2014 Geology

Higher

Finalised Marking Instructions

Part One: General Marking Principles for: Geology Higher

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.

(b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

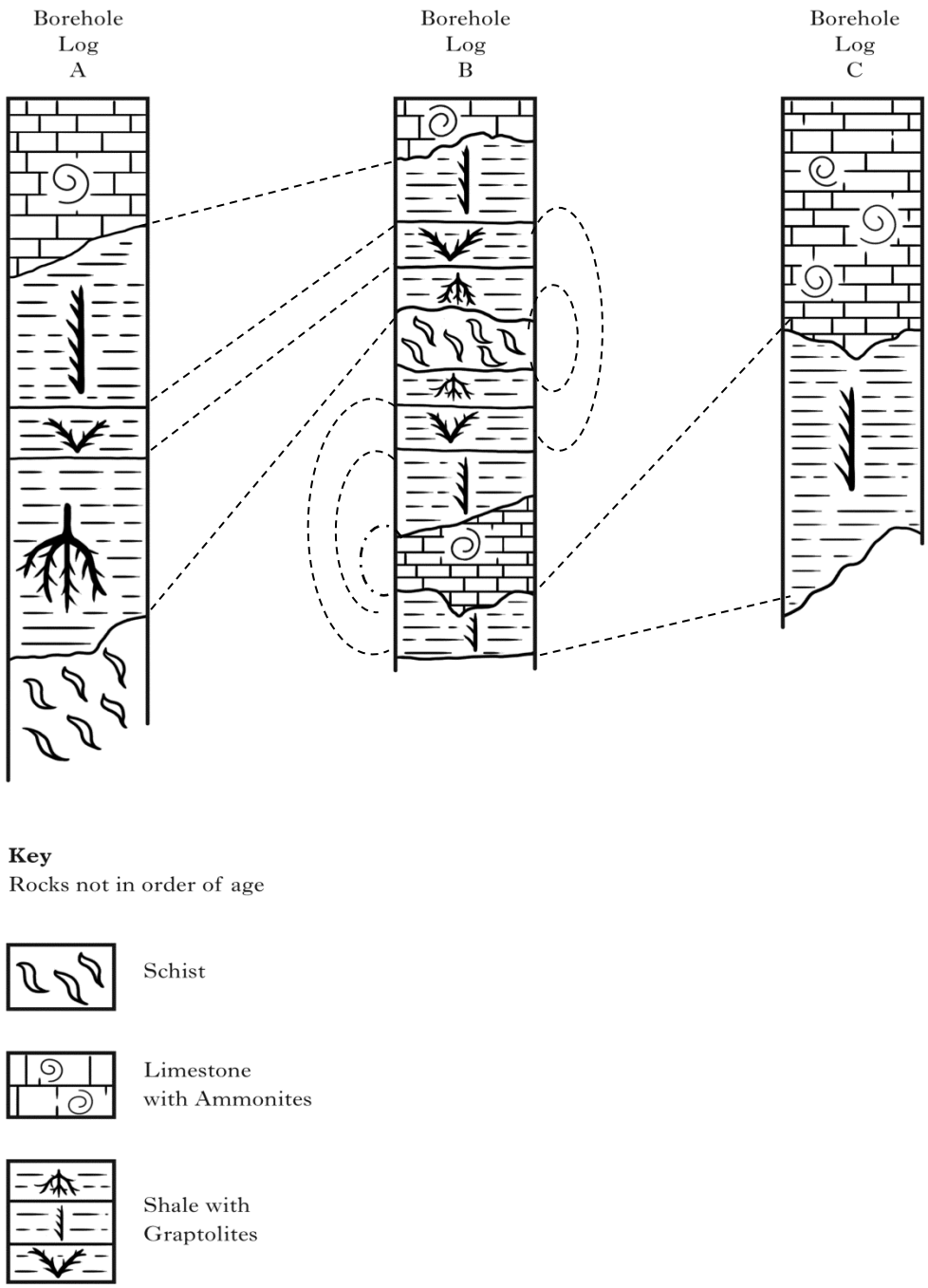
GENERAL MARKING ADVICE: Geology Higher

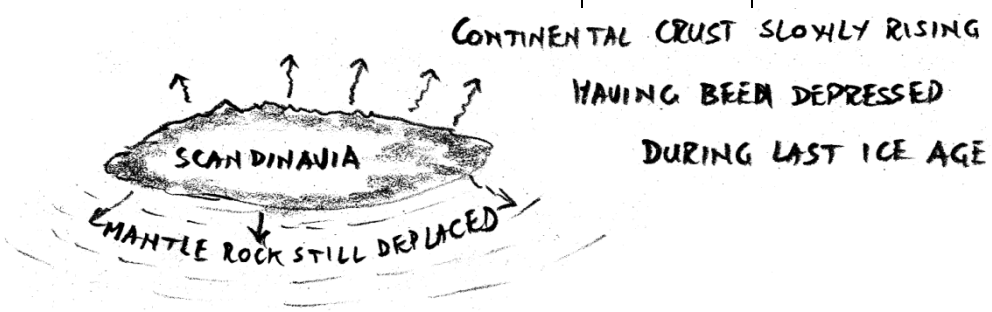
The marking schemes are written to assist in determining the "minimal acceptable answer" rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

Part Two: Marking Instructions for each Question

Section A

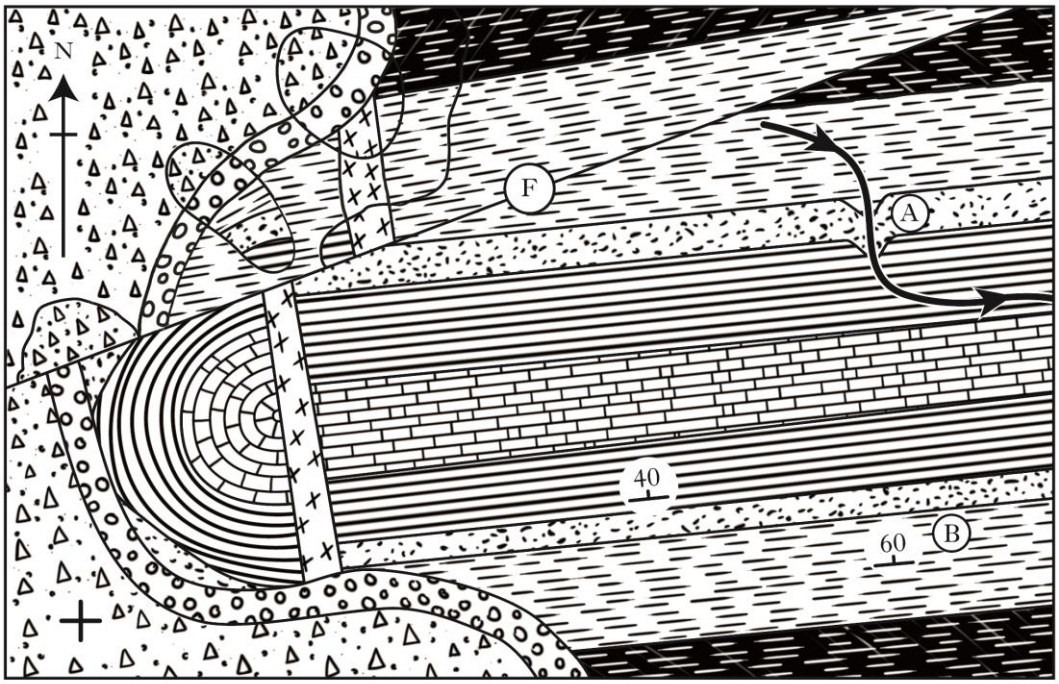
<table>
<tr><th colspan="3">Question</th><th>Expected Answer(s)</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>
<table>
<tr><td>Igneous rock</td><td>Acidic</td><td>Intermediate</td><td>Basic</td><td>Ultrabasic</td></tr>
<tr><td>Course grained</td><td>Granite</td><td>Diorite</td><td>Gabbro</td><td>Peridotite</td></tr>
<tr><td>Medium grained</td><td>Microgranite</td><td>Microdiorite</td><td>Dolerite</td><td>Not found</td></tr>
<tr><td>Fine grained</td><td>Rhyolite</td><td>Andesite</td><td>Basalt</td><td>Not found</td></tr>
</table>
</td><td>3</td><td></td></tr>
<tr><td>1</td><td>(b)</td><td></td><td>Give only the letter C</td><td>1</td><td></td></tr>
<tr><td>1</td><td>(c)</td><td>(i)</td><td>A: Olivine
B: Plagioclase
C: Pyroxene</td><td>3</td><td></td></tr>
<tr><td>1</td><td>(c)</td><td>(ii)</td><td>Dolerite</td><td>1</td><td></td></tr>
<tr><td>1</td><td>(d)</td><td></td><td>Silica tetrahedra is the building block of all the minerals but no quartz present</td><td>1</td><td></td></tr>
<tr><td>1</td><td>(e)</td><td></td><td>Dyke/sill/cone sheet/ring dyke</td><td>1</td><td></td></tr>
</table>

Question			Expected Answer(s)	Max Mark	Additional Guidance
2	(a)			3	
2	(b)		Give only the letter **D**	1	
2	(c)		Give only the letter **D**	1	

Question			Expected Answer(s)	Max Mark	Additional Guidance
3	(a)		56m **Working: 0·007 × 8000 = 56**	1	
3	(b)		Rates of uplift fastest over Gulf of Bothnia where ice sheet was at maximum thickness and crustal depression was greatest	2	
3	(c)		**Explanation:** Diagram to show crust depressed and mantle material displaced to accommodate this. Explanation that deficit of dense mantle material leads to negative gravity anomaly. Credit correct use of term 'isostatic disequilibrium'.  	2	
3	(d)		Type of anomaly…positive OR less negative than surrounding area Reason…iron ore is dense would tend to produce a positive anomaly	1	
3	(e)		Technique 1 magnetic Technique 2 borehole drill Technique 3 seismic Technique 4 geochemical Or any reasonable suggestion	2	

<table>
<tr><th colspan="3">Question</th><th>Expected Answer(s)</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>Give only the letter C</td><td>1</td><td></td></tr>
<tr><td>4</td><td>(b)</td><td></td><td>Coupled substitution (1 mark) – Na substitutes for Ca and at the same time Si substitutes for Al to maintain charge balance (correct explanation of coupled substitution – 1 mark)</td><td>2</td><td></td></tr>
<tr><td>5</td><td>(a)</td><td></td><td>Give only the letter C</td><td>1</td><td></td></tr>
<tr><td>5</td><td>(b)</td><td></td><td>Sequence 1 deposited under waning current conditions. Energy of environment decreased from high energy for bed A – scouring of substrate – presence of rip up clasts – sole marks – to low energy and settling out of clay particles from suspension for bed E. Credit mention of decreasing grain size/graded bedding. Credit correct explanation of turbidity current.</td><td>3</td><td></td></tr>
<tr><td>5</td><td>(c)</td><td></td><td>Give only the letter A</td><td>1</td><td></td></tr>
<tr><td>5</td><td>(d)</td><td></td><td>Older than 430Ma</td><td>1</td><td></td></tr>
<tr><td>5</td><td>(e)</td><td></td><td>1
<table><tr><td></td><td>Potassium atoms (K)</td><td>Argon atoms (Ar)</td><td>Number of half lives</td><td>Age in millions of years</td></tr><tr><td>H</td><td>64</td><td>192</td><td>2</td><td>2600</td></tr></table>K : Ar
64 : 92
=> 1 : 3
= 2 half lives
K : Ar
256 : 0
128
64
128 – 1½ life
192 – 2½ lives</td><td></td></tr>
<tr><td>5</td><td>(f)</td><td></td><td>‘Gneiss’ at J has melted and recrystrallised giving similar age to granite
Or ‘atomic clock’ reset by melting</td><td>1</td><td></td></tr>
</table>

Question			Expected Answer(s)	Max Mark	Additional Guidance
6	(a)			2	



Key

Rocks in order of age

- Arkose sandstone
- Conglomerate
- Dolerite dyke
- Limestone
- Shale
- Sandstone
- Coal measure rocks
- Mudstone

- F — Fault
- A — Outcrop A
- B — Borehole B
- Stream showing direction of flow
- 60 — Strike direction with dip in degrees
- Horizontal strata

0 50 100 150 200 250 300

metres

Question			Expected Answer(s)	Max Mark	Additional Guidance
6	**(b)**		Direction South Reason Outcrop exposed by river 'Vs' downriver OR Northern limb of syncline dipping south	**2**	
6	**(c)**		T = 1 metre **Working T= 2 × 0·5 = 1 metre**	**1**	
6	**(d)**		Give only the letter **B**	**1**	
				(40)	

Section B

Question			Expected Answer(s)	Max Mark	Additional Guidance
7	**(a)**		Concentration of metal bearing minerals at base of magma chamber due to settling of denser early formed crystals; role of volatiles especially from granitic intrusions associated with dolomitic limestones.	**6/7**	
7	**(b)**		Placers – rivers eroding through ore bearing rocks remove ore then heavy ore sinks in slow moving parts of river such as inside meanders, plunge pools Soluble ores will be carried down to the water table and precipitate out leaving non soluble ore minerals at surface. Secondary enrichment: chemical weathering of chalcopyrite vein. Cu^{2+} carried down to water table. Above water table Cu + $CO_2 \rightarrow$ carbonates. Below water table Cu displaces Fe from chalcopyrite so copper ore enriched Residual – formed in situ; chemical weathering; formation of Al and Ni deposits Transported ore bearing minerals will sink where water current slows eg inside meander loops	**6/7**	
7	**(c)**		Credit should be given for mentioning open cast mining, especially in connection with low grade ores. Underground mining of high grade/high value ores.	**3/4**	
				(15)	**Maximum total**

Question			Expected Answer(s)	Max Mark	Additional Guidance
8	**(a)**		**Credit reference to:** • hardness • lustre • colour • cleavage • streak • flame test • fracture • density • any reference to crystallography should be credited. **Award full marks only when specific examples are given of mineral eg Quartz, no cleavage, Micas have one perfect cleavage etc**	**5/6**	
8	**(b)**		**Credit reference to:** • pleochroism • cleavage • angle of cleavage • angle of extinction • relief, positive/negative/high/low • twinning • birefringence/double refraction/refraction indices • polarisation colours/Newtons scale/ orders • isotropic/anistrophic • Becke line/test • opaque **Award full marks only when specific examples are given of minerals eg olivine high relief pyroxene cleavage at 90° in thin section**	**6/7**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
8	**(c)**		**Credit reference to:** • Polymorphism – substance which exists in two or more distinct forms – having identical chemical compositions eg calcite and aragonite are polymorphs of calcium carbonate Diamond and graphite – carbon atoms arranged differently/strength of bonding Isomorphism – substitution of one ion by another in the case of different ions the same ionic radius and change eg Fe^{+2} replaced by Mg^{+2} same form but different Al^{+3} Fe^{+3} chemical composition Na^{+3} Ca^{+2} Substitution among similarly sized anions eg 0^{-2} OH^{-1} and F^{-1}	**4/5**	
				(15)	**Maximum total**

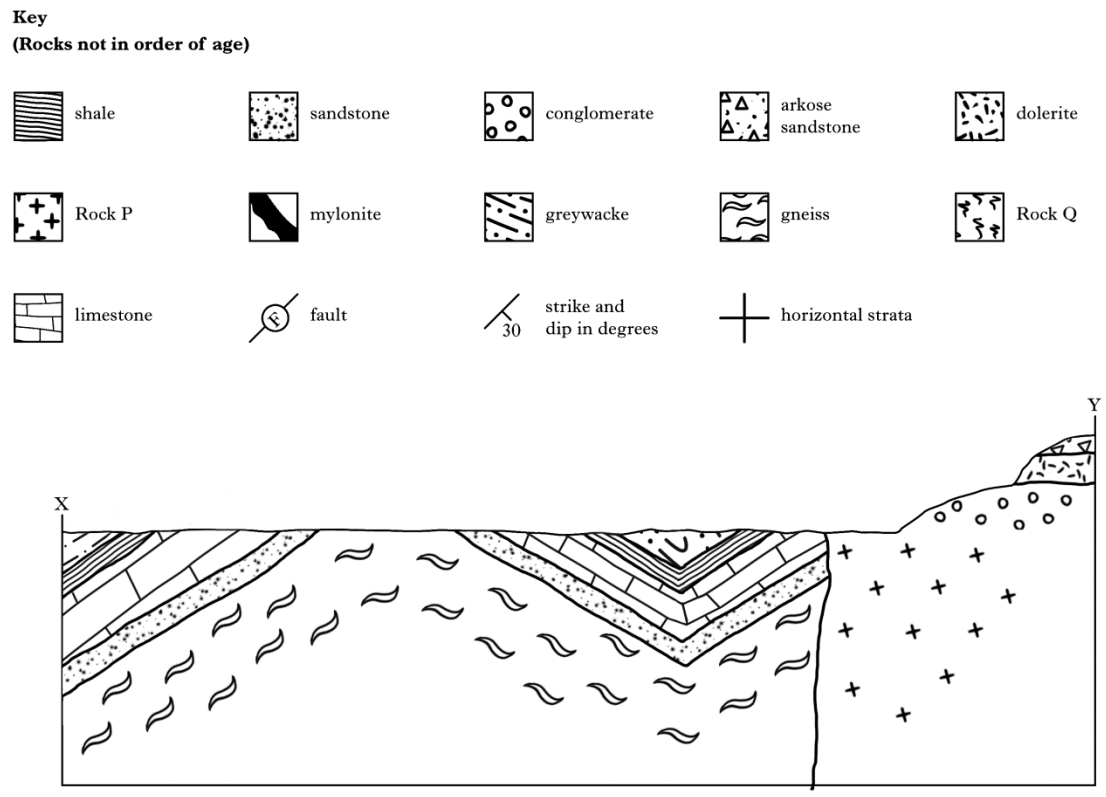
Question			Expected Answer(s)	Max Mark	Additional Guidance
9	**(a)**		Parting plates, mid ocean ridges, partial melting of upper mantle, eruption of basaltic lava, crystals of magnetite align with current magnetic field, positive and negative anomalies, width of anomalies confirm varying rates of spreading, provides evidence for reversal of earth's magnetic field, rates of spreading, radiometric dating of sea floor crust shows newest crust found along ridges. Polar wandering curves.	**6/7**	
9	**(b)**		Look like tear faults. Movement takes place away from ridges so movement should be opposite of that expected. Transform faults end by seeming to change or transform into other structures such as oceanic ridges, island arcs or mountain belts.	**2/3**	
9	**(c)**		Colliding plates, subduction zones, oceanic crustal plate, continental crustal plate, island arc, trenches, negative anomaly over trenches, positive over island arcs, mountains, positive anomaly cold sinking plate, denser than surrounding mantle, negative anomaly at trench due to less dense sea water.	**5/6**	
9	**(d)**		Molten material in upper mantle provides lubrication. Convection currents in mantle rise at oceanic ridges – sink at destructive margins, effects of gravity, injection of material at ridges shoves plates apart, ridge push, slab pull.	**2/3**	
				(15)	**Maximum total**

Section C

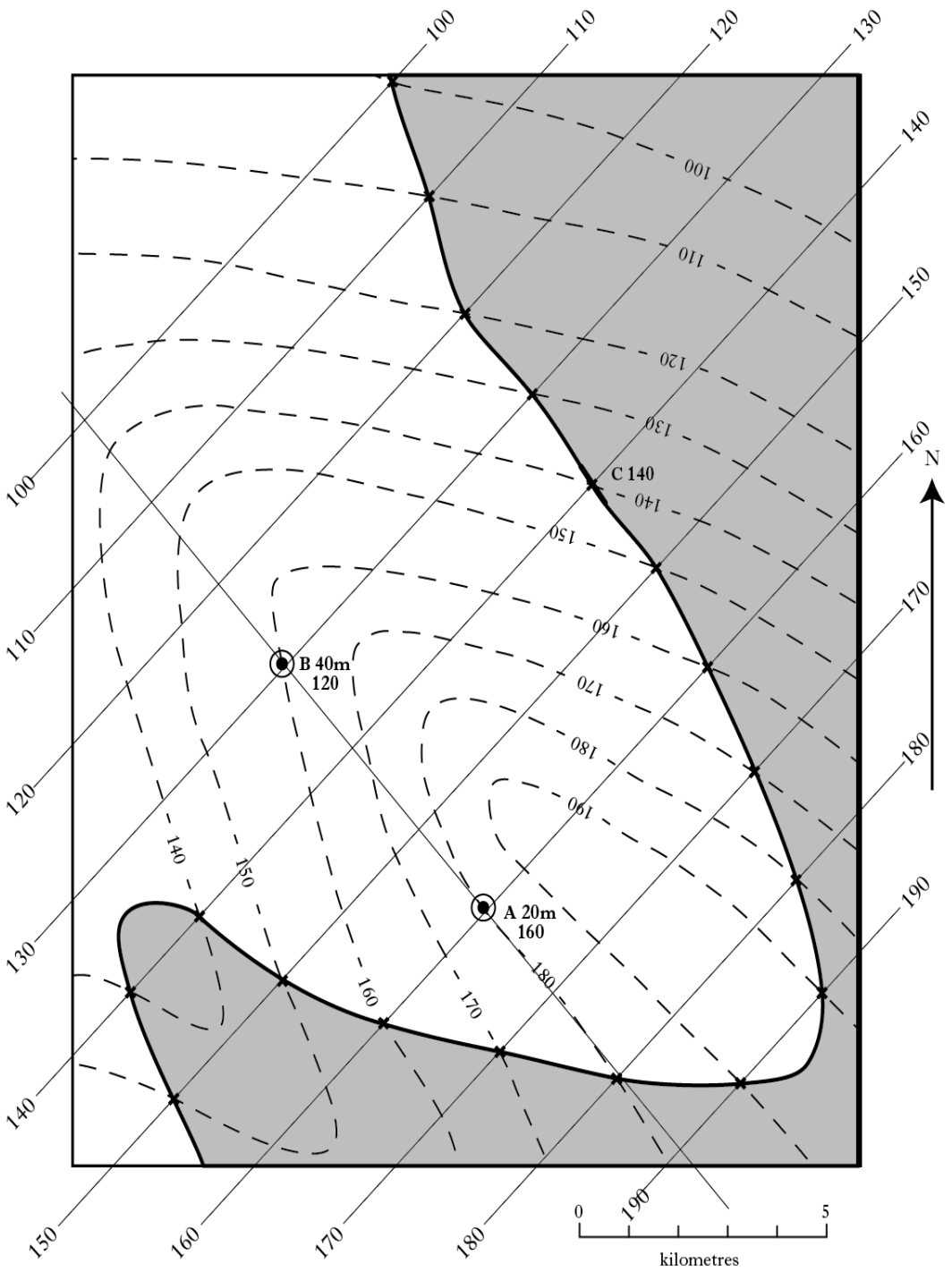
Question			Expected Answer(s)	Max Mark	Additional Guidance
10			Unconformable relationship – sandstone laid down then uplifted, tilted and eroded before conglomerate laid on top.	**3**	Maximum of 2 if diagram not used
11			**Layer one current bedding** – small infill channels – river or lacustrine fine grained suggesting fairly low energy **Layer two** – large angular clasts in sandy matrix – random orientation of clasts possible flash flood deposit or breccia towards foot of a scree slope **Layer three** – medium to coarse grain sandstone tregular bedding suggests low energy environment possible slow moving river. White reduction spots/layers imply some brief wetter periods	**3**	
12	**(a)**		Gas bubbles trapped in the magma are released as the lava reaches the surface. Lave degasses and some of the 'bubbles' remain as the lava cools and hardens.	**2**	1 mark only if diagram not used
12	**(b)**		Due to the presence of gas and possible therefore water, it may have been fairly viscous. Andesite has intermediate composition due to silica content.	**1**	
13	**(a)**		Two	**1**	
13	**(b)**		F1 cuts conglomerate and arkose but not dolerite therefore dolerite must have been included after they were deposited	**1**	
13	**(c)**	**(i)**	**Answer:** East **Reason:** width of outcrop in anticline wider east of F_2, width of outcrop in syncline narrower east of F_2	**1**	
13	**(c)**	**(ii)**	**Answer:** Normal **Reason:** Syncline has a narrow outcrop/ anticline (to the south) has a wider outcrop	**1**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
13	**(c)**	**(iii)**	**Answer:** Thrust fault **Reason:** presence of mylonite in the fault zone	**1**	
13	**(d)**	**(i)**	**Answer:** Cross polar **Reason:** plagioclase shows striped twinning pattern	**1**	
13	**(d)**	**(ii)**	A: Amphibole B: Quartz	**2**	
13	**(d)**	**(iii)**	Diorite	**1**	
13	**(d)**	**(iv)**	If the thin section is cut along one of the cleavage planes, only one cleavage will be visible	**1**	
13	**(d)**	**(v)**	Give only the letter **B**	**1**	
13	**(d)**	**(vi)**	Garnet	**1**	
13	**(d)**	**(vii)**	Garnet Mica Schist	**1**	Accept garnet schist

Question			Expected Answer(s)	Max Mark	Additional Guidance
13	(e)			5	



Question			Expected Answer(s)	Max Mark	Additional Guidance
13	(f)		**Youngest** F D I A C G B E H **Oldest** Give only the letters	3	

Question			Expected Answer(s)	Max Mark	Additional Guidance
14	**(a)**			**4**	
14	**(b)**		Angle 11° Direction North West $Tan\frac{100metres}{2000metres}=\frac{1}{2000}=0\times005=11°$	**2**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
14	**(c)**		Shaded area	**3**	
14	**(d)**		Shaded area	**1**	
				(40)	

[END OF MARKING INSTRUCTIONS]