GCE A LEVEL MARKING SCHEME

SUMMER 2024

A LEVEL
GEOLOGY – COMPONENT 3
A480U30-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE A LEVEL GEOLOGY

COMPONENT 3 - GEOLOGICAL APPLICATIONS

SUMMER 2024 MARK SCHEME

Instructions for examiners of A Level Geology when applying the mark scheme

1 Positive marking

It should be remembered that candidates are writing under examination conditions and credit should be given for what the candidate writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Worthwhile answers that meet the requirements of the question, but do not appear on the mark scheme are to be given credit.

2 Tick marking

Low tariff questions should be marked using a points-based system. Each credit worthy response should be ticked in red pen. The number of ticks must equal the mark awarded for the sub-question. The mark scheme should be applied precisely using the marking details box as a guide to the responses that are acceptable. Do not use crosses to indicate answers that are incorrect.

3 Annotated diagrams

Where a candidate has answered a question wholly or partly by use of an annotated diagram, credit must be awarded to the annotations which form credit-worthy responses as outlined in the marking details box. Candidates must be credited only once for valid responses which appear both as annotations to diagrams and within a section of prose in the answer to the same question.

4. Banded mark schemes

Banded mark schemes are divided so that each band has a relevant descriptor. The descriptor for the band provides a description of the performance level for that band. Each band contains marks. Examiners should first read and annotate a learner's answer to pick out the evidence that is being assessed in that question. **Do not use ticks** on the candidate's response. Once the annotation is complete, the mark scheme can be applied. This is done as a two-stage process.

Stage 1 – Deciding on the band

When deciding on a band, the answer should be viewed holistically. Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptor for that band. Examiners should look at the descriptor for that band and see if it matches the qualities shown in the learner's answer. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content.

Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Stage 2 – Deciding on the mark

Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is also provided for banded mark schemes. Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Section A

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)		Any **three x (1)** from: • transform fault / (conservative) plate boundary • shallow focus • relative displacement from plates moving at different speeds • quantified • plates locked • build-up of stress / friction / pressure		**3**		**3**		
	(b)	(i)	Intensity decreases with distance from the epicentre (1)	**1**			**1**		
		(ii)	Any **two x (1)** from: • Léogâne is closer to epicentre • distance measured • intensity IX (rather than VIII) / intensity is higher in the violent zone • less dissipation of energy closer to the epicentre • greater amount of shaking closer to the epicentre	**2**			**2**		
		(iii)	Any **three x (1)** from: • slightly closer to epicentre • unconsolidated sediment • poorly constructed buildings • steepness of ground • other reasonable answer e.g. resonance, liquefaction (+1 for development)	**3**			**3**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		**Any two x (1) from:** • liquefaction • sediment flows away from buildings • magnify effects of shaking / amplification of seismic waves • high water table / saturated sediment • competence of sediment • subsidence (+1) for development	**2**			**2**		
	(d)		**Any four x (1) from:** • build-up of stress • seismic gap • lack of preparedness / lack of education • buildings vulnerable to failure • lack of emergency planning • other reasonable suggestion (+1) for development			**4**	**4**		
			Question 1 total	**8**	**3**	**4**	**15**	**0**	**0**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	**Any two x (1) from:** • removing rock material from shallow excavation • reference to competence of rock • void space • undermines ground / foundations of buildings / instability • subsidence / collapse / sinkholes	**2**			**2**		
		(ii)	**Any three x (1) from:** • rock fall from roof of stalls • dissolution / weathering / erosion of limestone • decreases thickness of rock below foundations • quantified • dissolution of pillars • increased load on roof of stalls from buildings • higher population living in geohazard area (+1) for development			**3**	**3**		
	(b)	(i)	• 200 m x 200 m (1) • 40,000 m^2 (1)		**2**		**2**	**2**	**2**
		(ii)	• Area x 5 = 200,000 m^3 (1) Accept ecf		**1**		**1**		**1**
		(iii)	200,000 x 6m (depth) (1) = 1,200,000 1,200,000 x 0.9 (1) = 1,080,000 correct units m^3 (1) Accept ecf		**3**		**3**	**3**	**3**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iv)	**Any four x (1) from:** • would prevent subsidence • make ground more stable for buildings • location to dispose of waste However: • large quantity of material required • expensive • hard to move solid waste • dangerous to work in collapsing mine • waste may contaminate groundwater • waste would compact over time Credit other reasonable suggestions e.g. cost vs benefit, not all workings might need filling in, nature of the waste			**4**	**4**		
			Question 2 total	**2**	**6**	**7**	**15**	**5**	**6**

Section B

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		Overturned strata / 86 (1) Axial plane trace (syncline) / NE-SW (needs both directions) (1)	**2**			**2**		**2**
	(b)	(i)	2.5 * 200 (1) = 500m (1)		**2**		**2**	**2**	**2**
		(ii)	**Any two x (1) from:** • width of outcrop = approximately 500m • beds near vertical • width of outcrop therefore = true thickness		**2**		**2**	**2**	**2**
		(iii)	Outcrop width thins to SE (1) Despite the lower dip angle (1)	**2**			**2**		**2**
			Question 3 total	**4**	**4**	**0**	**8**	**4**	**8**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	**Any four x (1) from:** • scale indicated • cleavage labelled • dipping bedding planes labelled • cleavage refraction indicated by drawing • graded bedding labelled • correct angles labelled (bedding dip 30^{o} - 40^{o}) or (cleavage variable 60^{o} - 85^{o})		**4**		**4**	**1**	**4**
		(ii)	**Any two x (1) from:** • differences in lithology • reaction of stress to change in rock type. • differing competence of layers • mudstone / siltstone less competent or sandstone more competent	**2**			**2**		
	(b)	(i)	SE and NW (1) 8-0-0-11-7-0-0-4 (1) (note ecf)	**2**			**2**	**1**	**2**
		(ii)	Accuracy of plot (1) In correct directions (1)	**2**			**2**	**2**	**2**
		(iii)	**Any two x (1) from:** • cleavage strike is at 90 degrees to cleavage dip trend • cleavage strike / orientation and axial plane directions are similar • both NE-SW • both form by compressional forces / crustal shortening		**2**		**2**		
			Question 4 total	**6**	**6**	**0**	**12**	**4**	**8**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	5 (4.9-5.3) x 50,000 (1) 2500 m (2450 – 2650 m) (1)		**2**		**2**	**2**	**2**
		(ii)	Arrows identified (1) Left hand movement / sinistral (1)	**2**			**2**		
		(iii)	Crossmark (or equivalent) on the downthrow side (1)	**1**			**1**		
	(b)		**Any one x (2) from:** • slickensides (1) explained (1) • drag folds (1) explained (1) • offset of marker beds (1) explained (1)	**2**			**2**		
	(c)		Faults P & Q and the Kirkby fault reactivation are all normal faults (1) All faults have the same orientation as each other (1) All formed by tensional stresses / horizontal orientation of sigma min (1)		**3**		**3**		
			Question 5 total	**5**	**5**	**0**	**10**	**2**	**2**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)		**Any two x (1) from:** • discordant • discontinuous • linear • orientation (NE-SW) • dimensions (length, width) / use of numbers	**2**			**2**		
	(b)		**Any one x (1) from:** • dyke is discordant – (seen to cut Mho) and so younger than the surrounding beds • dyke is Devonian and beds are Silurian, so dyke younger • dyke near vertical (90º) - beds are dipping less steeply **Any two x (1) from:** • appears to be cut by one fault, therefore older than faulting. • inconclusive evidence of cross-cutting relationships of dyke by fault or vice versa • maybe just discontinuous (en echelon) nature of dyke • maybe same age as the faults which are otherwise roughly parallel and tensional normal faults (as is dyke)			**3**	**3**		**3**
			Question 6 total	**2**	**0**	**3**	**5**	**0**	**3**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	**Any two x (1) from:** • flute cast / structures • flared from bulbous end • use of numbers Credit other correct description	**2**			**2**		
		(ii)	No - Palaeocurrent from the NW / towards the SE (1) **Any three x (1) from:** • beds are sole structures / base of a bedding surface • their bulbous ends point up current / flare down current / wider down current • beds are overturned • so flute casts are inverted / now not orientated as originally formed			**4**	**4**		**4**
	(b)		**Any four x (1) from:** • turbidites identified / explained • graded bedding link to rapid deposition • flute casts – link to marine environment • sediments from the NW transported by turbidity current flow • to SE <u>down a slope</u> into a deeper marine basin • because **Gte** thins to the SE • as energy of the currents wain			**4**	**4**		**4**
			Question 7 total	**2**	**0**	**8**	**10**	**0**	**8**

Section C option 1 Quaternary Geology

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		Wide variety of composition of clasts from northwest (1) **Any one x (1) from:** • poorly sorted (indicates glacial deposition) • angular clasts (indicate glacial transport and lack of attrition)		**2**		**2**		
	(b)	(i)	Raised beach (1)	**1**			**1**		
		(ii)	**Any two x (1) from:** • above current high-water mark • marine fossils • rounded clasts / textural description Credit other reasonable answers.		**2**		**2**		
	(c)	(i)	Correctly substituting values recognising daughter & parent isotopes (1) working – correct application of BIDMAS (1) ANSWER = 0.1488 Ma (1) Accept (0.14-0.15 Ma) Max (2) if answer is 21.3		**3**		**3**	**3**	**3**
		(ii)	**Any two x (1) from:** • shells are too old • maximum extent of ^{14}C dating ≈50-60ka • short half-life of ^{14}C Do not accept 'lack of organic material to date'.		**2**		**2**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)	Drowned valley / ria (1)	**1**			**1**		
		(ii)	**Any three x (1) from:** • flooded valley formed during last glaciation • raised beach / wave cut platform from previous interglacial • isostatic uplift from weight of ice • greater than eustatic sea level rise • local vs global effects of isostasy & eustasy		**3**		**3**		
			Question 8 total	**2**	**12**	**0**	**14**	**3**	**3**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)	**Any two x (1) from:** • increased • non-linear • quantified	**2**			**2**	**2**	**2**
		(ii)	Drier (1) More variable (1)	**2**			**2**		
		(iii)	**Any three x (1) from:** • selects organisms able to adapt / natural selection • to cope with changing conditions / more able to survive • link to making tools • link to communication between individuals • link to problem solving abilities • other reasonable suggestion e.g. becoming more intelligent		**3**		**3**		
	(b)		**Any three x (1) from:** • not linked / not correct / not a clear pattern • fluctuations are too rapid / frequent • however, shorter period change for obliquity / precession • localised climatic change has greater effect • Milankovitch predicts change at high latitude / 60° • humans evolved at low latitudes / East Africa • credit reference to 'there are other Milankovitch cycles which may be affecting human evolution'			**3**	**3**		
			Question 9 total	**4**	**3**	**3**	**10**	**2**	**2**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10			**Indicative content:** **Pollen** Well preserved, easily fossilised abundant material Sampled from sediments of different types, particularly lake deposits Relative abundance of pollen types used to reconstruct vegetation community Use of pollen diagrams to present data Doesn't allow for quantified climatic reconstruction Only reconstructs a proxy for the climate **Invertebrates (e.g. Beetles)** Highly sensitive to climatic factors Distribution often controlled by climate Widespread and diverse group Preserve well in anaerobic conditions Evolutionary stability leads to application of uniformitarianism to determine climatic controls Overlap of climatic controls within assemblage gives range of quantified climatic conditions Accept reference to other invertebrates (e.g. gastropods) **Vertebrates (e.g. Mammoths)** Application of uniformitarianism – relating modern mammals to fossils Found preserved in glacial ice. Heavy fur coats as an indicator of colder conditions. Use of individual species, rather than community, to reconstruct climate – mutual climatic range "Snapshot" of climatic conditions rather than continuous sequence Accept reference to other vertebrates (e.g. Irish Elk) **5-6 marks:** A thorough understanding of how fossils can provide evidence of climates during the Quaternary. Knowledge of pollen, vertebrate	**6**			**6**		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			and invertebrate fossils and how they indicate Quaternary climates (distribution and adaptation). Discussion of proxy data used to reconstruct climate and uniformitarian ideas. *The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.* **3-4 marks:** A sound understanding of how fossils can provide evidence of climates during the Quaternary. Some knowledge of **at least two** of pollen, vertebrate and invertebrate fossils and at least one way in which they indicate Quaternary climates (distribution or adaptation). Supported by limited discussion of how climates are reconstructed using fossils. *The candidate constructs a coherent account including many of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.* **1-2 marks:** A partial understanding of how fossils can provide evidence of climates during the Quaternary. May be some awareness of the use of distribution or adaptation as an indicator of past climates**.** Supported by generic discussion of the geological evidence. *Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.* **0 marks:** *The candidate does not make any attempt or give an answer worthy of credit.*						
			Question 10 total	**6**	**0**	**0**	**6**	**0**	**0**

Section C Option 2 Evolution of Britain

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)	**Any two x (1) from:** • poorly sorted • boulders / large clasts / quantified • reference to the matrix • reference to shape of clasts	**2**			**2**		**2**
		(ii)	**Any two x (1) from:** • ice floated clasts / clasts in icebergs • dropstones • deposited when icebergs melted • into fine sediment on sea floor		**2**		**2**		

	(b)	(i)	**Any three x (1) from:**
			• deposition of cap carbonate sediment
			• indicates rapid global warming as a result of:
			  ○ build-up of atmospheric CO_2 / greenhouse gasses
			  ○ link to volcanic activity
			  ○ excess alkalinity in seawater/carbon transfer to sea
			or
			• methane hydrate
			• becomes unstable / sublimates
					3		**3**		

		(ii)	**Any two x (1) from:** • multiple layers of glacial deposit • quantified • interbedded with different lithologies • carbonate beds indicate warming		**2**		**2**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)	Correctly substituting values recognising daughter & parent isotopes (1) working – correct application of BIDMAS (1) ANSWER = 57.7 Ma (1) Accept (57-58 Ma) Max (2) if answer is 21.3		**3**		**3**	**3**	**3**
		(ii)	**Any two x (1) from:** • dykes result of crustal tension • age shows part of Palaeogene Igneous Province • mafic composition related to divergent margin • NW-SE alignment related to opening of Atlantic		**2**		**2**		
			Question 11 total	**2**	**12**	**0**	**14**	**3**	**5**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
12	(a)	(i)	Unconformity (1)	**1**			**1**		
		(ii)	**Any three x (1) from:** • Carboniferous younger series • cuts across fault / Carboniferous is not affected • fault cuts Ordovician older series • post-Ordovician / pre-Carboniferous • NE – SW alignment of fault		**3**		**3**		
	(b)	(i)	**Any three x (1) from:** **either** • gravity survey / potential field measurements / gravimeter • low density of granite / density contrast with country rock • lower gravitational pull • negative Bouguer anomaly **or** • seismic (reflection) survey • generated seismic waves • reflect off granite contact • density contrast with country rock	**3**			**3**		
		(ii)	**Any three x (1) from:** • this is likely because there were different types of plate margin **early intrusion of magma - Ordovician:** • subduction • partial melting of lithosphere • closure of Iapetus • close to suture			**3**	**3**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
			late intrusion of magma – Devonian: • continental-continental convergence • deep burial of continental crust • melting of wet continental crust • collision of Laurentia & Gondwana Max (2) if only one period is referred to.						
			Question 12 total	**4**	**3**	**3**	**10**	**0**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
13			**Indicative content:** **Triassic** • terrestrial environments in most of Britain • semi-arid environments • dune-bedded red sandstones • breccias from wadi environments • evaporites showing shallow hypersaline marine conditions (North Sea, Cheshire Plain, Northern Ireland) **Jurassic** • tropical shallow marine environments • marine transgression at start of period • reef deposits containing corals and other fauna. • conditions for coral growth (temperature, depth, light). • wave action of sea in warm shallow lagoon transporting ooids / pisoliths. • high energy environment, relationship of ooid size and energy levels. • low energy back-reef lagoons. **Cretaceous** • chalk - remains of marine algae (coccoliths). • deeper water deposition • application of uniformitarianism - analogy with modern calcareous oozes. **5-6 marks:** A thorough understanding of the geological evidence from these periods. Knowledge of the different types of marine deposits (such as limestone formed in different environments during the Jurassic) as well as terrestrial deposits in the Triassic. Exemplification of sedimentary environments linked to lithology using the British geological record.	**6**			**6**		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout. **3-4 marks:** A sound understanding of the geological evidence from these periods. Some knowledge of the different types of marine deposits (such as limestone formed in different environments during the Jurassic) or terrestrial deposits in the Triassic. There may be exemplification of a sedimentary environment from the British geological record. *The candidate constructs a coherent account including many of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.* **1-2 marks:** A partial understanding of the geological evidence from these periods. There is some awareness of lithologies indicating sea level change. The answer may be supported by generic examples of geological evidence. *Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.* **0 marks:** *The candidate does not make any attempt or give an answer worthy of credit.*						
			Question 13 total	**6**	**0**	**0**	**6**	**0**	**0**

Section C Option 3 Geology of the Lithosphere

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
14	(a)	(i)	~40 Ma (34-46 Ma) (1) (accept 'from 70 Ma -110 Ma')		**1**		**1**	**1**	**1**
		(ii)	Correctly substituting values recognising daughter & parent isotopes (1) Working (correct application of BIDMAS) max (1) ANSWER = 83.7 Ma (accept 83-84 Ma) (1) Max (2) if answer is 21.3		**3**		**3**	**3**	**3**
	(b)		**Any two x (1) from** • best fit line • distance over time = age • use of numbers (e.g. 3500km /130Ma)		**2**		**2**	**1**	**1**
	(c)	(i)	**Any three x (1) from** • link between seismic anomaly and correct reason for lower velocity e.g. less rigid/hotter mantle/rising mantle (do not just credit a reference to the seismic anomaly) • continental flood basalt 130Ma = above the plume top • volcanic track from Tristan = as plate moves over plume tail • age profile increases (to the NE – direction of plate movement) • reference to intra-plate setting Other appropriate – e.g. reference to splitting of Africa from South America			**3**	**3**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	**Any three x (1) from** • ref to the variation in range of age data of older lavas • lava up to 40 Ma younger than expected • different chemistry of lavas erupted at the same location • composition B does not fit the general trend / not found along entire chain		**3**		**3**		
			Question 14 total	**0**	**9**	**3**	**12**	**5**	**5**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
15	(a)	(i)	**Any two x (1) from:** • a surface / boundary at which seismic velocities change / at which waves are reflected or refracted • increase or decrease in velocity • abruptly	**2**			**2**		
		(ii)	**Any three x (1) from:** • change from granitic continental crust to mantle peridotite • incompressibility and / or rigidity of rock • increase • at a greater rate than the increase in density		**3**		**3**		
	(b)	(i)	P2 – reflected (1) P3 – refracted (1)	**2**			**2**		
		(ii)	P3 arrives before P1 (1) P1 arrives before P2 (1) (Accept P2 arrived before P1 ONLY if explained as in part b(iii)) (accept P1 arrived before P3 ONLY if explained as in part b(iii))	**2**			**2**		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	**Any two x (1) from:** • P3 – travels through the crust (slower) but with increased velocity in the upper mantle peridotite • reference scale - greater distance travelled through mantle (approximately 500 km) at higher velocity between explosion and seismometer • reference distance to MOHO is relatively small **Any two x (1) from:** • P1 – travels through continental crust only – shortest distance = second to arrive • P2 – travels through continental crust only – reflected, therefore longer distance of travel – (arrives after P1) **to a maximum of 3 marks** Alternative reasoning – P2 arrives before P1 as incompressibility and rigidity increases within the crust with depth towards the MOHO (2) Alternative reasoning – P1 arrives before P3 as the P1 wave shows the highest amplitude, therefore is the wave that has travelled the shortest distance.		**3**		**3**		
			Question 15 total	**6**	**6**	**0**	**12**	**0**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
16			**Indicative content:** Lithospheric loading – Foreland basins form as an adjacent mountain belt grows as a result of crustal shortening/orogen. This exerts a significant increase in mass on the lithosphere. This is compensated by local bending/flexing of the lithosphere downwards by isostatic sinking. Associated with upward flexing of the forebulge to provide a basin that fills with sediment. Horizontal (sigma max) stresses create reverse/thrust faults, nappes, as foreland basin and sediments deform. **5-6 marks:** A thorough understanding of the factors affecting the formation of foreland basins – orogeny, faults and nappes identified and an appreciation of the isostatic effects of an increase in mass in causing both depression and bulging up of the lithosphere. *The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.* **3-4 marks:** A sound understanding of the nature of a foreland basin and the factors affecting their formation – orogeny, crustal shortening and the associated faults identified. An appreciation of the isostatic effects of the increase in mass of the mountain range on flexing at the surface. *The candidate constructs a coherent account including many of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.*	**6**			**6**		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			1-2 marks: A partial understanding of the factors affecting the formation of a foreland basin. Crustal shortening and the formation of reverse / thrust faults identified. A limited appreciation of the isostatic effects in the formation of the basin. *Coherence is limited by omission and / or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.* **0 marks:** *The candidate does not make any attempt or give an answer worthy of credit.*						
			Question 16 total	**6**	**0**	**0**	**6**	**0**	**0**