Suggested Answers:
Extension Questions

E1. (a) *Weathering*

(b) Grains get *smaller* and more *rounded*

(c) Reasonable description of *compaction* and *cementation* processes

(d) Changes to *minerals* (re-crystallisation + chemical reaction to form new minerals), and *textures* (tendency for minerals to align forming foliation).
Also tendency for rocks to become harder/less porous as a result.
Not Heat & Pressure – these are agents of change, not the changes themselves.

(e) Description of mountain building (caused by plate collision) causing either *folding* or *faulting* (e.g. reverse fault) in context of crustal compression /thickening. Bonus marks for mentioning removal of overlying rocks by weathering/erosion!

E2. (a) (i) Crater

(ii) Made up of layers of both ash and lava flows

(iii) Magma is molten rock *below* ground; lava is molten rock flowing *on the surface.* Magma contains dissolved gases that escape when it reaches the surface whilst most of the gas has already escaped from lava.

(iv) "Ash" means fragments of rock and/or pumice blown out of the volcano by explosions.

(v) Y is a *dyke*.

(b) Viscous means thick and sticky – as opposed to runny.
Discussion point: Even "runny" magmas are like golden syrup or honey – the really viscous ones will barely dent if hit with a sledge-hammer!

(c) (i) Gases are released due to loss of pressure as the magma approaches the surface, causing it to froth up and explode as eruption takes place. Rock and pumice fragments are then thrown high into the atmosphere.

(ii) A mixture of hot gas and "ash" that forms a dense fluid able to flow downhill at high speeds (speeds >100 mph not unknown!).

(d) (*Aims to provoke discussion more than to test knowledge)*

(i) There are many signs - none entirely reliable for prediction: credit **one**:
- minor earthquakes (associated with rising magma),
- increased output of gases from the crater (or other gas vents),
- swelling or bulging of volcano (St. Helens, 1980)
- increased heat output measured from satellites

(ii) Credit any **two** of the following:
- respiratory damage or death (ash is *very* damaging to lungs),
- roof collapse due to ash accumulation,
- damage to crops, loss of livestock,
- pollution of water supplies,
- damage to jet engines if aircraft stray near ash column
- *lahars* – mudflows formed from a mixture of volcanic ash and flood-water. (These claim more lives than any other volcanic hazard.)

E3 (a)

	Type of igneous body	Reason
Igneous body **A**	**SILL**	Intrudes between rock layers
Igneous body **B**	Dyke	**Cuts across the layers**

(b) Lava flow cools quicker on contact with air – crystals smaller.
(c) It is more resistant to weathering and/or erosion than the surrounding shale.
(d) Igneous body A (sill) is oldest – it is cut by the dyke (B) which is itself cut (overlain) by lava flow (C).
A *discussion point* here (a more extensive geological history) - is that the dyke (B) has intruded along a *fault* which displaces the sill (A); faulting must have happened *after* sill A, but *before* dyke B was intruded.
Later still, erosion must have planed off the land surface (and dyke B) *before* lava C was erupted….
(e) It has been heated and *metamorphosed* (contact metamorphism) by the sill.

E4. (a) (i) Bedding planes
(ii) Joints
(b) Add a drop of dilute HCl – limestone reacts/fizzes
(c)

Statement	Weathering OR Erosion
The breakdown of rock without it being moved	**Weathering**
Wearing away of rock during transport of rock particles	**Erosion**
The effect of wind and moving ice or running water	**Erosion**
The effect of plants growing in rock joints and fractures	**Weathering**

(d) Freeze-thaw (frost-shattering). Water seeps into joints and expands when it freezes, forcing the rocks apart. Process repeated over time breaks rock away from cliff to form scree.
(e) (i) Size – smaller,
(ii) Shape – more rounded,
(iii) Sorting – better sorted; smaller range of grain size.

E.5 (a)

Weathering type 1. physical 2. chemical	Agent of transport 1. gravity 2. river 3. wind	Deposit produced 1. lake sediment 2. rounded pebbles & sand 3. sand dune grains 4. angular boulders
Physical	Gravity	**Angular boulders**
Physical	**Water (river)**	Rounded pebbles & sand
Chemical	Water (river)	**Clay mud** (+ mudcracks)
Physical	**Wind**	Sloping sand layers

(b) (i) **4, 2, 3**. in boxes from left to right
(ii) Become smaller and more rounded (due to attrition).

E.6 (a) (i) Coarse
(ii) Finer grained. Smaller igneous body so more rapid cooling.
(b) (i) Fossils fragments.
(ii) Contain *carbonate* (hence fizzing => CO_2) –in this case $CaCO_3$
(c) (i) No fossil fragments in rock D (present in C)
Interlocking crystals in D (not present in C)
(ii) C = limestone, D = marble
(iii) Heat from igneous body A
- recrystallised the limestone (without melting it)
- destroyed the fossil fragments.

E.7 (a) Fossil of sea-creature
(b) (i) Bedding surfaces or sediment layers.
(ii) Pressure distorts fossils; recrystallisation of the rock may destroy them.
(c) Ability to split (*fissility*, or *slaty cleavage*) results from:
- squashing of the Earth's crust (tectonic stress) compressing the rock, *and/or*
- recrystallisation of clay/mud to form new minerals (micas) that lie flat.
(at 90^o to maximum stress direction)
(d) (i) **Any 2**: Roofing, flooring, gravestones, garden decoration, snooker (or pool or billiard) tables
(ii) **Any 2**: Impermeable, easily split, plentiful, strong, durable, attractive, flat