EARTH PHYSICS, STRUCTURAL GEOLOGY AND PLATE TECTONICS

QUICK QUIZ ANSWERS

QUICK QUIZ 1

1. Stress — The amount of force applied to a unit area of rock is the strict definition of stress. Geologists often use the word in a looser context referring to the forces being exerted on a particular piece of rock.

   Strain — A similar meaning to deformation. It is the result of stress in a rock which leads to the change of shape or volume or both.

   Elastic strain — The type of strain where the original shape and volume of a rock is re-established when the stress is removed.

   Plastic strain — The type of strain where the new shape or volume of a rock is retained when the stress is removed.

   Brittle behaviour — The rock is easily broken. Rupture / fracture occurs at low levels of stress before little elastic or plastic strain has occurred.

   Ductile behaviour — The rock does not break easily and will continue to change shape even at high levels of stress. Rupture / fracture does not occur until extremely high levels of stress.

   Elastic limit — The stress above which a rock ceases to behave elastically and behaves plastically instead.

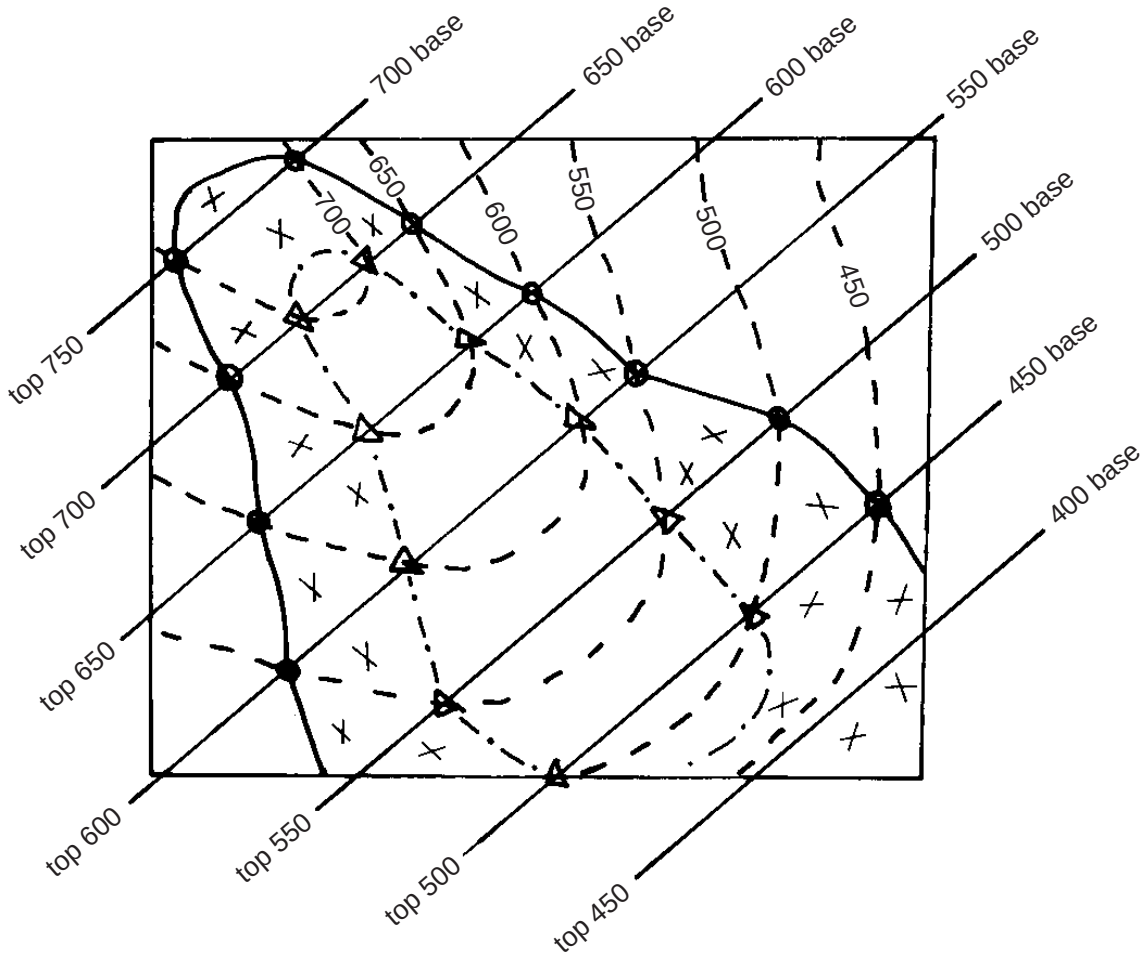
   Creep — Creep introduces the extra dimension of time into deformation. Long periods of low stress can cause plastic strain at levels below the elastic limit. This is creep taking place.

2. (i) Strike is the compass bearing of a horizontal line on a planar structure. The horizontal is found using a clinometer or spirit level and then a compass is used to find the bearing of this horizontal line.

   (ii) The true dip is the angle between the plane and the horizontal measured at right angles to the strike. A clinometer is used to measure this angle.

   (iii) Apparent dip is the angle between the horizontal and the planar feature not measured at 90^{o} to the strike. This is what you normally see in a quarry or road cutting. It is always less than the true dip.

3.

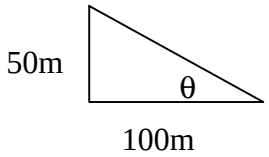


(i) 3 marks for parallel (1 mark), evenly spaced: 2 cm, (1 mark) and accurately drawn (1 mark).

(ii) 2 marks for the correct intersect points of structure contour and topographic contours marked and the outcrop put in. 1 mark for interpreting reasonably the outcrop beyond the last intersect points.

(iii) 2 marks for correct outcrop with intersect points. 1 mark for shading the correct area.

(iv)



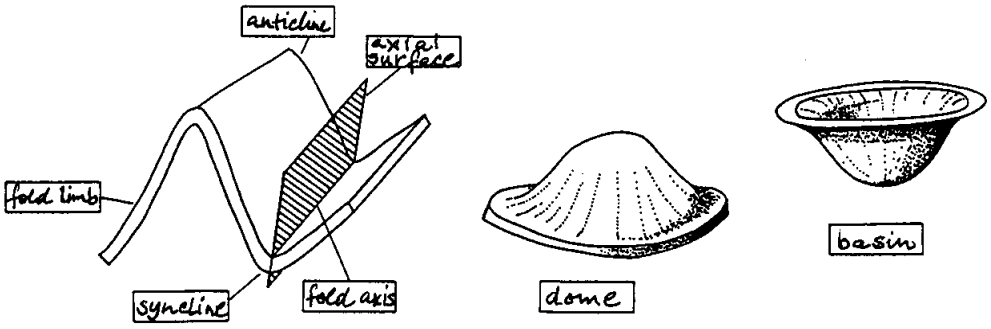
$\tan \theta = \frac{50}{100}$ (1 mark)

$\theta = \tan^{-1} 0.5 = 26.6^{o}$ (1 mark)

Total marks /25

QUICK QUIZ 2

1. (a)



2. (a) Symmetrical.

   (b) (i) 50°
   (ii) Closed

3. (i) Plug

   (ii) (a) Sill
   (b) Dyke

   (iii) Batholith

   (iv) Lava flow

4. (i) Normal

   (ii) Thrust

   (iii) Reverse

   (iv) Tear

5.

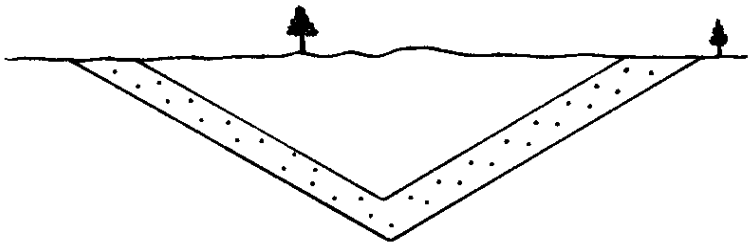
Anticline	m	Dyke	a	Normal fault	n
Syncline	b	Sill	l	Reverse fault	h
Dome	k	Batholith	d	Thrust fault	g
Basin	i	Plug	j	Tear fault	f
Unconformity	e	Lava flow	c		

6.

Anticline	a or i	Dyke	b or d	Normal fault	e
Syncline	c or l	Sill	k	Reverse fault	n
Dome	a or i	Batholith	m	Thrust fault	f
Basin	c or l	Plug	b or d	Tear fault	g
Unconformity	j	Lava flow	h		

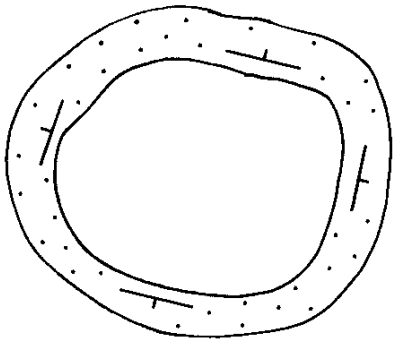
QUICK QUIZ 3

1. (a)



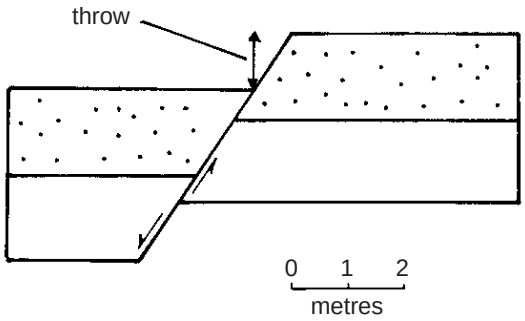
½ mark for syncline, ½ mark for open, ½ mark for symmetrical

1. (b)



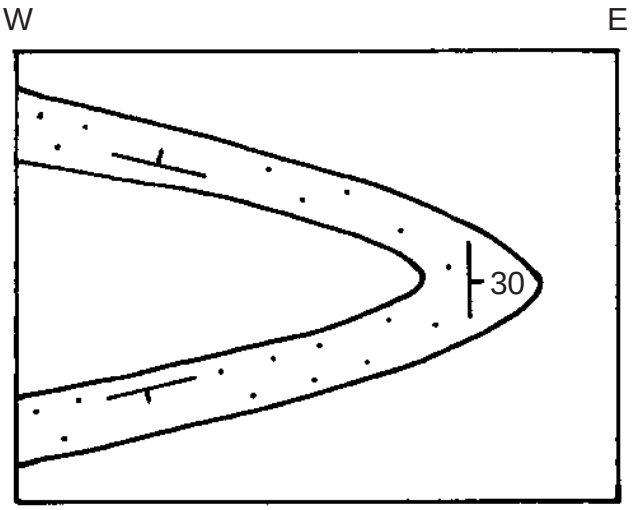
½ mark for outcrop pattern, ½ mark for dip and strike symbols.

1. (c)



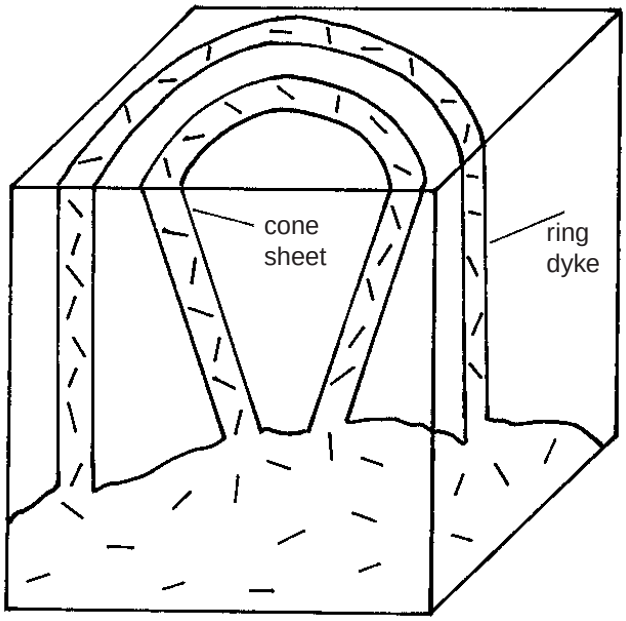
½ mark for a normal fault, ½ mark for footwall to east, ½ mark for 1m of throw.

1. (d)



½ mark for outcrop pattern with close to east, ½ mark for dip symbol at the fold closure, ½ mark for other dip and strike symbols.

1. (e)



Ring dyke, ½ mark for section, ½ mark for map.
Cone sheet, ½ mark for section, ½ mark for map.

2. (a) Linear grooves and ridges on the surface of rocks forming the walls of a fault plane. (1)

(b) A layer of brecciated rock along a fault plane caused by the break up of the rock which forms the walls. (1)

(c) A fold with a horizontal axial surface which is often carried above a thrust fault. (1)

(d) A similar fold is where the thickness of a bed when measured at right angles to the bedding varies but remains constant when measured parallel to the axial surface. (1)

A parallel fold is where the thickness of a bed when measured at right angles to the bedding remains unchanged whilst it varies when measured parallel to the axial surface. (1)

3. (a) Columnar joints are formed in sills or lava flows by contraction of a cooling igneous rock. (1)

(b) A lineation is formed by intersecting planar structures or by rod shaped structures formed during deformation. (1)

(c) Shear joints are formed by slight shear movements on joints that are oblique to the maximum and minimum stress directions. (1)

(d) A large number of fine fractures are formed close together along which movement takes place. (1)

(e) A period of erosion follows a long period of time in which a variety of processes may have taken place, such as folding, faulting, igneous activity. The new set of rocks deposited on this eroded landscape are not conformable with those underneath. (1)

4. (a) North – south (1)

(b) (i) Upthrown to the south east (½)

(ii) Reverse (1)

(c) Northwest – southeast (1)

(d) The sandstone on the SW limb has a wider outcrop. If the topography is similar at the two limbs then only the dip can alter the width of the outcrop. (1)

(e) Northwest – southeast. (1)

(f) Maximum, northwest – southeast. (½)

Minimum (tension possibly), northeast-southwest. (½)

(g) An original rock was metamorphosed into a schist (1)

Dolerite dykes were intruded (1)

The mudstone and sandstone were deposited and folded into a syncline. (1)

The thrust fault and reverse fault were formed probably more or less at the same time as they were formed by the same orientation of forces. (1)

A period of erosion was followed by the deposition of conglomerate and limestone.
The limestone was placed under stress that formed the joint pattern. (1)

5. (i) Structure contours (overleaf) (4)

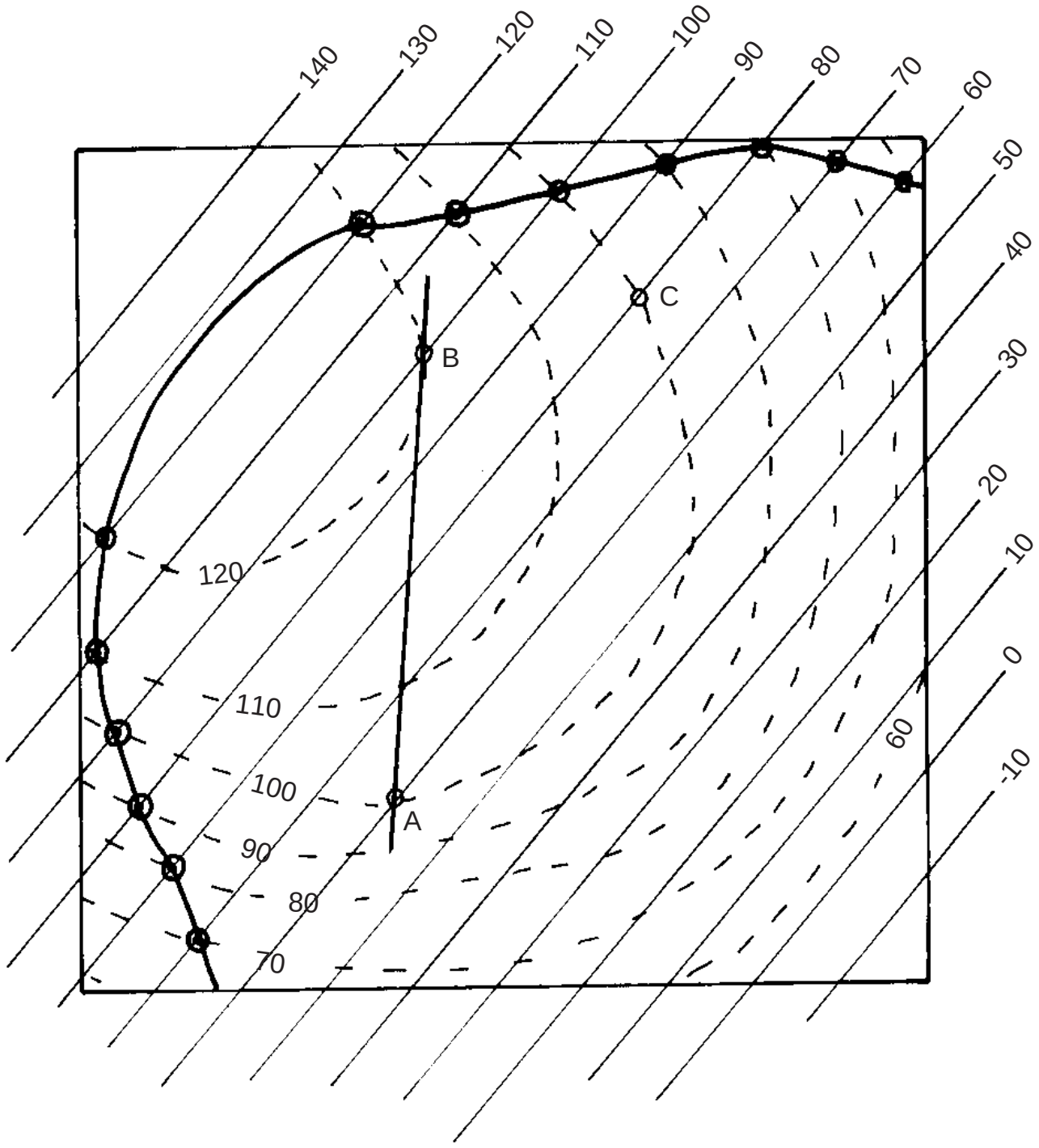
(ii) Outcrop pattern (2)

(iii) $\tan \theta = \frac{20}{10}$

$\theta = \tan^{-1} 2 = 63^{o}$ (2)

(iv) Reverse (1)

(v) Maximum compression northwest – southeast. (2)


140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
120
110
100
90
80
70
60
A
B
C

QUICK QUIZ 4

1. Fold mountain belts
   Shield areas
   Maximum extent of glaciation 250 Ma. Any two (2)

2. Fit of 1000m. submarine contour
   Continuous fold mountain belts and shield areas across the join
   Erratic blocks, glacial striae and maximum extent of a 250 Ma glaciation
   Freshwater *Mesosaurus* found on both continents
   Similar rock types of the same age. Any three (3)

3. The Caledonian Mountain belt is continuous across the join
   Similar fossils
   Good fit on continental margins. Any one (1)

4. b, e, and g. (3)

5. Changes its shape
   Changes its strength
   Changes its position. (3)

6. Electric currents flowing in the Earth's core. (1)

7. Those igneous rocks with a high iron content such as basalt, dolerite or gabbro. (1)

8. The high iron content allows magnetism to be retained (1)

9. It is the continents that move large distances rather than the poles. (1)

10. The two continents joined between 100 Ma and 40 Ma and then separated again. (1)

11. b, d, and e (3)

12. The rocks of the oceanic crust are mostly basalt. (1)

    As the basalt cooled down when it was formed at the ridge it was magnetised by the Earth's magnetic field. (1)

13. d (1)

QUICK QUIZ 5

1. (a) The magnitude which is measured on the Richter Scale is a measure of how much energy is released during an earthquake. (2)

   (b) $30 \times 30 \times 30 \times 30 = 810000$ times more energy. (1)

   (c) The intensity which is measured on the Mercalli Scale is a measure of how much shaking occurs at the Earth's surface immediately following an earthquake. (2)

2. As P- and S-waves penetrate deeper into the mantle they speed up and undergo a series of small refractions which produces a curved path. (2)

3. P-waves travel faster than S-waves. (1)

   The lag time between the arrival of the P- and S-waves increases at a regular rate away from the epicentre. A certain lag time therefore corresponds to a certain distance from the epicentre. (1)

4. (a) The rocks on either side of a major discontinuity have very different physical properties. (1)

   It is these physical properties which alter the speed and hence the direction of P- and S-waves. (½)

   (b) (i) S-wave slows down and bends towards the normal.
   (ii) S-wave speeds up and bends away from the normal.
   (iii) A change of speed may have occurred but no change of direction as the wave has met the boundary at 90^o.
   (iv) The wave stops at the boundary. The second layer could be a liquid. (1 each / 4)

5. This layer is partly molten which slows up both P- and S -waves. (1)

6. (a) Oceanic crust is made up of mostly basalt, dolerite and gabbro with a thin skin of sediment. (2)

   Continental crust is varied and complex containing all known sedimentary, igneous and metamorphic rocks. (2)

   (b) The mantle is made up of peridotite. (1)

   (c) The outer core is a mixture of iron and sulphur in liquid form. (1.5)

   (d) The inner core is an iron nickel mixture in the solid state. (1.5)

7. (i) The continental crust
   (ii) The low speed layer.
   (iii) The inner core
   (iv) The outer core.
   (v) The continental crust
   (vi) The oceanic crust
   (vii) The mantle. (½ each/ 3½)

8. (i) Stony meteorites came from the mantle / crust of broken up bodies from space. (1)

   (ii) Iron meteorites come from the core of broken up bodies from space. (1)

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QUICK QUIZ 6

1. It is a unifying theory that provides an explanation for the time and geographical location at which a number of geological processes take place. (1)

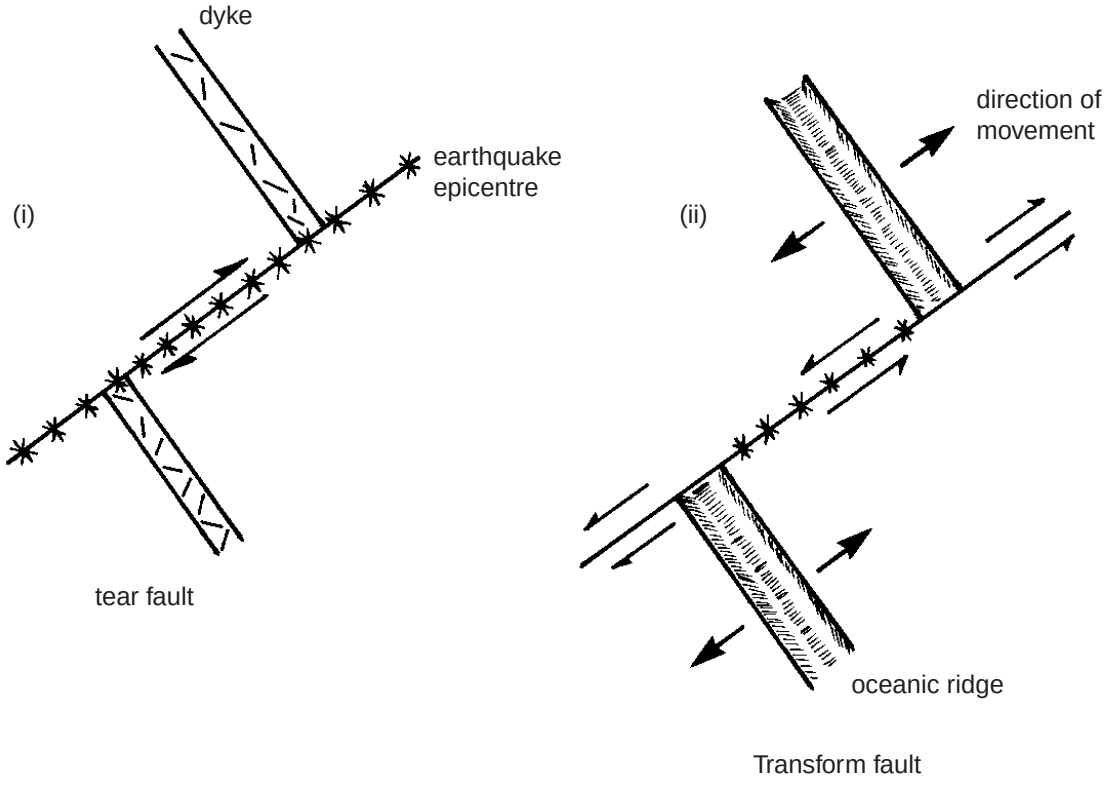
2. A constructive plate margin
   A conservative plate margin
   A destructive plate margin (½ each / 1 ½)

3. (i) A constructive plate margin (½)

   (ii) Basic magma from the mantle rises and intrudes as dykes and extrudes as pillow lavas to construct new plate material. (½)

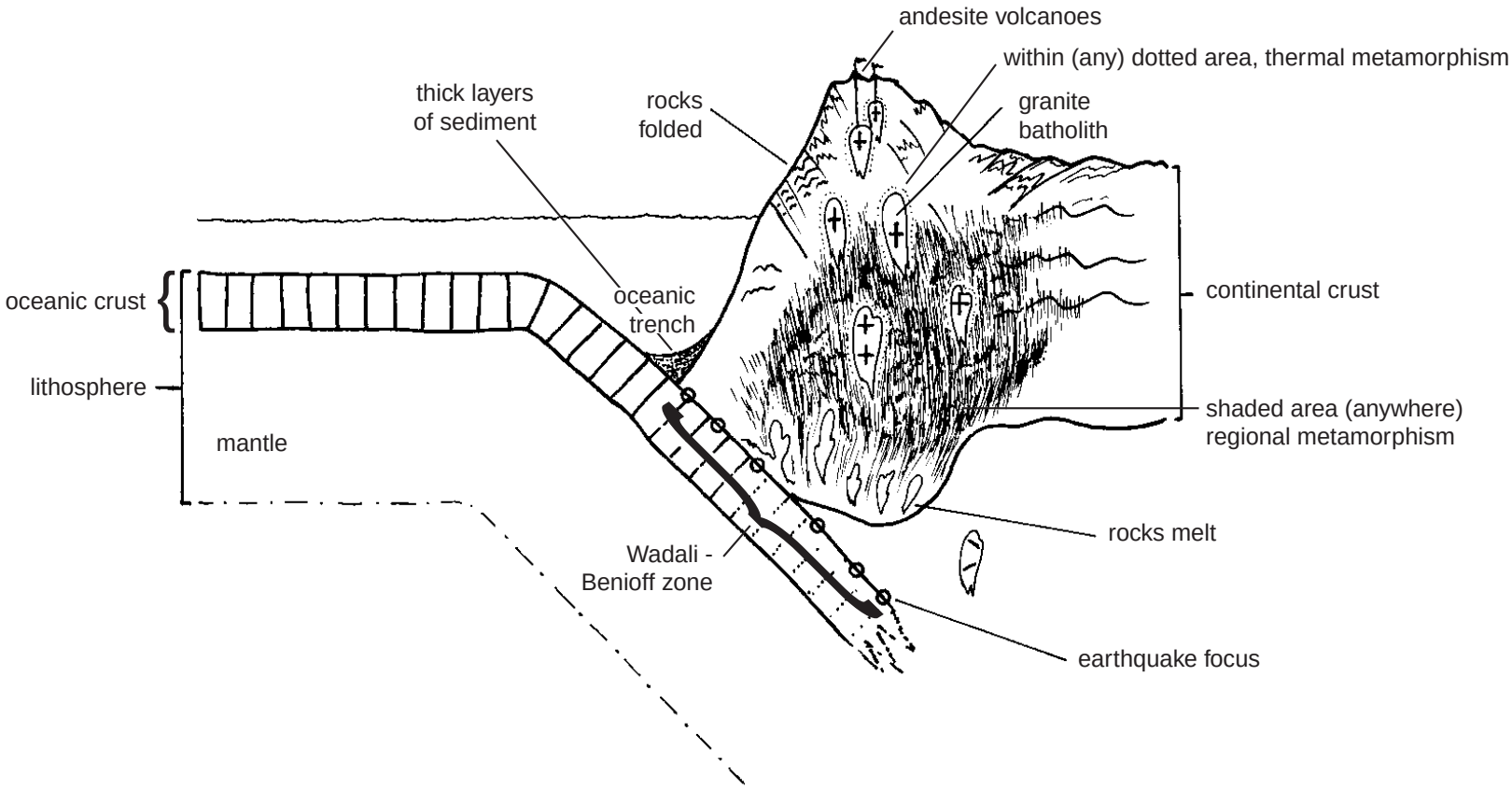
   This occurs as the two separate plates move apart at an ocean ridge. (½)

4. A transform fault crosses an ocean ridge, so movement occurs on both the fault and at the ridge.



(2)

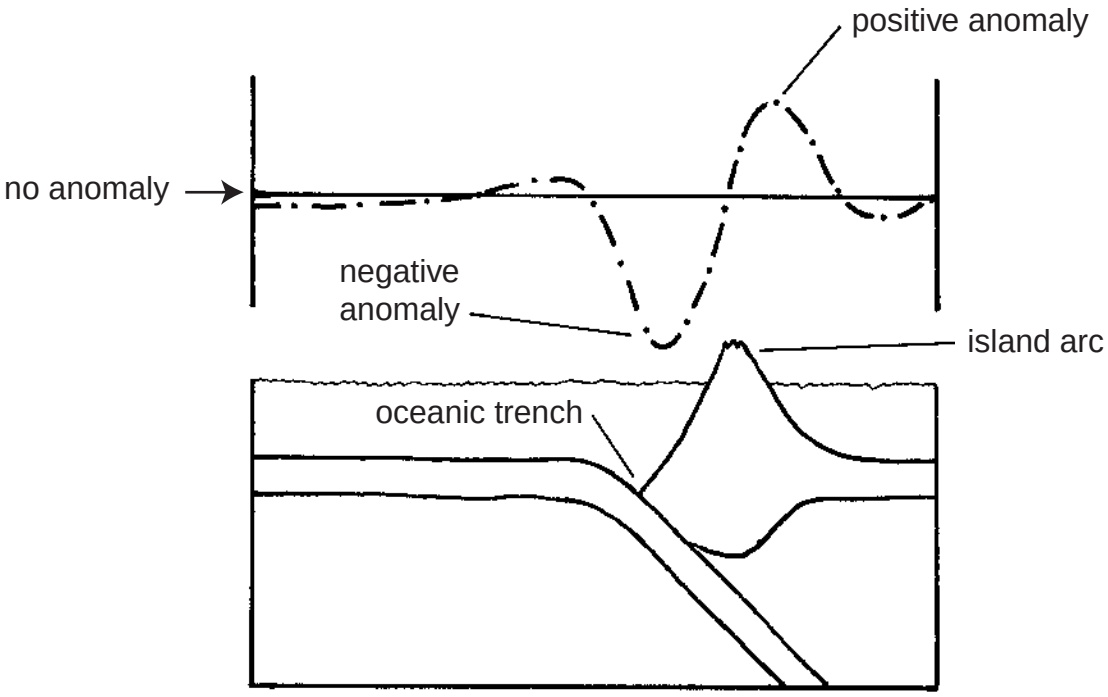
5.


andesite volcanoes
within (any) dotted area, thermal metamorphism
thick layers
of sediment
rocks
folded
granite
batholith
oceanic crust
oceanic
trench
continental crust
lithosphere
shaded area (anywhere)
regional metamorphism
mantle
rocks melt
Wadali -
Benioff zone
earthquake focus

(4)

6. (i) Positive
   (ii) None
   (iii) The fact that it is magnetic is not relevant except to indicate that it is probably magnetite and as that has a high density it will probably produce a positive anomaly.
   (iv) Negative.
   (v) Negative if any. (5)

7.



(2)

8. During an ice age water is locked up as ice and hence the sea level drops. The weight of ice also causes an isostatic imbalance and hence a depression in the level of the crust occurs to regain isostatic equilibrium.

   At the end of the ice age the ice melts and the sea level rapidly rises and produces beach levels. The removal of the ice creates isostatic imbalance and hence the continent rises to regain isostatic equilibrium.

   When isostatic equilibrium is regained the beach level has been lifted clear of the sea. (3)

9. (i) Remanent from the Earth's formation
(ii) Radioisotope decay. (2)

10. (i) As pressure increases the melting point also increases. (1)

(ii) The temperature within the Earth increases with depth as does the pressure. In the low speed layer the temperature is above the melting point and hence the peridotite starts to melt. At greater depth the increase in pressure raises the melting point above the actual temperature and at shallower depths the temperature drops faster than the melting point and hence the rock is also below its melting point. (2)

(iii) In the outer core the temperature is higher than the melting point and thus the core is liquid.
With increased depth the pressure increases the melting point above actual temperature and hence it is a solid. (2)

(iv) The presence of water lowers the melting point. (1)

Total marks / 28