACCEPT** stress as alternative to energy |
| | | iv | Richter; | 1 | Richter must be spelled correctly<br>**ACCEPT** moment magnitude **OR** local magnitude **OR** seismic moment |

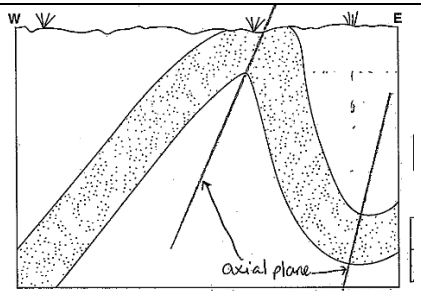
<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><th>location (epicentral angle)</th><th>statement A, B, C or D</th></tr>
<tr><td>at the epicentre (0°)</td><td>B</td></tr>
<tr><td>between 103° and 142°</td><td>C</td></tr>
<tr><td>between 103° and 103°</td><td>D</td></tr>
<tr><td>between 0° and 103°</td><td>A</td></tr>
</table>
</td><td>3</td><td>1 or 2 correct = 1<br>3 correct = 2<br>4 correct = 3</td></tr>
<tr><td></td><td>c</td><td>i</td><td> 

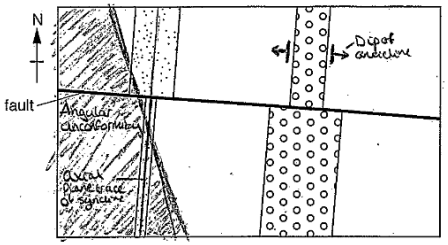
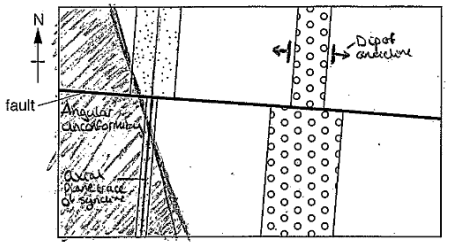
all 3 labelled correctly as on the graph;</td><td>1</td><td>all must be correct for 1 mark</td></tr>
<tr><td></td><td></td><td>ii</td><td>P and S waves can travel through the Earth OR P and S waves can travel through the core / mantle OR P and S waves are not restricted to the surface;</td><td>1</td><td>DO NOT ACCEPT goes through the crust</td></tr>
<tr><td></td><td></td><td>iii</td><td><u>size of the outer core</u><br>any 1 point<br>• size / position of the P wave shadow zone OR size / position of the S wave shadow zone;<br>• P wave shadow zone between 103° - 142°;<br>• S wave shadow zone between 103° - 103°;<br>• the time it takes for P-waves to pass through the core;<br><br><u>state of the outer core</u><br>any 1 point<br>• <u>liquid</u> as S waves stop at the outer core;<br>• <u>liquid</u> as P waves refracted at the outer core;<br>• <u>liquid</u> as P waves slow down at the outer core;</td><td>1<br><br>1</td><td>AW shadow zone away from the epicentre<br><br>ACCEPT Gutenberg discontinuity OR core - mantle boundary instead of outer core</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>13</td><td></td></tr>
</table>

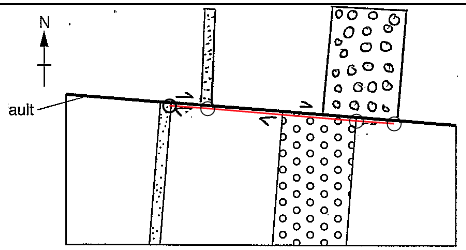
| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 3 | a | i | deep ocean trench: arrow anywhere within the “below 6000 m” area;<br><br>island arc: arrow anywhere within the “0 - 1000m” area; | 1<br><br>1 | |
| | | ii | arrow pointing west on the Pacific plate to the right of the middle of the “below 6000 m” area **AND** east on the Fiji plate to the left of the middle of the “below 6000 m” area**;** | 1 | |
| | | iii | convergent **OR** oceanic - oceanic; | 1 | **DO NOT ACCEPT** subduction zone<br>**ALLOW** destructive |
| | b | i |  <br>high heat flow above the island **AND** low heat flow above the trench; | 1 | both the high heat flow and low heat flow need to be correct for 1 mark |
| | | ii | high heat flow due to rising magma **OR** high heat flow due to volcanic activity **OR** high heat flow due to hot rising convection currents;<br><br>low heat flow due to cold sinking convection currents **OR** low heat flow due to the cold sinking slab of oceanic crust; | 1<br><br>1 | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | c | i |  <br>Fiji plate at the surface **AND** Pacific plate parallel to the Benioff zone but with top surface running through **OR** to include the foci **OR** just below the foci; | 1 | see diagram<br><br>need both plates drawn correctly for 1 mark<br><br>Pacific plate can include all the earthquakes<br><br>Fiji plate at the surface and no deeper than 100 km **AND** the Pacific plate no thicker than 200 km |
| | | ii | <u>describe</u> any 1 point<br>• the foci become deeper away from the trench;<br>• the foci become deeper towards the west;<br>• the foci become deeper towards letter **E**;<br>• this is the Benioff zone;<br><br><u>explain</u> any 1 point<br>• due to the subduction **AND** friction**;**<br>• subduction of the Pacific plate beneath the Fiji plate;<br>• that plates are in contact and pressure / stress is exerted; | 1<br><br>1 | **ACCEPT** reverse argument<br><br>**ALLOW** any other correct explanation |
| | | iii | any 1 point<br>• the plate is (partially) molten / ductile / plastic / rheid / not brittle so will not fracture / fault / rupture;<br>• the plate is (partially) molten / ductile / plastic / rheid / not brittle so stress / strain energy will not build up;<br>• the plate is (partially) molten / ductile / plastic / rheid / not brittle so there will be no sudden release of energy; | 1 | **ALLOW** rock / lithosphere / crust **AW** for plate<br><br>**ACCEPT** shear / compression / tension as an alternative to stress |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | d | i | any 2 points<br>• the asthenosphere is carried by the convection currents (in the upper mantle) **OR** the asthenosphere is in contact with the convection currents;<br>• the lithosphere is dragged / carried / moved by the asthenosphere;<br>• convection currents can form in the asthenosphere;<br>• the asthenosphere is partially melted / rheid **AND** so flows / moves / convects; | 2 | **ACCEPT** plate as alternative to lithosphere<br><br>**DO NOT ACCEPT** crust as alternative to lithosphere |
| | | ii | any 2 points<br>• MOR with a high heat flow **OR** rising magma at the MOR **OR** volcanoes / eruption of lava at MOR;<br>• new crust is created at MOR **AND** older crust is further away;<br>• magnetic stripes are symmetrical about the MOR;<br>• subduction zone with a low heat flow **OR** subduction zone with evidence for compression **OR** subduction zone with trench;<br>• ridge push at MOR **OR** slab pull at subduction zone;<br>• volcanic island chains with different ages at hot spots; | 2 | **ACCEPT** divergent / constructive plate boundary as alternative to MOR<br>**ACCEPT** convergent / destructive plate boundary as alternative to trench / subduction<br><br>max 1 for general statement referring to MOR **AND** subduction zone |
| | | | **Total** | **15** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 4 | a | i | the words occur in this order:<br>reverse;<br>south;<br>north;<br>compressive; | 3 | 1 or 2 correct = 1<br>3 correct = 2<br>4 correct = 3 |
| | | ii | 3.2 metres +/- 0.1 metres; | 1 | |
| | b | i |  <br>both axial planes need to be drawn correctly; | 1 | the synform axial plane as drawn or up to vertical<br>the antiform axial plane as drawn or within 10° either way<br>the axial plane must go through the sandstone and extend into the shale |
| | | ii | <u>name of fold</u><br>antiform **OR** anticline;<br><br><u>description</u> any 2<br>asymmetric;<br>steeper eastern limb **OR** steeper dip to the East **ORA;**<br>closed **OR** interlimb angle of 60° +/- 10°;<br>rounded hinge;<br>west limb = 50° +/- 10°;<br>east limb = 70° +/- 10°; | 1<br><br>1 | the term must be spelled correctly<br><br>take name of fold or description marks from any part of the answer |
| | | iii | from the west **OR** from west to east **OR** westerly **OR** towards the east **OR** from the left **OR** to the right**;** | 1 | AW<br>**DO NOT ALLOW** just “west” |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | c | i |  <br>centre of syncline in middle of sandstone bed on both sides of the fault - as shown on diagram above; | 1 | axial plane trace shown as a line in centre of syncline – label not needed<br><br>no mark if line drawn in both folds and not labelled |
| | | ii | two arrows diverging either side of the conglomerate to show the anticline; | 1 | see diagram for guidance |
| | | iii |  <br>a line cutting across any part of the western part of the map with a different orientation to the older beds and across the fault and part of the sandstone; | 1 | |
| | | iv | any 1 point<br>• the bed / outcrop width is narrower on the downthrown / north side of the anticline **OR** the conglomerate is narrower on the downthrown / north side;<br><br>• the bed / outcrop width is wider on the downthrown / north side of the syncline **OR** the sandstone width is wider on the downthrown / north side; | 1 | **ORA** |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | d | |  <br>both beds drawn as shown on the diagram with all the beds offset 1 metre (+/- 10cm) to the right **AND** maintains the same width of beds | 1 | sandstone and conglomerate both need to be correct |
| | | | **Total** | **13** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 5 | | | general point<br>Joint is a fracture with no observable displacement / movement | 1 | max 1 for good description but incorrectly named joint |
| | | | tectonic joints any 3 points<br>• diagram showing the joints around a hinge and the stress arrows to show compression at sides **OR** diagram showing the joints around a hinge and the stress arrows to showing tension at hinge **AND** one correct label;<br>• form during folding under compressive forces;<br>• tension / stretching around the hinge of a fold causes fractures **OR** tension / stretching around the hinge of a fold causes tension joints;<br>• occur in competent **OR** brittle rocks **OR** limestone **OR** sandstone;<br>• joints form on the fold limbs as cross joints / oblique joints / longitudinal joints;<br>• joints on the limbs often form two sets at 90° to each other; | 3 | **i**n order to get the 3 marks there must be a diagram attempted otherwise max 2<br>labels could include hinge / trough / crest / limb / tension / competent rock / joints / compression<br>labels can only be credited once on the diagram or as text<br>**ACCEPT** crest or trough instead of hinge |
| | | | cooling joints any 3 points<br>• diagram showing arrows contracting inwards **AND** hexagonal / polygonal joints **AND** one correct label;<br>**OR**<br>• diagram showing joints in an appropriate part of a sill / lava flow / dyke **AND** one correct label;<br>• form during cooling of magma **OR** cooling of lava **OR** cooling of igneous rock **OR** cooling of molten rock;<br>• cooling centres form;<br>• rock contracts (towards the cooling centres);<br>• tensional stress causes fractures / joints;<br>• forms hexagonal / polygonal shapes **OR** forms columns;<br>• fractures at 90° to the cooling surface;<br>• form in basalt / dolerite **OR** lava flows / sills / dykes / batholiths | 3 | 1 mark max for diagrams<br>in order to get the 3 marks there must be a diagram attempted otherwise max 2<br>labels could include joint / cooling centre / cooling surface / contracting / hexagonal / polygonal / tension / country rock<br>**ALLOW** any correct igneous rock |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | | unloading joints any 3 points<br><br>• diagram showing joints parallel to the surface with arrows showing expansion **AND** one correct label;<br>**OR**<br>• Two diagrams (one showing batholith buried under rocks and another showing batholith exposed with joints parallel to the surface);<br><br>• rocks initially deeply buried **AND** under high pressure **OR** under high confining pressure / load pressure **OR** under high pressure from overlying rocks;<br>• rocks above are eroded;<br>• (confining) pressure is released / reduced;<br>• the rocks expand;<br>• rocks fracture **OR** fractures are parallel to the (erosion) surface;<br>• forms in granite **OR** forms in a batholith; | 3 | **i**n order to get the 3 marks there must be a diagram attempted otherwise max 2<br><br>labels could include batholith / granite / overlying beds / erosion / joints / expansion / uplift |
| | | | **Total** | **8** | |

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