



**DEPARTMENT OF
EDUCATION**

**UPPER SECONDARY
SCHOOL CERTIFICATE
EXAMINATIONS**

GEOLOGY

Wednesday

24 October 2012

Time allowed:

2 hours and 30 minutes

(11:00 am – 1:30 pm)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to fully
utilise the allocated time

GL

INSTRUCTIONS TO CANDIDATES

(To be read by the external invigilator to all candidates)

1. The subject code for **Geology** is **8**.
2. There are **10** printed pages in the question booklet.
3. An Electronic Answer Sheet and a **6 printed** page Part B Answer booklet are inserted in the centre of the question booklet.
4. There are two sections in this paper.

Section A : Multiple Choice Questions (Question 1 – 30) 30 marks

This section will be electronically marked.

All answers to the Multiple Choice Section **MUST** be answered on this Answer Sheet.

Carefully following the instructions, fill in your Candidate Information and Subject Information.

If you make a mistake, rub it out completely using an eraser and shade the correct answer on the Electronic Answer Sheet.

Section B: Short Answer Questions (Question 31 – 40) 70 marks

Write your name, your school name and complete your 10 digit candidate number on the Section B Answer Booklet provided.

5. You are required to only write the correct answer in the space Provided.
6. Answers written on the question paper or any other paper will not be marked. Write answers neatly in spaces as allocated on the answer booklet. Answer **ALL** questions.
7. Correction Fluid is not allowed on the answer sheet. Where you have made an error, cross out all the working and start on a new line.

**PENALTY FOR CHEATING OR ASSISTING TO CHEAT IN
NATIONAL EXAMINATIONS IS NON-CERTIFICATION.**

DO NOT TURN OVER THE PAGE

AND DO NOT WRITE

UNTIL YOU ARE TOLD TO START.

SECTION A: MULTIPLE CHOICE

(QUESTIONS 1 to 30 1)

30 MARKS

Answer each question by shading in with HB pencil, the circle directly under the correct alternative A, B, C or D .

If you make a mistake, rub it out completely using an eraser and shade the correct answer on the Electronic Answer Sheet.

QUESTION 1

Which of these is not a sulphide mineral?

- A. Pyrite B. Chalcopyrite C. Magnetite D. Galena

QUESTION 2

Which rock type is produced by metamorphic process?

- A. Slate B. Mudrocks C. Conglomerate D. Lapilli tuff

QUESTION 3

Metallic iron and nickel are highly concentrated in the _____.

- A. mantle B. oceanic crust C. core D. continental crust

QUESTION 4

On average, Earth's crust is _____.

- A. thicker in oceanic plate B. thinner in continental plate
C. thicker in both oceanic and continental plates D. thicker in continental plate

QUESTION 5

What is the chemical formula for *pure* limestone?

- A. $MgCO_3$ B. $FeCO_3$ C. $CaCO_3$ D. CaO

QUESTION 6

The Porgera gold deposit in Enga Province of Papua New Guinea was formed in Late Miocene; the epoch Late Miocene belongs to the _____ era.

- A. Precambrian B. Paleozoic C. Mesozoic D. Cainozoic

QUESTION 7

Which rock type is most likely to contain fossils?

- A. Lava flows B. Mudstone C. Schist D. Gabbro

QUESTION 8

An index fossil whose first appearance and disappearance are known will define the relative age of the host _____.

- A. granodiorite B. metamorphic rock C. siltstone D. gneiss

QUESTION 9

Active hydrothermal mineral deposition is currently occurring at Eastern Manus Basin; such mineralization will be of _____ age.

- A. Miocene B. Eocene C. Paleogene D. Holocene

QUESTION 10

The lithosphere, one of the major earth systems, comprises the _____.

- A. crust, hydrosphere and atmosphere B. continental crust, biosphere and hydrosphere
C. crust and uppermost part of the upper mantle D. subducted oceanic crust and lower mantle

QUESTION 11

The level of water table of a groundwater system is mostly controlled by the _____.

- A. creeks, streams and rivers B. host rocks
C. topography D. plants and organisms in the ground

QUESTION 12

The sources of sediments comprise pre-existing _____.

- i. sedimentary rocks
- ii. igneous rocks
- iii. metamorphic rocks

- A. i only B. ii only C. i and ii D. i ,ii and iii

QUESTION 13

Where tectonic plates are sliding past each other, _____ will form.

- A. a convergent fault B. a transform fault C. a divergent fault D. an unconformity

QUESTION 14

Which of the following provides evidence of continental drift?

- i. subduction
- ii. spreading centre
- iii. rifting

- A. i only B. ii only C. i and ii D. i ,ii and iii

QUESTION 15

An *on-land* evidence of tectonic activity in Papua New Guinea is _____.

- A. New Britain Trench B. Eastern Manus Basin C. Trobriand Trough D. Papuan Fold Belt

QUESTION 16

One of the *direct* effects of plate movements is _____.

- A. re-vegetation B. faulting C. sedimentation D. chemical weathering

QUESTION 17

The material produced by a volcano can be divided into two major groups, which are _____.

- A. igneous and volcanic rock
- B. extrusive and intrusive rocks
- C. plutonic and igneous rocks
- D. lava and pyroclastic rocks

QUESTION 18

Which of the following towns and places in Papua New Guinea are prone to the effects of volcanic activity?

- A. Gazelle Peninsula, Manam Island and Kokopo
- B. Rabaul, Tabubil and Lae
- C. Karkar Island, Alotau and Port Moresby
- D. Kimbe, Madang and Daru

QUESTION 19

The hypocenter can be defined as the _____.

- A. exact location in the Earth where the earthquake movement is focused
- B. exact location of the earth quake on the surface of the Earth
- C. location of the fault
- D. maximum distance that the earthquake waves can travel

QUESTION 20

Which of the following waves generated by an earthquake cannot travel through a liquid medium?

- A. Primary waves
- B. Secondary waves
- C. Sea waves
- D. Surface waves

QUESTION 21

Ramu lateritic deposit in the Madang Province of Papua New Guinea will produce nickel, cobalt and chromium whose chemical formulae are _____ respectively.

- A. Ne, Ce and Cr
- B. Ni, Co and Cm
- C. Ni, Co and Cr
- D. Nc, Cb and Cr

QUESTION 22

Which of the sedimentary rocks is the most common reservoir for oil and gas accumulation?

- A. Sandstone
- B. Organic-rich mudrock
- C. Conglomerate
- D. Sedimentary breccia

QUESTION 23

Which region of the world produces bulk of the world's oil supply?

- A. North Atlantic Sea
- B. Timor Sea
- C. Middle East
- D. South America

QUESTION 24

Which mines in Papua New Guinea produce gold and silver?

- A. Tolukuma and Porgera
- B. Tolukuma and Hidden Valley
- C. Lihir and Ok Tedi
- D. Hidden Valley and Lihir

QUESTION 25

Field exploration for mineral and petroleum occurrence on land can be undertaken by

- i. cutting forested areas
- ii. field geological mapping
- iii. collecting sediments and rock samples

- A. i only B. iii only C. i and iii D. ii and iii

QUESTION 26

Refining of metallic ores can be done by _____.

- A. smelting and electrolysis B. grinding and flotation
C. crushing and grinding D. flotation and carbon-in-pulp

QUESTION 27

Fossil fuels can be refined using _____.

- A. condensation and evaporation B. transpiration and condensation
C. sublimation and condensation D. distillation and fractional distillation

QUESTION 28

Some mines in Papua New Guinea are dumping waste rock and mill tailings directly into the river systems. Two of the operating mines involved in this practice are _____.

- A. Hidden Valley and Misima B. Porgera and Hidden Valley
C. Simberi and Ok Tedi D. Porgera and Lihir

QUESTION 29

People along the northern coast of mainland Papua New Guinea can be prepared for Tsunami by

- A. building houses close to the coastline and establishing disaster committees.
B. making gardens near the coastline and undertaking awareness programs.
C. undertaking tsunami awareness programs, formulate and practise evacuation exercises.
D. not constructing escape routes and discouraging involvement in disaster committees.

QUESTION 30

What are some of the important tasks that the Government of Papua New Guinea and Provincial Government should do to help the people who have been affected by Timbi Landslide in Hela Province?

- A. Delay funding and prolong evacuation activities.
B. Investigate the causes of the landslide and also provide some relief supplies.
C. Provide advice that there is no funds budgeted money for such disasters.
D. Shut down the operations of the PNG LNG Project.

SECTION B: SHORT ANSWERS

(QUESTIONS 31 to 40)

70 MARKS

There are 10 questions in this section. Each question is worth 7 marks. Write the answers to ALL the Questions on the spaces provided in the Section B Answer Booklet.

QUESTION 31

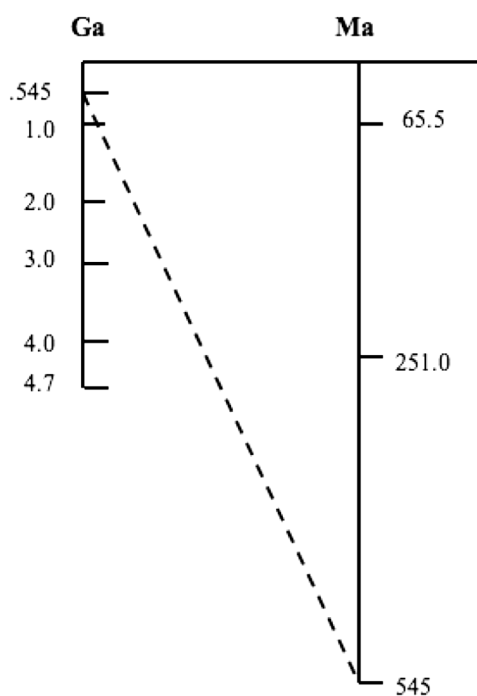
Provided below is a simplified classification table of igneous rocks.

Grain size	Felsic (silicic)	Intermediate	Mafic (basic)	Ultramafic
Coarse grained	Granite	Diorite	Gabbro	Peridotite Pyroxenite
Medium grained	Microgranite	Microdiorite	Dolerite or Diabase	
Fine grained	Rhyolite Dacite	Andesite	Basalt	

- A. Apart from grain size, name one of the major characteristics that is used to classify igneous rocks. [1 mark]
- B. Name one igneous rock that will have a colour index of greater than 40. [1 mark]
- C. Name one igneous rock that will have no igneous quartz. [1 mark]
- D. Name one igneous rock that will have the highest SiO₂ (silica) content. [1 mark]
- E. Which igneous rock is the intrusive equivalent of basalt? [1 mark]
- F. Name the extrusive equivalent of diorite. [1 mark]
- G. Why is basalt fine-grained? [1 mark]

QUESTION 32

Below is an over simplified geological time scale from 4.7 billion of years (Ga) to the present time; Ma means millions of years.



- A. Name the *eon* defined by each age range below. (*The spelling must be correct for full marks.*) [3 marks]
- 545 – 250 Ma
 - 250 – 65 Ma
 - 65 – 0 Ma
- B. Name the *youngest epoch* of the geological time scale. [1 mark]
- C. Name the period that is before Jurassic. [1 mark]
- D. When did dinosaurs disappear? [1 mark]
- E. The period of time older than 542 Ma is called Precambrian, which comprises of two *eons*; name one of the eons. [1 mark]

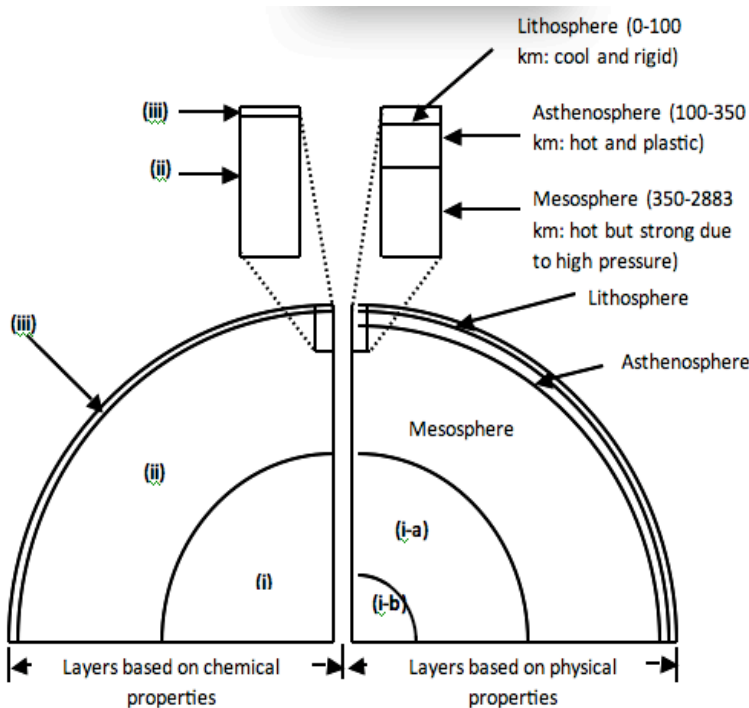
QUESTION 33

After a mining licence is approved, a company can go ahead with construction stages. This is followed by extraction, processing and refining of economic minerals (e.g., chalcopyrite) to obtain economic metal (e.g., copper).

- A. Name two types of mines that are constructed to extract the economic minerals and industrial minerals and rocks. [2 marks]
- B. In a copper-gold mine such as Ok Tedi, chalcopyrite is an ore (ie, economical) mineral occurring in intrusive rocks, skarns and siltstone. After blasting, the rock fragments are sent to crushers for crushing, followed by grinding and then flotation (for collection of chalcopyrite).
Explain why such blasted fragments are crushed and ground before flotation. [2 marks]
- C. Ok Tedi is an open pit mine that dumps waste and mill tailings into a river system. Name two other mines that also dump waste rock and mill tailings into the river. [2 marks]
- D. Name the *final product* that is sold by Ok Tedi Mining Limited to international smelters. [1 mark]

QUESTION 34

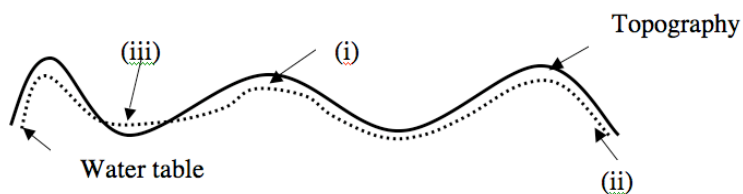
The sketch below shows the internal structure of the Earth whose layers are subdivided based on the chemical and physical properties.



- A. Name the zones labeled (i), (i-a), (i-b), (ii) and (iii). [5 marks]
- B. State the main physical difference between (i-a) and (i-b). [1 mark]
- C. What makes up the lithosphere? [1 mark]

QUESTION 35

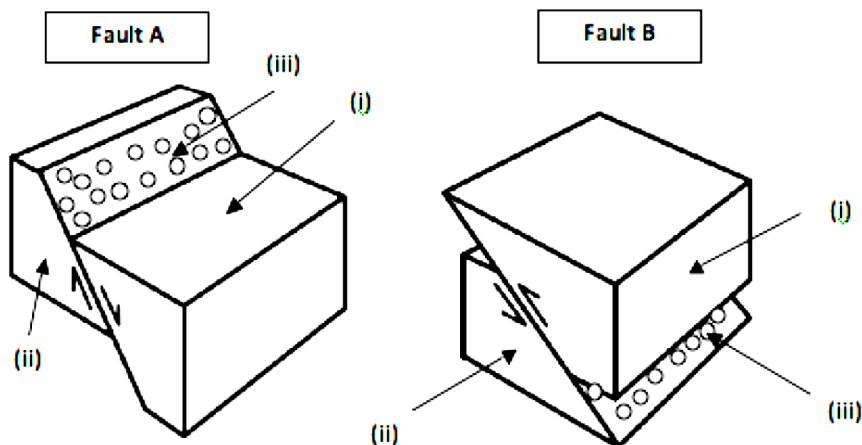
A simplified profile of the groundwater system is provided below.



- A. Names the zones labelled (i) and (ii). [2 marks]
- B. What will happen when the water table intersects the ground surface as shown at (iii)? [1 mark]
- C. What name is used to describe a layer of rock that allows migration of ground water? [2 marks]
- D. If fresh water at a coastal village in a tropical country (e.g; Papua New Guinea) is excessively pumped out via a well, what will happen to the remaining fresh water? [1 mark]
- E. What is the relationship between the water table and topography? [1 mark]

QUESTION 36

Provided below are two schematic diagrams of two main fault types labelled as A and B; the arrows show the principle direction of movement.



- A. Provide the correct name for Fault A. [1 mark]
- B. Provide the correct name for Fault A whose dip angle is greater than 45°. [1 mark]
- C. Provide the correct name for the fault component labelled (i). [1 mark]
- D. Provide the correct name for the fault component labelled (ii). [1 mark]
- E. Provide the correct name for the fault component labelled (iii). [2 marks]
- F. If Fault B has a dip angle that is less than 45°, provide the suitable name for this fault type. [1 mark]

QUESTION 37

Two kinds of volcanic eruption will produce two kinds of products - either lavas or pyroclastic (fragmented) rocks; a pyroclastic deposit can also be termed tephra deposit. The table below shows a simplified classification of the pyroclastic deposits based on grain size.

Grain size (mm)	Pyroclastic deposits	
	Unconsolidated tephra	Consolidated pyroclastic deposit
>64	Block tephra Bomb tephra	Pyroclastic rock (i)
2 - 64	(ii)	Lapilli tuff or lapilli stone
1/16 - 2	Coarse ash	(iii)
<1/16	(iv)	Fine tuff

- A. What type of volcanic eruption produces lava? [1 mark]
- B. What type of volcanic eruption produces pyroclastic rocks? [1 mark]
- C. Name the unconsolidated and consolidated deposits labelled (i), (ii), (iii) and (iv). [4 marks]
- D. Some igneous rocks, especially lava flows, possess a “porphyritic texture”. Briefly define or explain the phrase “porphyritic texture”. [1 mark]

QUESTION 38

Exploration for mineral and petroleum occurrence in Papua New Guinea or elsewhere involves several staged activities. Such sequential activities may comprise literature review to determine the prospect of the area concerned, application for an exploration licence or petroleum prospecting licence, meeting with incorporated landowner groups, approval of the application by relevant Government authorities and actual commencement of exploration.

- A. Why is it critical to involve and/or have meeting with landowners before final approval is given to the company for exploration? [2 marks]
- B. Field geological investigations are a critical component of these exploration activities. Name *two* sample types that may be collected when traversing a stream, creek or river. [2 marks]
- C. In surface observations, assay results of collected samples and geophysical anomalies are interpreted to indicate significant (e.g., copper and gold) mineralization at depth. Which exploration technique (excluding trenching and sampling) would then be taken? [1 mark]
- D. Geophysical exploration methods aid mineral exploration. One of the methods utilized is to determine the total amount or intensity/signature of magnetic minerals in a rock. Provide the correct name of this geophysical exploration survey. [1 mark]
- E. Name a *national government bodies* in Papua New Guinea that is involved in approving mining licences. [1 mark]

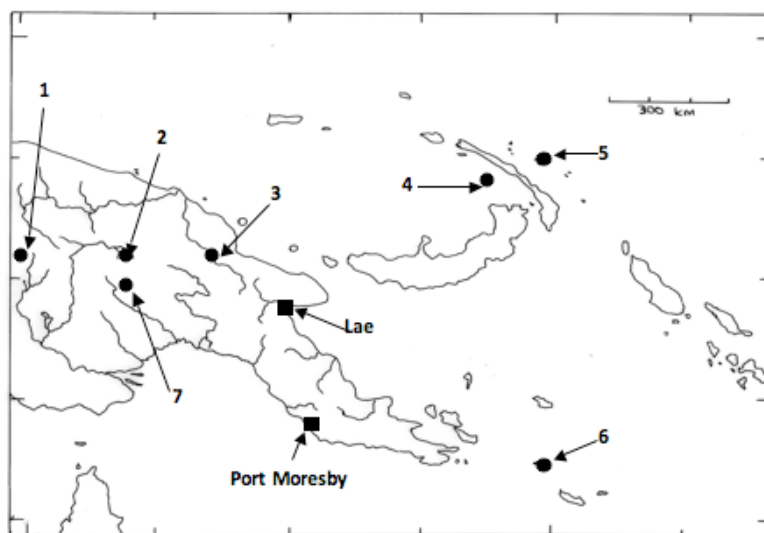
QUESTION 39

Mining will directly and indirectly affect an environment where people, animals and plants live and how they interact.

- A. It is a requirement that mining companies must submit an *environment document* to the Department of Environment and Conservation as a component of the submission to develop a mine.
What is the full name of this *environment document*. [1 mark]
- B. Name *two* main activities of Ok Tedi that will pollute the streams, creeks and/or rivers draining the mine site. [2 marks]
- C. Ok Tedi currently dumps sulphide-rich waste material into the Ok Tedi River, which subsequently joins the Fly River. If excessive sulphuric acid is produced in the presence of atmospheric oxygen and water in a small pool located at the banks of the Ok Tedi River system, what will happen to its *pH*? [1 mark]
- D. Ok Tedi is currently dumping mill tailings into the Ok Tedi River. Some *current* mines in PNG are dumping these tailings into the sea. Name *two* of these mines. [2 marks]
- E. What will happen to an operating mine when the ore (i.e., economical) minerals are completely mined out? [1 mark]

QUESTION 40

Below is a map of PNG showing the approximate locations of major mineral and petroleum occurrences labelled 1 to 7.



- A. Gold is currently produced at mines labelled 1, 2 and 5. Copper is also produced at mine 1.
Name mines 1 and 5. [2 marks]
- B. Name mine 3 and one of the economic metals that will be produced. [2 marks]
- C. Location 4 will become the first mine of its kind in the world. What kind of mine will it be? [1 mark]
- D. Mine 6 used to produce gold and silver and is currently being rehabilitated by the mining company in consultation with the Government of Papua New Guinea. Name this mine. [1 mark]
- E. The location labelled 7 is where oil was first commercially produced in Papua New Guinea. Provide the correct overall name of the oilfield. [1 mark]

END OF EXAMINATION

GEOLOGY — 2012

SECTION B - ANSWER BOOKLET

Write your name, province and school codes and your candidate number correctly and clearly in the space provided below.

Year		Province		School			Candidate No		
1	2								

Candidate Name: _____

School Name: _____

ANSWERS WRITTEN ON THE QUESTION PAPER OR ANY OTHER PAPER WILL NOT BE MARKED.

WRITE ANSWERS NEATLY IN THE SPACES PROVIDED IN THIS ANSWER BOOKLET

FOR MARKERS USE ONLY

	Score	Markers' Initials	
		Marker 1	Marker 2
SECTION B			
QUESTION 31			
QUESTION 32			
QUESTION 33			
QUESTION 34			
QUESTION 35			
QUESTION 36			
QUESTION 37			
QUESTION 38			
QUESTION 39			
QUESTION 40			
FINAL TOTAL	70		

START YOUR WORK ON THE NEXT PAGE

SECTION B - ANSWERS

Write your answer in the space provided below. Your answers must be clear and precise.

QUESTION 31

A. _____	1
B. _____	1
C. _____	1
D. _____	1
E. _____	1
F. _____	1
G. _____	1
For Markers Use Only	Q 31 Total

QUESTION 32

A. (i) _____	1
(ii) _____	1
(iii) _____	1
B. _____	1
C. _____	1
D. _____	1
E. _____	1
For Markers Use Only	Q 32 Total

QUESTION 33

A. (i) _____ (ii) _____	1 1
B. _____ _____ _____	2
C. (i) _____ (ii) _____	1 1
D. _____	1
For Markers Use Only	Q 33 Total

QUESTION 34

A. (i) _____ (i-a) _____ (i-b) _____ (ii) _____ (iii) _____	5
B. _____ _____ _____	1
C. _____ _____	1
For Markers Use Only	Q 34 Total

QUESTION 35

A. (i) _____	1
(ii) _____	1
B. _____ _____	1
C. _____	2
D. _____ _____	1
E. _____ _____	1
For Markers Use Only	Q 35 Total

QUESTION 36

A. _____	1
B. _____	1
C. _____	1
D. _____	1
E. _____	2
F. _____	1
For Markers Use Only	Q 36 Total

QUESTION 37

A. _____	1
B. _____	1
C. (i) _____ (ii) _____ (iii) _____ (iv) _____	4
D. _____ _____ _____	1
For Markers Use Only	Q 37 Total

QUESTION 38

A. _____ _____	2
B. (ii) _____ (iii) _____	1 1
C. _____	1
D. _____	1
E. _____	1
For Markers Use Only	Q 38 Total

QUESTION 39

A. _____	1
B. (i) _____	1
(ii) _____	1
C. _____	1
D. (i) _____	1
(ii) _____	1
E. _____	1
For Markers Use Only	Q 39 Total

QUESTION 40

A. Mine 1. _____	2
Mine 5. _____	
B. _____	2
C. _____	1
D. _____	1
E. _____	1
For Markers Use Only	Q 40 Total