OCR
Oxford Cambridge and RSA

# GCE

# Geology

Unit **F791:** Global Tectonics

Advanced Subsidiary GCE

# Mark Scheme for June 2015

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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.

| Annotation | Meaning |
|---|---|
| BP | Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response |
|  | Unclear |
| BOD | Benefit of the doubt |
|  | Contradiction |
|  | Incorrect response |
| ECF | Error carried forward |
| I | Ignore |
| R | Reject |
| NBOD | Benefit of the doubt **not** given |
| ^ | Information omitted |
|  | Correct response |
|  | Point has been noted, but not credit has been given |
|  | Poor diagram |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| 1 | (a) | | **ANY 2 points from:**<br>cloud of gas / dust spinning in space **OR** cloud of gas / dust hit by a shockwave**;**<br>planets coalesced from dust cloud **OR** accretion from dust cloud **OR** cloud of dust collapsed **OR** formation of protoplanetary disc**;**<br>gravitational force forms the planets **OR** dust particles drawn together by gravity **OR** electrostatic attraction pulls dust particles together**;**<br>planetary material separated into layers **OR** planetary material separated into terrestrial planets and gas giants**;**<br>asteroid belt may be material that failed to make a planet **OR** asteroid belt is debris from an exploded planet**;** | 2 | **ALLOW** 1 mark for a general comment using parts of 2 marking points<br>**ALLOW** microplanets / planetesimals<br>**ALLOW** correct alternative terms for dust eg. material / matter / rocks<br>**DO NOT ALLOW** gas without any mention of solid matter<br>**ALLOW** mantle and core<br>**ALLOW** AW for all mark points |
| | (b) | (i) | Earth **AND** Mars **AND** Mercury **AND** Venus **;** | 1 | All four correct planets need to be ticked for 1 mark<br>**DO NOT ALLOW** if more than four ticks shown |
| | | (ii) | terrestrial planets = 5.03 **OR** 5.0<br>**AND**<br>gas giants = 1.24 **OR** 1.2; | 1 | Both correct for 1 mark<br>**ALLOW** ECF from **(b)(i)**<br>**ALLOW** correct answers to more than 2 dp or whole number for terrestrial planets |
| | (c) | | surface rocks / crust density is between 2.7 and 3.0 g/cm$^3$ **OR** crust density is less than whole earth density**;**<br>mantle and core must be greater than 5.5 g/cm$^3$ / earth average **OR** core must be greater than 5.5 g/cm$^3$ / earth average **;** | 1<br>1 | **ALLOW** max 1 for general statements with no numeric data quoted |
| | (d) | (i) | **ANY 1 point from:**<br>samples / specimens / physical materials collected from Moon (but not Mars) **;**<br>description from human astronaut on Moon (but not Mars) **;** | 1 | |

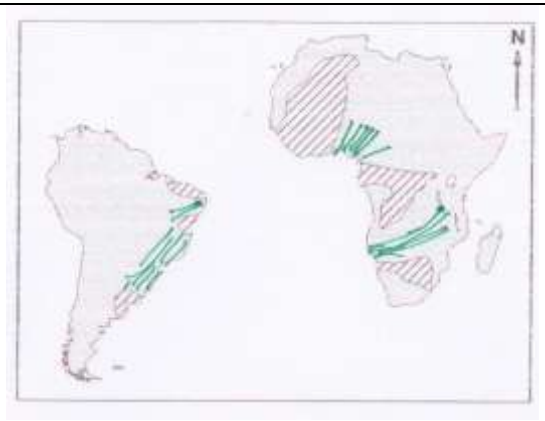
| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | | | | |
| | | (ii) | Scale<br>volcanoes are large scale **OR** Olympus Mons is a huge volcano **OR** approximately 27km high with a diameter of approximately 600km **OR** Mars volcanoes larger than any on Earth<br>**AND**<br>Type<br>shield volcanoes **OR** Hawaiian type **OR** fissure type **OR** basaltic / mafic **OR** effusive **OR** non-viscous**;** | 1 | Must refer to both scale and type in the answer<br><br>**ALLOW** basic<br>**ALLOW** not erupting at present / extinct / dormant |
| | | | **Total** | **8** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| **2** | **(a)** | **(i)** | **ANY 2 points for 1 mark from:**<br>intensity levels are observed **OR** residents enter effects they felt on USGS website **OR** people complete questionnaires ;<br><br>intensity values are plotted (on a map) ;<br><br>points of equal intensity are joined up **OR** separate areas of different intensity **;** | 1 | |
| | | **(ii)** | **ANY 1 point from:**<br>depends on the underlying geology which may vary **OR** rocks may be different **OR** rock density may be different<br>unconsolidated areas will have a higher than expected intensity **ORA ;**<br>liquefaction will increase the intensity **;** | 1 | **ALLOW** low quality of building construction will cause greater damage **ORA** |
| | **(b)** | **(i)** | **R** anywhere within the VII intensity zone **;** | 1 | Letter R anywhere between the VII and VIII lines |
| | | **(ii)** | suitable isoseismal line drawn between V and VII<br>**AND**<br>moderate damage to buildings | 1 | Must have both line drawn and correct description for 1 mark |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | (c) | | focus **;**<br>epicentre **;**<br>0 (km) / 70 (km) **;**<br>70 (km) / 0 (km) **;**<br>surface **;**<br>amplitude **;** | 5 | 1 or 2 correct = 1 mark<br>3 correct = 2 marks<br>4 correct = 3 marks<br>5 correct = 4 marks<br>6 correct = 5 marks |
| | (d) | | **ANY 1 point from:**<br>as the ground moves a heavy weight /mass dampens movement of pen **AND** plots / records the movement ;<br>part of the seismometer will move (with the Earth) while the other part will not move **AND** plots / records the movement ;<br>measures vibrations / movement in the ground **AND** plots / records the movement ; | 1 | **ALLOW** a diagram with two correct annotations<br>**ALLOW** AW |
| | (e) | (i) | Type of plate margin<br>conservative **;**<br>Description **ANY 1 point from:**<br>shear movement ;<br>plates move horizontally past each other ;<br>plates neither created or destroyed ;<br>horizontal movement along the San Andreas Fault ;<br>plates move past each other in same direction at different speeds**;**<br>movement along a transform fault **OR** strike slip **OR** tear fault (on land) ; | 1<br>1 | conservative must be spelled correctly for mark<br>**ALLOW** lateral movement as alternative to horizontal |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | (ii) | **ANY 1 point from:**<br>the plates are not subducting **OR** there is no Benioff Zone**;**<br>movement is along shallow faults **OR** movement is along transform / tear / strike-slip faults**;**<br>movement only in crustal rocks **;**<br>lithosphere <70 km thick ; | 1 | |
| | | | **Total** | **13** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| **3** | **(a)** | **(i)** | the outcrops of the continental shields matches up between both the continents **OR** the rock types in both continents are the same / match up **;**<br>the shield areas are the same age in both continents **OR** the shield areas are both Precambrian / older than 700 Ma**;** | 1<br>1 | **ALLOW** both marks if marking points have been put into one answer<br>**ALLOW** max 1 for general statement of both outcrop and age **OR** rock type and age are the same without reference to continents<br>**ALLOW** specific igneous or metamorphic rock<br>**DO NOT ALLOW** just “they match up”. It needs an explanation. |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | (ii) |  | | Fold mountains need to be correctly matched on both continents<br><br>**DO NOT ALLOW** any part of fold mountains drawn in shield areas |
| | | | one correct fold mountain chain drawn on map matching on <u>both</u> continents **;** | 1 | |
| | | | linear shape going across both continents **OR** structures such as folds / faults follow the same trend **OR** continuous belt across both continents**;** | 1 | **ALLOW** AW |
| | **(b)** | | **ANY 2 points from:**<br>overlap due to deposition at coasts **OR** overlap due to delta formation **;**<br>gaps due to the erosion of coasts **;**<br>the coastline is not the edge of the continental plate **OR** edge of the plate is at base of the continental slope **OR** edge of the plate is at the edge of the continental shelf **OR** edge of the plate is 1000m **OR** 500m below sea level ;<br>sea level is constantly changing ; | 2 | **ALLOW** max 1 for ideas of erosion and deposition without the link to gaps and overlap |

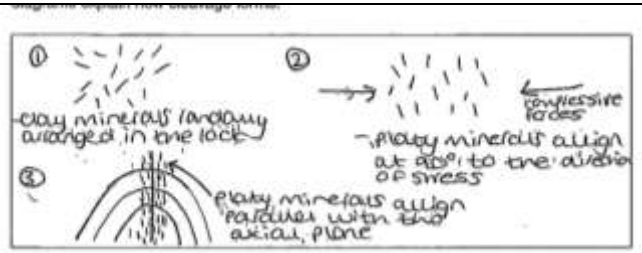
| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | (c) | | Named example<br>*Cynognathus* **OR** *Glossopteris* **OR** *Mesosaurus* **;**<br><br>**ANY 1 point from:**<br>Explanation<br>the same fossils match up across the join of the continents ;<br>fossils are the same age on each continent ;<br>they could not have swum / moved / spread across the ocean **;** | 1<br><br>1 | **ALLOW** *Lystrosaurus*<br>**ALLOW** other correct examples with correct explanation<br>**ALLOW** general description e.g. land living plant, freshwater reptile or freshwater fish if no genus is given<br>**ALLOW** AW |
| | (d) | (i) | **ANY 2 points for 1 mark from:**<br><br>rock with magnetic minerals / iron minerals / magnetite **OR** mafic rock **OR** measure the orientation / inclination / alignment / direction (of iron minerals) **OR** orientation / inclination / alignment / direction of palaeomagnetism ;<br><br>indicates the (palaeo)latitude **OR** position of magnetic pole**;**<br><br>determine the age of the rock **;**<br><br>join up rocks with different ages to make curve ; | 1 | **ALLOW** any named mafic rock<br><br>**DO NOT ALLOW** just iron / iron particles in rocks |
| | | (ii) | when polar wandering curves are the same it indicates that the continents were joined **OR** curves are the same from 300 Ma to 100 Ma so continents were joined ;<br><br>when the polar wandering curves diverge then continents have separated **OR** curves are different after 100 Ma so continents were separate **;** | 1<br><br>1 | **ALLOW** max 1 for general statement about continents were joined and then separate |

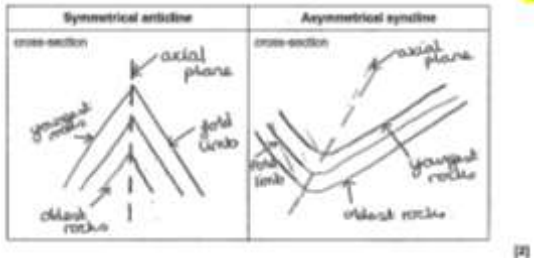
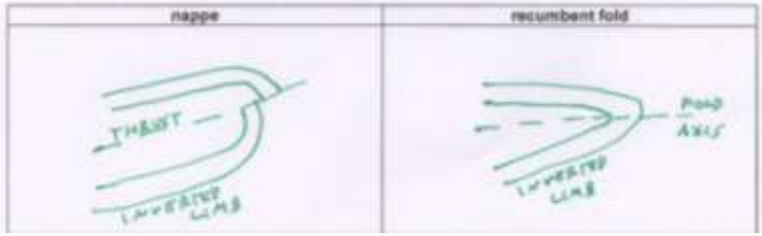
| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | (e) | | | 4 | 1 correct row = 1 mark<br>2 correct rows = 2 marks<br>3 or 4 correct rows = 3 marks<br>5 or 6 correct rows = 4 marks<br><br>Granite batholiths – **ALLOW** a tick for oceanic-oceanic |

| | convergent plate margins | | |
|---|---|---|---|
| **Feature** | **Oceanic - oceanic** | **Oceanic - continental** | **Continental - continental** |
| Benioff zone | ✓ | ✓ | |
| island arc | ✓ | | |
| granite batholiths | (✓) | ✓ | ✓ |
| fold mountain chains | | ✓ | ✓ |
| ocean trench | ✓ | ✓ | |
| reverse faults | ✓ | ✓ | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| | | | **Total** | **15** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| **4** | **(a)** | **(i)** | <u>description</u> **ANY 1 point from:**<br>large amount of stress needed for a small amount of strain;<br>fractures after little strain;<br>elastic limit is reached after small amount of strain;<br>stress increases rapidly before fracture**;** | 1 | |
| | | | <u>explanation</u> **ANY 1 point from:**<br>sandstone is a competent rock which can withstand more stress **OR** sandstone is a competent rock which can store more energy ;<br>competent rock will fracture with less strain **OR** competent rock will fracture with little plasticity;<br>there is little plastic deformation before the rock ruptures / fails / fractures / reaches elastic limit**;** | 1 | **ALLOW** sandstone is competent and brittle **OR** sandstone is competent and fractures **OR** sandstone is competent and not ductile / plastic |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | (ii) | **ANY 2 points from:**<br>small amount of stress causes a large amount of strain **OR** fractures after a lot of strain **;**<br>shale has long period of plastic / ductile deformation before brittle failure;<br>shale is ductile / plastic **AND** incompetent **OR** shale behaves in an incompetent manner **OR** shale is incompetent so can form cleavage**;**<br>shale is unlikely to fault unless the strain is very high **;**<br>the thickness of a bed of shale will often change becoming thinner on the limbs of a fold **;**<br>folds can be very small scale and / or very tight **;** | 2 | **ALLOW** deformation as an alternative to strain<br>**ALLOW** faulting or joint formation as an alternative to brittle failure |
| | (b) | (i) | **ANY 1 point from:**<br>tension at the fold hinge / crest / trough occurs so the rocks at the top of the fold will fracture ;<br>the outer layer of rock is stretched and breaks **OR** tensional forces on the outside of the fold hinge cause joints**;**<br>tension joints form parallel to the axial plane trace ;<br>cross joints form on the limbs of folds ; | 1 | |
| | | (ii) |  <br>clay minerals align at 90° to the compressive stress **OR** align parallel to the fold axial plane **;** | 1<br>1 | 1 mark for diagram **AND** two labels eg. random clay minerals, aligned clay minerals / muscovite, platy minerals, axial plane, compression / pressure, (pressure) arrows<br>**ALLOW** 2 marks for a well annotated diagram that includes explanation<br>1 mark for explanation |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | (c) | (i) | compression **OR** compressional **OR** compressive**;** | 1 | Spelling must be correct for mark |
| | | (ii) |  <br>symmetrical anticline correctly drawn **AND** two labels **;**<br><br>asymmetrical syncline correctly drawn **AND** two labels **;** | <br><br>1<br><br>1 | see diagram<br><br>max 1 for two correct diagrams but no correct labels<br><br>max 1 for correct labels on both diagrams but diagrams incorrect<br><br>max 1 for one correct diagram with any one set of correct labels<br><br>**DO NOT ACCEPT** overfold for the syncline<br><br>**DO NOT ACCEPT** symmetrical anticline diagram if dips of limbs differ by more than 5 degrees unless labelled as different<br><br>**Labels**: youngest **OR** oldest rock / younging direction, axis / axial plane (vertical), axis / axial plane (inclined), hinge, limb, crest, trough, angle of dip, direction of maximum pressure, (tension) joints |
| | (d) | |  <br>nappe correctly drawn **AND** two labels from recumbent fold, axis / axial plane, thrust fault, low angled reverse fault, fault plane, | <br><br>1 | see diagram<br><br>the correct sense of movement must be shown on the nappe diagram<br><br>max 1 for two correct diagrams but no correct labels<br><br>max 1 for correct labels on both diagrams but diagrams incorrect |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| | | | inverted limb, limb half arrows on thrust fault, direction of maximum pressure **;**<br><br>recumbent fold correctly drawn **AND** two labels from axis / axial plane, limbs close to horizontal/<30°, axial plane at (low angle), inverted limb, limb, younging direction, hinge, direction of maximum pressure **;** | 1 | max 1 for one correct diagram with any one set of correct labels<br><br>**ALLOW** folds and faults above thrust plane |
| | **(e)** | | First feature<br>slickensides<br><br>**ANY two from:**<br>Descriptions of first feature<br>scratch marks **OR** grooves **OR** ridges **OR** striations **;**<br>marks which feel smooth in the direction of movement and rough opposite **;**<br>mineralisation on one fault surface showing grooves **;**<br>polished **OR** parallel **OR** in the direction of movement**;**<br>……<br>Second feature<br>fault breccia<br><br>**ANY two from:**<br>Descriptions of second feature<br>angular fragments **;**<br>rotated fragments **OR** broken fragments **OR** brecciated fragments**;**<br>fragments of faulted rock **OR** fragments of wall rock **OR** fragments from either side of fault plane ;<br>within a clay matrix / clay gouge / rock flour**;**<br>mineralisation **OR** (mineral) cement **;** | 1<br><br>1<br><br>1<br><br>1<br><br>1 | 1 mark for the name of the feature<br><br>need 2 description points for 1 mark<br><br>1 mark for the name of the feature<br>**ALLOW** mylonite **OR** cataclasite<br><br>need 2 description points for 1 mark<br><br>**ALLOW** 1 max for one description mark from each feature |
| | | | **Total** | **16** | |

| Question | | | Answer/Indicative content | Mark | Guidance |
|---|---|---|---|---|---|
| **5** | | | **Deep mines and boreholes** | | |
| | | | • boreholes / mines allow samples / cores to be brought up from the crust<br>• samples obtained by drilling boreholes<br>• boreholes / mines can give information (eg. geothermal gradient, geophysical characteristics, geochemistry / composition) about the crust **OR** boreholes can give information about the lithosphere<br>• deep mines 4 – 6 km deep **OR** boreholes 8 – 13 km deep<br>• samples are used to inform about rocks that may not be found at the surface **OR** any named sedimentary, igneous or metamorphic rocks brought to the surface | max 3 | If no examples of rock types then **max 7** |
| | | | **Volcanic activity** | | |
| | | | • magma feeding the volcanoes may come from the crust **OR** upper mantle **OR** magma rising up vents may come from the upper mantle<br>• magma may be brought up by explosive volcanic activity<br>• analysis of basalts allow estimate of mantle composition<br>• xenoliths / fragments broken from the sides of the vent **OR** xenoliths within basalt **OR** xenoliths within kimberlite **OR** xenoliths from the upper mantle<br>• material in kimberlite pipes may include diamonds formed at depth (250km) / upper mantle / high pressure<br>• basalt / andesite / rhyolite from the crust **OR** basalt from the upper mantle **OR** mantle rocks are most commonly peridotite **OR** other ultramafic rocks **OR** mantle rocks brought to the surface may contain the mineral olivine | max 3 | |
| | | | **Ophiolites** | | |
| | | | • ocean crust has been broken off at a convergent plate margin / subduction zone<br>• ophiolite has been thrust / obducted onto continental crust<br>• the ophiolite shows the sequence / section of oceanic crust rocks<br>• deformation and erosion has exposed the ophiolites at the surface<br>• sequence is deep sea ooze / limestone / chert, basalt, dolerite, gabbro, peridotite | max 3 | **ALLOW** uplifted<br>**ALLOW** any three in correct order<br>Sequence could be shown on a diagram |
| | | | **Total** | **8** | |

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