View Attempt 2 of unlimited

Title:	**Quiz2**
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Completed

1.

Igneous rocks form by:

	Student Response	Value	Correct Answer	Feedback
A.	lithification (rock formation) of sediments.			
B.	hydrothermal circulation at mid-ocean ridges.			
C.	chemical or biochemical precipitation of minerals.			
D.	crystallization of molten rock.	100%	☑	yes, igneous
E.	solid state changes due to increased temperatures and/or pressures.			

General Feedback: igneous rocks form by solidification of molten rock.

Score: 1/1

2.

The main factor determining the bulk composition of the planets and their satellites is _____.

	Student Response	Value	Correct Answer	Feedback
A.	distance from the Sun, because the temperature in the solar nebula decreased with distance from the Sun	100%	✓	
B.	rotation rate of the planet, because planets with higher rotation speed attract more material			
C.	the presence of a magnetic field, because magnetic fields attract iron			
D.	distance from the Sun, because the temperature in the solar nebula increased with distance from the			

	Student Response	Value	Correct Answer	Feedback
	Sun			
E.	size of the planet, because larger planets attract more iron			

Score: 1/1

3.

The Perseid meteor shower is a yearly event. The photo (APOD; Fred Bruenjes) is a time exposur the Perseids. The Perseid meteor shower occurs when:

	Student Response	Value	Correct Answer	Feedback
A.	Perseus wants to remind us			

	Student Response	Value	Correct Answer	Feedback
	of his heroic deeds.			
B.	the Earth passes through the debris trail left by Comet Swift-Tuttle.	100%	☑	Yup. The comet last zipped by in 1992 and is d back August 14, 2126 (if calculations are corre It is one of the comets (that we know about) th can come pretty darn close to the Earth. How c will it really be next time...?
C.	the Perseid asteroids (part of the Apollo asteroid group) pass by the Earth and some enter the Earth's atmosphere.			

Score: 1/1

4.

Which of the following characteristics of the Moon are an expected result of the giant impact form hypothesis?

There may be multiple correct answers; wrong answers are penalized.

	Student Response	Value	Correct Answer	Feedback
A.	The crust and the lithosphere (crust and uppermost mantle) of the Moon is much thicker than that of the Earth		☑	
B.	The Moon's mantle is, proportionately, a very thin layer compared to its the metallic core.			

	Student Response	Value	Correct Answer	Feedback
C.	The average composition of the Moon has a much lower proportion of iron and nickel than does the Earth.	40%	✓	Yes. The Moon has an extremely small meta core.
D.	The Moon and Earth have very similar compositions (proportionately), which is consistent with the the impact hypothesis.			
E.	The interior of the Moon contains almost no volatile compounds (such as water and carbon dioxide).	40%	✓	Yes. From our current measurements, the c of the Moon is very dry. There is some wate on the surface, hidden in shadowed craters that is likely a remanent of comet impacts.

Score: 1.6/2

5.

Which of the following points describing the Earth's magnetic field are true?

[There could be more than one answer - wrong answers penalized]

	Student Response	Value	Correct Answer	Feedback
1.	approximately 90% of the Earth's field has the shape of a dipole field.	25%	✓	This is true. The field is more complex than a simple dipole field, but in general, the dipole describes it pretty well.
2.	The magnetic north pole is the location on the Earth's	25%	✓	Yup, that's true too.

	Student Response	Value	Correct Answer	Feedback
	surface where the inclination (or dip) of the magnetic field is vertical.			
	3. dipole axis is currently tilted approximately 10 degrees from the rotational axis.		✓	
	4. The field intensity is constant over time (except during a reversal).			
	5. Averaged over a long period of time, the Earth's magnetic field looks like a dipole aligned with the Earth's rotation axis	25%	✓	

Score: 1.5/2

6.

The inclination (or dip) of the Earth's magnetic field to the Earth's surface varies.
Which of the following is true?

The present inclination of the Earth's magnetic field is approximately: *[It may help to visualize th problem by sketching the dipole shape of the field around the Earth]*

	Student Response	Value	Correct Answer	Feedback
	A. horizontal (or			

	Student Response	Value	Correct Answer	Feedback
	parallel to the Earth's surface) at the magnetic poles			
B.	vertical (or perpendicular to the Earth's surface) at the magnetic poles	100%	✓	
C.	horizontal (or parallel to the Earth's surface) at the geographical (i.e., rotational) poles			
D.	vertical (or perpendicular to the Earth's surface) at the geographical (i.e., rotational) poles			
E.	equal to the declination			

Score: 1/1

7.

The Earth's magnetic field is primarily:

	Student Response	Value	Correct Answer	Feedback
1.	generated by currents flowing in the mantle			

	Student Response	Value	Correct Answer	Feedback
	2. generated by convection in the inner core			
✓	3. generated by convection in the outer core	100%	✓	
	4. due to magnetization in the inner core			
	5. due to magnetization in the cool crustal rocks			

Score: 1/1

8.

Parallel stripes or bands of the oceanic crust are observed to have alternating magnetizations. Th because the new crust formed at the mid-ocean ridges gets magnetized in the direction of the Ea magnetic field as it solidifies. The stripes occur because:

	Student Response	Value	Correct Answer	Feedback
	1. of periodic variations in composition.			
✓	2. the direction of the Earth's magnetic field reverses.	100%	✓	
	3. some of the material gets demagnetized later.			
	4. the temperature decreases symmetrically away from			

Student Response	Value	Correct Answer	Feedback
the ridgecrest.			

Score: 1/1

9.

The Earth's magnetic field has reversed many times. The dipole field remains relatively stable for while, and then may temporarily become unstable and collapse. The dipole field then "powers bac again in either the current "normal" or "reversed" direction.

What is the average length of time *between* reversals?

How long does an actual reversal take (i.e., collapse through powering back up in the opposite direction)?

1000-20000 ye

100-200 years

50,000 - 100,0(years

5 - 10 million y(

0.5-1 million ye

Statement	Response	Value	Correct M
What is the average length of time *between* reversals?	0.5-1 million years	50.0%	0.5-1 milli years
How long does an actual reversal take (i.e., collapse through powering back up in the opposite direction)?	1000-20000 years	50.0%	1000-200(years

Score: 2/2

10.

The 'secular variation' of the Earth's magnetic field results in a number of different effects we can observe, and its cause is reasonably well understood. Which of the following are observations associated with secular variation or cause(s) of the secular variation?

More than one answer may be correct - penalty for answering wrong

Student Response	Value	Correct Answer	Feedback
A. the distribution of ferromagnetic minerals in			

	Student Response	Value	Correct Answer	Feedback
	the convecting mantle			
B.	declination (aziumuth, or angle relative to geographic north) of the field	25%	✓	
C.	the number of lightning strikes			
D.	intensity or strength of the field	25%	✓	
E.	inclination (dip) of the field		✓	
F.	the solar wind intensity			
G.	the convective flow patterns in the outer core		✓	

Score: 1/2

11.

To have an active dipole magnetic field now, 4.6 billion years after forming, a planet/moon requir following:

[More than one answer may be correct. Wrong answers are deducted]

	Student Response	Value	Correct Answer	Feedback
A.	Temperature of the crust must be cool enough to allow remanent			

	Student Response	Value	Correct Answer	Feedback
	magnetization to function.			
B.	The planet must rotate.	25%	✓	
C.	It needs to be large enough. Smaller bodies cool more quickly and as the planet/moon cools, less of the core is liquid (and eventually none).		✓	
D.	It must have ferromagnetic minerals in the crust for remanent magnetization to play a role. It cannot have a fully 'ice' surface.	-20%		
E.	At least part of the core must be liquid and convecting.	25%	✓	
F.	A metallic core.	25%	✓	

General Feedback: Having active plate tectonics may also play a role in that efficient convection in the ma would keep the outer core convecting as well (by removing heat from the surface of th core.

Score: 1.1/2

12.

In plate tectonics, the "plate" is:

	Student Response	Value	Correct Answer	Feedback
	1. The lithosphere: a layer of the Earth which is warm and flows readily.			
	2. The crust: that part of the Earth which is cold and behaves rigidly.			
	3. The crust: that part of the Earth which is less dense and "floats" on the mantle.			
	4. The asthenosphere: that part of the Earth which is cold and behaves rigidly.			
	5. The asthenosphere: a layer of the Earth which is warm and flows readily.			
	6. The lithosphere: that part of the Earth which is cold and behaves rigidly.	100%	✓	

Score: 1/1

13.

A key process in plate tectonics is called 'seafloor spreading'. That term describes:

	Student Response	Value	Correct Answer	Feedback
1.	The sinking of cold crust at mid-ocean ridges			
2.	Stretching of the seafloor by the motion of continents			
3.	Divergent motion between the seafloor and a continent			
4.	The creation of new crust at mid-ocean ridges due to divergent motion of the seafloor	100%	✓	

Score: 1/1

14.

Slab pull is one of the forces driving plate motions. It occurs because subducting lithosphere is _____ than the surrounding asthenosphere and lower mantle.

You can answer this by just thinking about the differences in composition and properties of these layers...

	Student Response	Value	Correct Answer	Feedback

	Student Response	Value	Correct Answer	Feedback
A.	hotter, and therefore less dense			
B.	cooler, and therefore more dense	100%	☑	remember, the oceanic crust is made up of very similar material to that of the mantle. And the m protion of the lithosphere is the same compositic the mantle below. However, the lithospheric plat colder (that is why it is more rigid). Therefore it denser. It cools, and gets thicker, as it moves aw from the ridgecrest where the crust is produced.
C.	more mafic and therefore more dense			
D.	cooler, and therefore less dense			
E.	hotter, and therefore more dense			
F.	less mafic, and therefore less dense			

Score: 1/1

15.

Another main driver of large plate motion is dubbed 'ridge push'. The name, however, is slightly misleading.

Which of the following statements describing 'ridge push' are **correct**?

More than one answer may be correct

	Student Response	Value	Correct Answer	Feedback
A.	The			

	Student Response	Value	Correct Answer	Feedback
	asthenosphere convects below the oceanic lithosphere, dragging the plates along above. This pulls apart the plates.			
B.	Magma rising from the mantle forces the plates apart.	-50%		There is insufficient force generated by the buoyant rising hot rock/magma to 'push' the plates apart. Instead, the plates are pulled ap that decreases the pressure below - and mag rises to fill the gap.
C.	The heat of the rising rock below the spreading center means the rock in the region expands. Therefore, there is a high ridge at the spreading center. The plates are pulled down and away from the ridge by gravity.	100%	✓	Yup. Better to call it 'ridge pull'...
D.	Continent collision generates large mountain belts (ridges). The collisions 'push' the plates apart, allowing magma to fill in the gap.			

General Feedback: A misconception is that magma 'forces' the plates apart. There is insufficient force generated by the buoyant rising hot rock/magma to 'push' the plates apart. Instead, t plates are pulled apart by the other 3 forces. That decreases the pressure below - and magma rises to fill the gap.

Slab pull (gravity pulling the cold, dense lithosphere down into the mantle at a subduc zone), ridge push (gravity pulling the high ridgecrest apart and down), and drag of the convecting asthenosphere against the base of the lithosphere are the three primary fo

Score: 1/2

16.

The **North American plate** is bounded by what kind or kinds of plate boundaries? (It may help t look at a map of the plates.)

More than one answer is possible on this one.

	Student Response	Value	Correct Answer	Feedback
A.	transform	33%	✓	e.g., the Queen Charlotte fault, the San Andreas fault
B.	divergent	34%	✓	e.g., the Mid-Atlantic Ridge, and the spreading centre down the Gulf of California, separating mainland Mexico from the Baja Peninsula
C.	convergent	33%	✓	e.g., Cascadia, the Aleutian subduction zone, the subduction zone under southern Mexico
D.	passive			

General Feedback: A passive margin is not a plate boundary.
It is the change from continental to oceanic crust.

The North american plate is bounded by all types of plate boundaries. For example:
Divergent: Mid-Atlantic ridge, ridge down the Gulf of California
Convergent: Our own Cascadia subduction zone, the Alaskan subduction zone
Transform: The Queen Charlotte Fault, the San Andreas Fault

Score: 2/2

17.

The relatively abrupt transition from continental to oceanic crust is called the continental margin.

Which of the following are **active** margins?
[Hint: Look at earthquake maps... or maps of plates and their motions]

Select all *correct* answers (there may be more than one correct answer, penalty for error).

	Student Response	Value	Correct Answer	Feedback
1.	The eastern coast of New Zealand's North Island	50%	✓	Yup. Subduction occurs with the Pacific Plate sinking back into the mantle at a long trench extends from the Tonga Islands to the north c past the east coast of the North island of New Zealand.
2.	The west coast of Costa Rica	50%	✓	Yes. Costa Rica is a similar situation to here ir Cascadia. A small plate subducting from the w
3.	The east coast of South America			
4.	The west coast of southern California	-25%		Heh heh, a tricky one. No. It is a passive mar LA is actually on the Pacific Plate with the plat boundary running through the middle of Califo
5.	Hawaii (the big island)			
6.	The east coast of Newfoundland			
7.	The south coast of India/SriLanka	-25%		No - they are both on the Indian (or Indo-Australian) plate. The plate boundary is in the Himalayan collision zone.

Score: 1/2

18.

Rates of plate convergence or divergence have:

	Student Response	Value	Correct Answer	Feedback
A.	been constant through time.			
B.	changed through time, but are always the same everywhere on Earth.			

	Student Response	Value	Correct Answer	Feedback
C.	changed through time, but currently average approximately 4 cm/year	100%	✓	
D.	changed through time, but currently average approximately 4 m/year			
E.	changed through time, but currently average approximately 4 km/year			

Score: 1/1

19.

At a subduction zone, the 'plate' that sinks down into the mantle:

(one answer)

	Student Response	Value	Correct Answer	Feedback
A.	is always continental lithosphere			
B.	is always oceanic lithosphere		✓	
C.	is always oceanic crust	0%		The plate is the lithosphere, not just the crust.
D.	is either oceanic or continental lithosphere			

	Student Response	Value	Correct Answer	Feedback
E.	is either oceanic or continental crust.			
F.	is always continental crust			

Score: 0/2

20.

You pour a hot cup of tea. An example of conduction dominating the transfer of heat is:

	Student Response	Value	Correct Answer	Feedback
A.	your hand gets warm as you hold your hand above (but not touching) the cup.			
B.	the tea cools faster as you blow across the top of the cup.			
C.	your hand gets warm as you hold your hand beside (but not touching) the cup.			
D.	your hand gets warm as you			

	Student Response	Value	Correct Answer	Feedback
	spill the tea.			
E.	your hand gets warm as you hold the cup.	100%	✓	conduction - direct contact and heat transfer

Score: 1/1

21.

You are sitting outside at a cafe. Every once and a while, the breeze immerses you in the wonder aroma coming from the bakery a few stores down the block. You realize that is an example of:

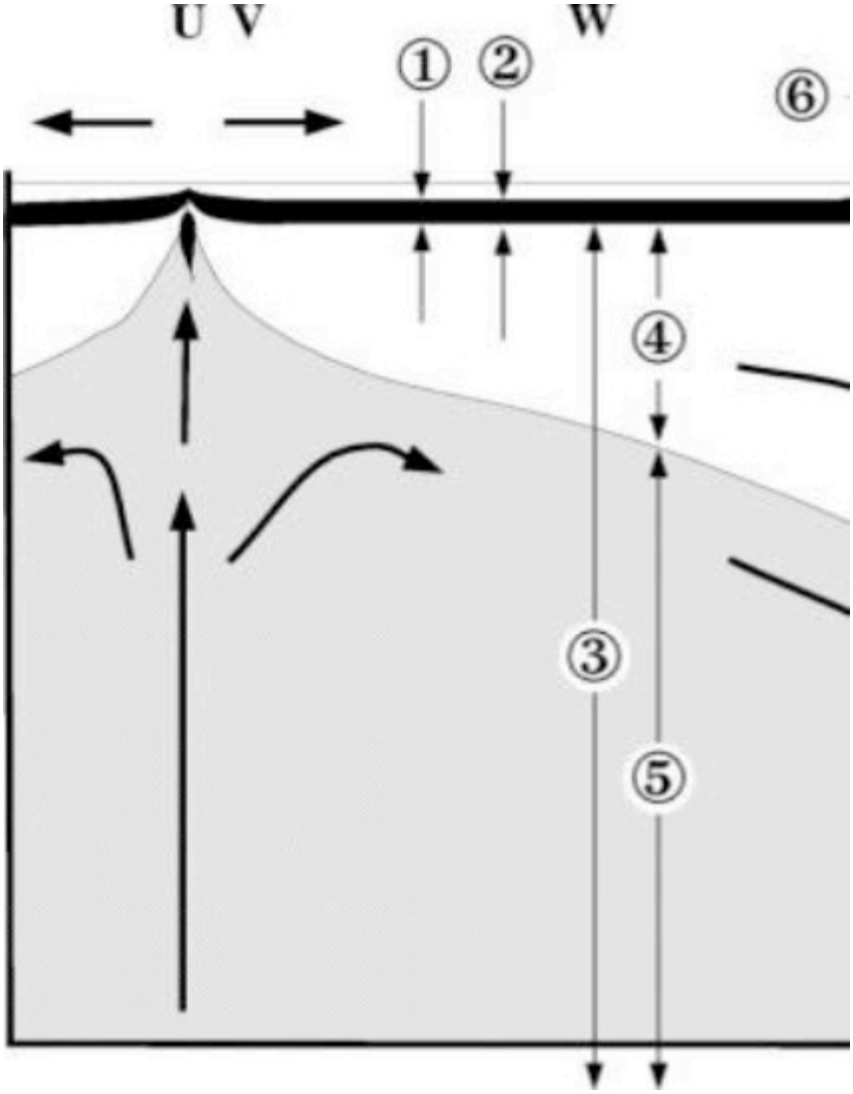
	Student Response	Value	Correct Answer	Feedback
A.	radiation			
B.	convection			
C.	conduction			
D.	advection	100%	✓	The rising heat carries with it the compounds yo smell - but it is the breeze that blows those compounds horizontally, advecting the 'aroma', l also the heat toward you.

Score: 1/1

22.

The figure shows a simple cross-section through a ridgecrest. The vertical axis goes from sealeve down to about 200 km. Black is the crust, the white zone is the mantle portion of the lithosphere, the grey is mantle below the base of the lithosphere.

As you move away from the ridgecrest (from U to V to W), the mantle portion of the lithosphere (zone labelled 4) gets thicker and thicker. This is because: (one answer)



	Student Response	Value	Correct Answer	Feedback
A.	More and more intrusive igneous rocks are gradually added to the plate.			
B.	As the plate slides away from the hot ridge where its crust is formed, the plate cools. Flow in the	100%	✓	Remember, the mantle portion of the lithosph is the same rock as the asthenosphere beneat The plate is formed at the ridge - where it is t young and hot. (sounds like some fashion magazine). As it moves away from the ridge, gets older and cools (quickly at first due to convection and conduction, then more slowly when it is only cooling by conduction). As it c

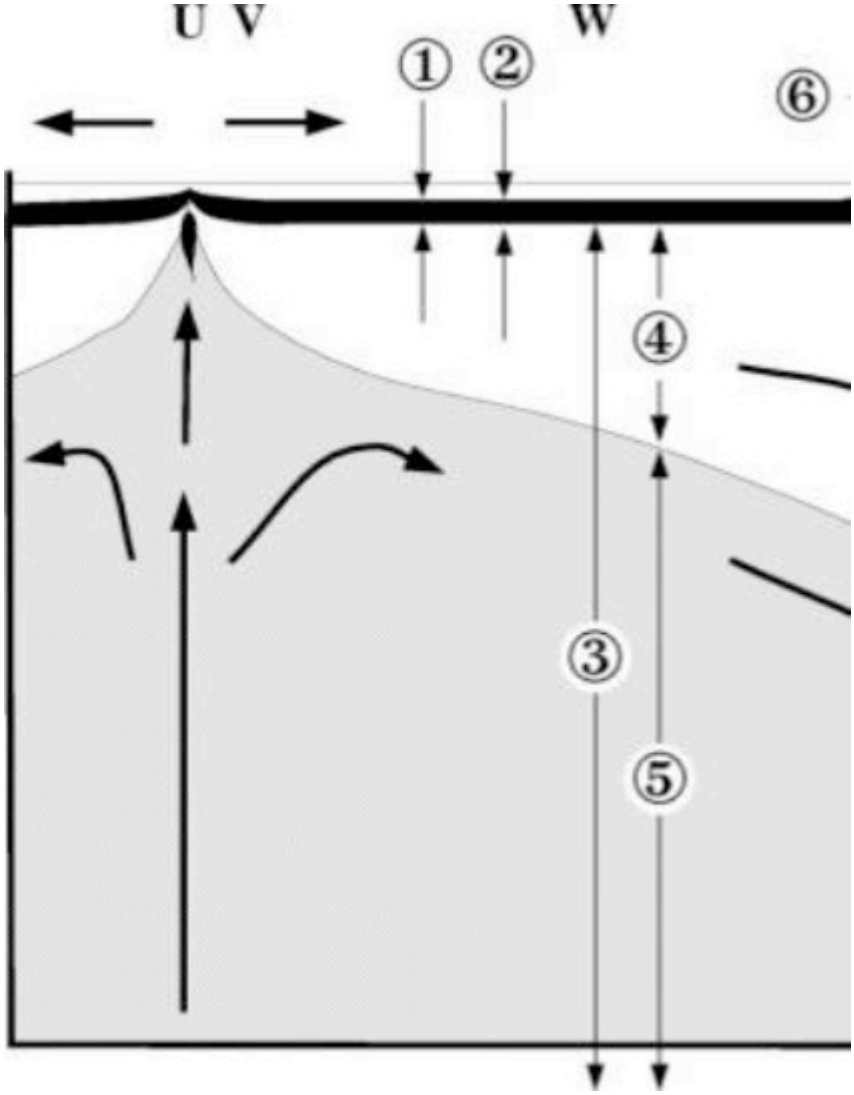
	Student Response	Value	Correct Answer	Feedback
	asthenosphere is also moving away with the plate above, gradually cooling. Essentially, the upper asthenosphere cools by conduction and becomes lower lithosphere. Gradually, the lithosphere thickens.			it gradually thickens. So the further from the ridge, the thicker the lithosphere. Similarly, ir continents, the thickest lithosphere is usually beneath the parts of the continent that have b undisturbed for the longest period of time (m time to cool).
C.	Basal drag of the asthenosphere against the base of the lithosphere adds mantle rock to the lithosphere.			
D.	Less partial melt is available away from the ridgecrest.			
E.	It is an accretionary wedge that thickens away from the ridgecrest.			

Score: 2/2

23.

The figure shows a simple cross-section through a ridgecrest. The vertical axis goes from sealeve down to about 200 km. Black is the crust, the white zone is the mantle portion of the lithosphere, the grey is the rest of the mantle below the base of the lithosphere.

The heat transferred from the top of the oceanic crust into the ocean water is different at the sea below V as compared with that measured at the seafloor below W. Which one of the following statements is **WRONG**?



Student Response	Value	Correct Answer	Feedback
A. Hydrothermal circulation efficiently cools the hot, young crust near the ridgecrest.			
B. Sediments increasingly			

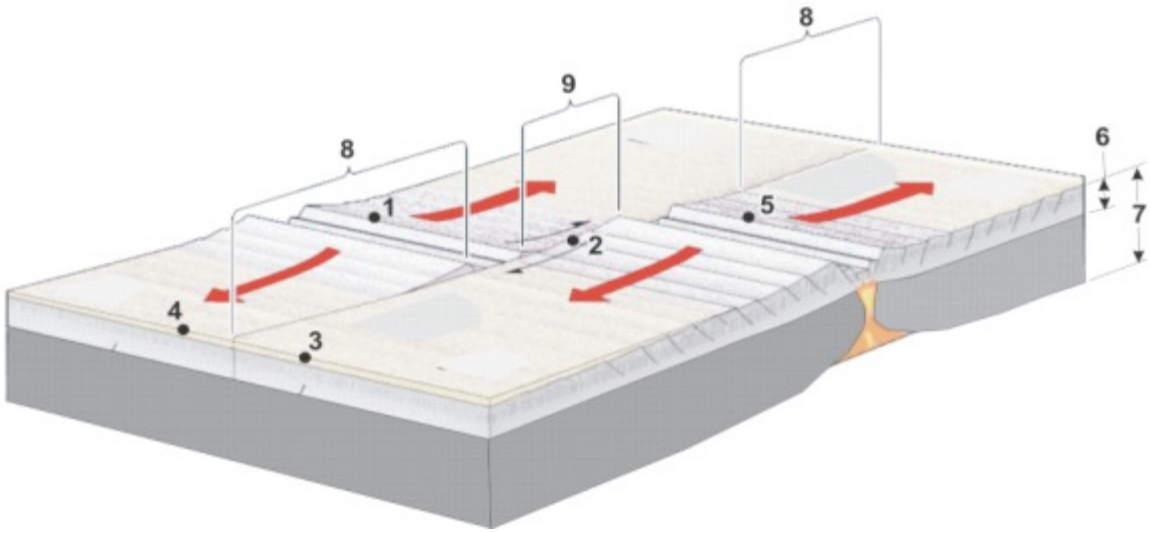
	Student Response	Value	Correct Answer	Feedback
	blanket the crust with time, sealing off hydrothermal circulation paths			
C.	The oceanic crust is older at W than at V, so has had more time to warm through radioactive decay.		☑	
D.	Conduction occurs everywhere from the top of the oceanic crust but convection only occurs in specific places.	0%		This is true. Convection moves heat very efficiently, but it can only do this in certain are Magmatic zones were the magma is convectin Hydrothermal zones where water is convecting

Score: 0/1

24.

The sketch below is a cross-section of an oceanic ridgecrest and transform fault (that offsets the ridge). If you look at a map of the seafloor where there is a spreading ridge, you'll see many of th types of offsets (take a look on Google Earth or in the textbook).

Which of the following is true? (There are several correct answers)



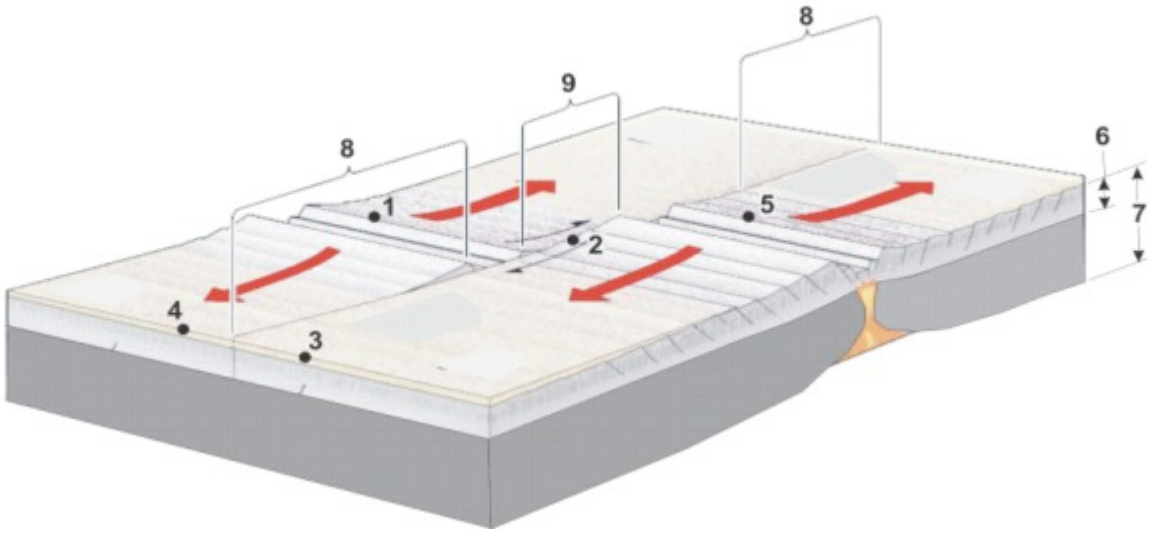
	Student Response	Value	Correct Answer	Feedback
A.	Location 3 is on the same plate as location 4	50%	✓	yes! Although the ridges are offset, the new crus moving away moves together so the only earthquakes are along the *transform* between th ridges.
B.	Location 3 is on a different plate than location 4			
C.	Rock at location 4 is younger than rock at location 3	50%	✓	Yes, it is closer to the ridgecrest. So, assuming t the offset spreading centres are spreading at the same rate (a pretty good assumption), 4 is older than 3.
D.	Rock at location 4 is older than rock at location 3			
E.	Rock at location 1 is older than rock at location 3			

General Feedback: Many people said that 3 and 4 were on different plates. Make sure you understand tha they are on the same plate - that also requires the only places for earthquakes would along the ridgecrests (normal, tensional faulting) and between the ridges (9) - the zor that 'transforms' the motion, linking the ridges. That's a transform fault (strike-slip mo Tuzo Wilson, a Canadian, proved that to be the case - that was one of the major findin the proof of plate tectonics in the mid-1960s.

Score: 2/2

25.

Which of these statements is correct?



	Student Response	Value	Correct Answer	Feedback
A.	The temperature of the crust at location 3 is warmer than at location 4			
B.	The temperatures of location 3 and 4 should be about the same since they are on the same plate	0%		

	Student Response	Value	Correct Answer	Feedback
C.	The temperature of the crust at location 3 is cooler than at location 4		☑	

Score: 0/1

26.

Match the type of fault to the deformation that causes it.

Normal fault	Compression
Thrust (or reverse) fault	Regional shear
Strike-slip fault	Extension

Statement	Response	Value	Correct Match
Normal fault	Extension	Correct	Extension
Thrust (or reverse) fault	Compression	Correct	Compression
Strike-slip fault	Regional shear	Correct	Regional shear

Score: 2/2

27.

The size of earthquakes, and whether they occur at all, is in part controlled by the rheology (or strength) of the rock. Temperature and depth (pressure) play a major role in that.

This question involves identifying typical types of faulting and magnitudes for general classes of earthquakes.

Question: *For earthquakes at a mid-ocean ridgecrest* (e.g., the Juan de Fuca ridge, the Mid-Atlar Ridge, etc.):

Fault type expected	thrust
Maximum magnitudes for earthquakes in this area:	normal
	up to M7-M8

	up to M9+ strike-slip below M7

Statement	Response	Value	Correct Mat
Fault type expected	normal	50.0%	normal
Maximum magnitudes for earthquakes in this area:	below M7	50.0%	below M7

General Feedback: For a spreading centre or ridgecrest earthquake:
fault motion: normal (it is a tensional fault)

Typical depth range: very shallow. Spreading centres are hot - therefore only the coole most brittle crust tends to 'break' and generate an earthquake. In the oceanic crust, tl only about a 7 km thick zone.

Maximum magnitudes: below M7. Hot rock can't sustain very much pressure before breaking since it is quite weak. In addition, the tensional forces that build up strain jus aren't that strong. So no really large earthquakes occur.

Score: 2/2

28.

This question involves identifying typical types of depth ranges for general types of earthquakes.

For earthquakes at a mid-oecan ridgecrest (e.g., the Juan de Fuca ridge, the Mid-Atlantic Ridge, e

Typical depth range for earthquakes in this area:	Very shallow (0-10 km) mostly in the upper crust (0-20km), but extending into tl lithospheric mantle (perhaps even to 100km depth) Only in the asthenosphere At the interface at the base of the lithosphere Full depth range (surface to approximately 670 km)

Statement	Response	Value	Correct Match
Typical depth range for earthquakes in this area:	mostly in the upper crust (0-20km), but extending into the lithospheric mantle (perhaps even to 100km depth)	0.0%	Very sha (0-10 km

General Feedback: For a spreading centre or ridgecrest earthquake:
fault motion: normal (it is a tensional fault)

Typical depth range: very shallow. Spreading centres are hot - therefore only the coole most brittle crust tends to 'break' and generate an earthquake. In the oceanic crust, tl only about a 7 km thick zone.

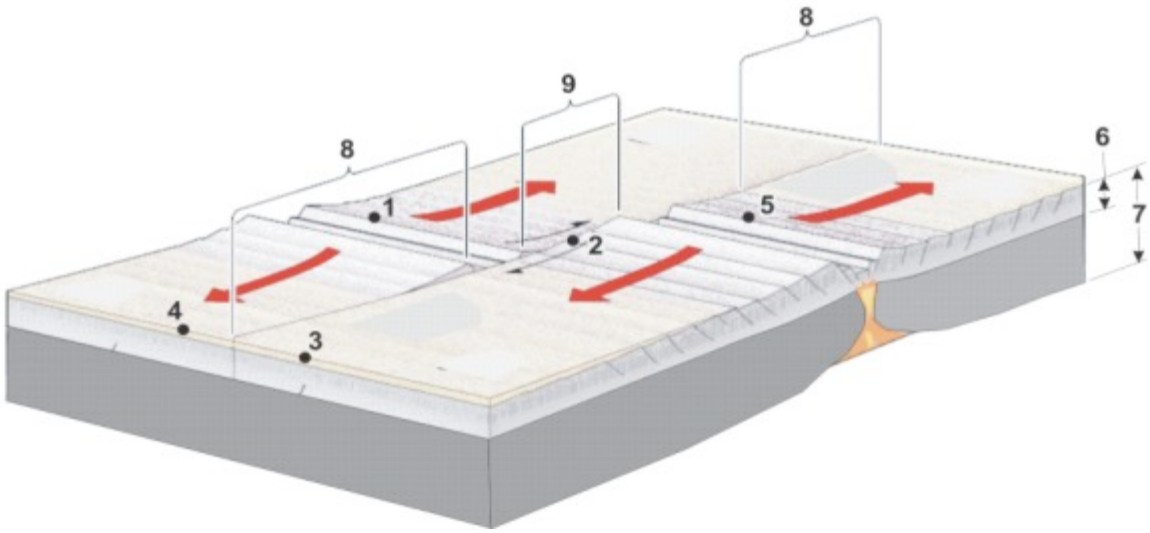
Maximum magnitudes: below M7. Hot rock can't sustain very much pressure before breaking since it is quite weak. In addition, the tensional forces that build up strain jus aren't that strong. So no really large earthquakes occur.

Score: 0/1

29.

The sketch below is a cross-section of an oceanic ridgecrest and transform fault (that offsets the ridge).

Where would transform fault earthquakes occur?



	Student Response	Value	Correct Answer	Feedback
A.	region 8			
B.	region 9	100%	✓	
C.	regions 8 and 9			
D.	regions 1 and 5			
E.	regions 1, 5, 8, and			

Student Response	Value	Correct Answer	Feedback
9			

General Feedback: Make sure you understand the answer on this one. This concept was actually a key adv in the early progress of plate tectonics (and a problem solved by a Canadian too - Tuzo Wilson at UofT). If quakes occurred at 8 and 9, it would mean that each side (e.g., #3 #4) were separate plates.

However, it turned out that quakes occur only along 9. That means that #4 and #3 are the same plate. The offset between them is simply because of the difference in age (a therefore of heat) in adjacent bits of crust. e.g., Rock at #3 would be older and cooler rock at #4.

Score: 1/1

30.

The size of earthquakes, and whether they occur at all, is in part controlled by the rheology (or strength) of the rock - and temperature/depth (pressure) plays a major role in that.

This question involves identifying typical types of faulting, magnitudes and depth ranges for gene types of earthquakes.

Question: For earthquakes in a continental transform fault zone (e.g., the San Andreas in Califor

Statement	Response	Value	Correct Match
Fault type expected	strike-slip	50.0%	strike-slip
Maximum magnitudes for this plate boundary	below M7	0.0%	up to M7 to mid-M8 rar

General Feedback: Continental transform faults can generate large earthquakes like the ones in southern California and Turkey. They aren't as large as those along the megathrust interface at subduction zones. However, they can occasionally reach into the low-to-mid Mw8 rang

Score: 1/2

31.

This question involves identifying depth ranges for general types of earthquakes.

For earthquakes in a continental transform fault (e.g., San Andreas system in southern California)

Statement	Response	Value	Correct Match
Depth range for earthquake foci	Mostly in the upper crust (0-20km), but extending into the lithospheric mantle (perhaps even to 100km depth)	100.0%	Mostly in the upper crust (0-20 but extending into the lithosphe mantle (perhaps even to 100kn depth)

General Feedback: Note: With a continental transform fault like that in southern California and Turkey, the earthquakes primarily occur in the upper crust. However, you can have relatively large quakes throughout the crust and extending down into the mantle.

Score: 1/1

32.

We'll be talking a lot about 'Cascadia' (the Pacific Northwest including southwest BC) through the earthquakes/volcanoes sections. Here is a sketch of a cross-section of the Cascadia area that we of here in Vancouver (I'd expect you to be able to roughly sketch and label the basic types of plat boundaries like this).

Note that this could be a cross-section through just about any oceanic-continental subduction zon Cascadia is a little unusual (but not too unusual) in that there is a ridgecrest within a few hundre kilometres of the trench.

The sketch isn't exactly to scale but is reasonable. The bottom of the sketch is at roughly 150-25 The different shades/textures represent major differences in either composition or rheology of the

Rather than label it by hand, your job is to match the labels on the drawing with a list I've provid fine to use labels more than once if you need to.

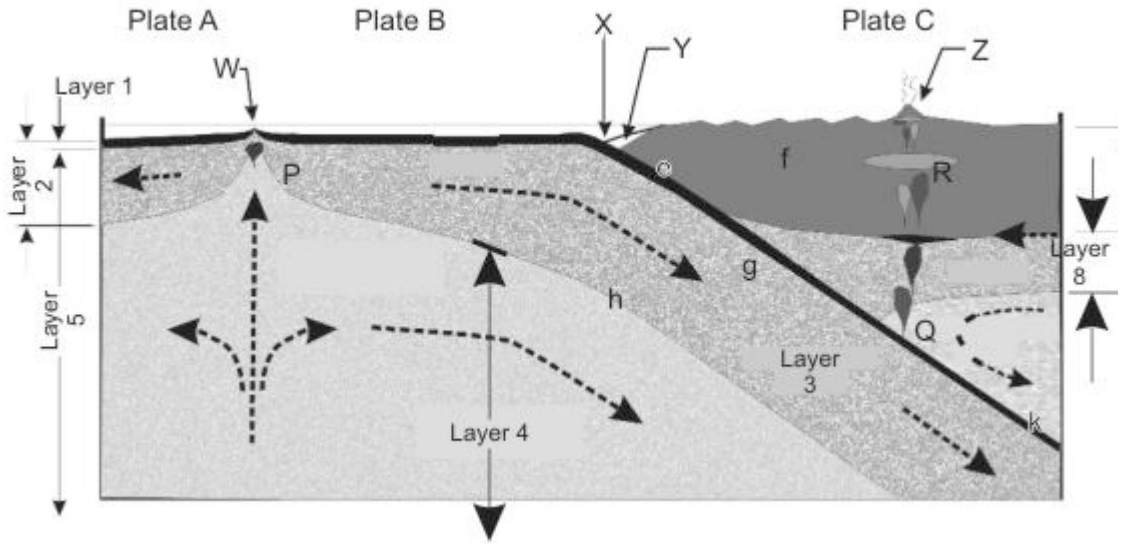


Plate A	Juan de Fuca Plate
Plate B	North American Plate
Plate C	Farallon Plate
	Nazca Plate
	Pacific Plate

	Atlantic Plate

Statement	Response	Value	Correct Match
Plate A	Pacific Plate	33.33%	Pacific Plate
Plate B	Juan de Fuca Plate	33.33%	Juan de Fuca Plate
Plate C	North American Plate	33.34%	North American Plate

General Feedback: Make sure you understand this question - as well as adapt to similar ones for other pla boundaries. Sketch out the different plate boundaries (this one gives you two). Add all other info. composition, rheology, thicknesses, earthquakes, volcanism, motion, heat f good way to consolidate info.

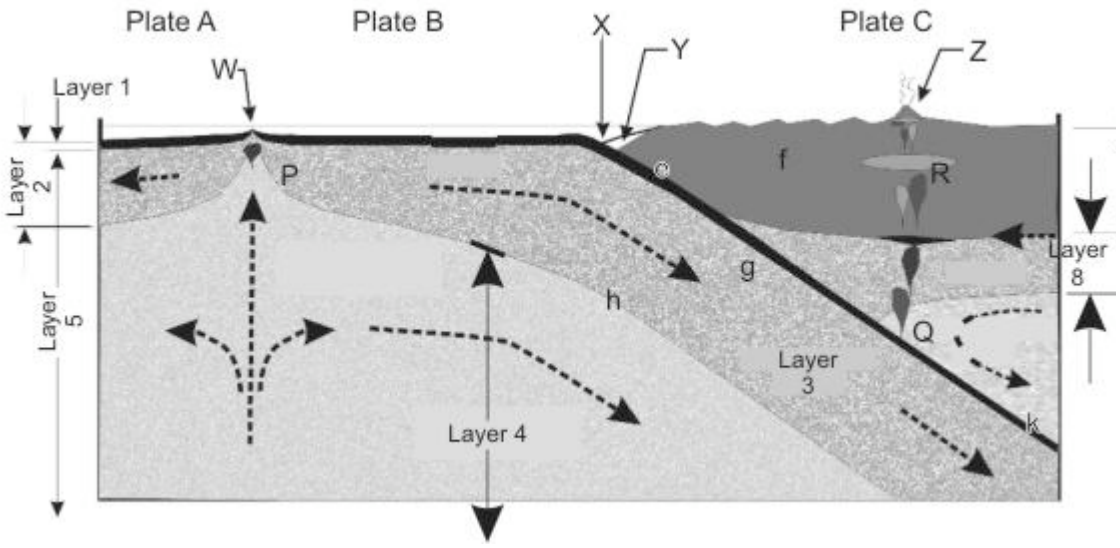
If you put Farallon plate instead of Juan de Fuca plate... well, you were partially correc suppose. The Juan de Fuca is a last remaining fragment of the once giant Farallon plat Check out the animations of plate motion in the Plate Tectonic Resources section. Yu'll how the JuandeFuca plate as well as the Nazca and other small plates down the west s Central/South America used to be part of the Farallon Plate. Pretty neat animations...

Score: 1.5/1.5

33.

Same sketch, a cross-section through the ridge offshore and our subduction zone here in Cascadi Choose the best answer to the following layers.

Note: be careful - There isn't anything 'tricky, but you have to look carefully to see some of the a that define where the layer in question extends to/from. It's easy to go too quickly and make a mistake...



Name of layer 1 (thin black layer)	oceanic lithosphere
Name of Layer 2	continental lithosphere
Name of Layer 4	oceanic crust
Name of Layer 5	wadati-benioff zone
Name of Layer 6	inner core
Name of Layer 7	asthenosphere
Name of Layer 8	mantle
	outer core
	top of the transition zone
	continental crust
	lithospheric mantle
	bottom of the transition zone

Statement	Response	Value	Correct Match
Name of layer 1 (thin black layer)	oceanic crust	14.28%	oceanic crust
Name of Layer 2	oceanic lithosphere	14.28%	oceanic lithosphe
Name of Layer 4	asthenosphere	14.28%	asthenosphere
Name of Layer 5	top of the transition zone	0.0%	mantle
Name of Layer 6	continental crust	14.28%	continental crust
Name of Layer 7	bottom of the transition zone	0.0%	continental lithos
Name of Layer 8	continental lithosphere	0.0%	lithospheric mant

General Feedback: Make sure you understand this question - as well as adapt to similar ones for other pla boundaries. Sketch out the different plate boundaries (this one gives you two). Add all other info. composition, rheology, thicknesses, earthquakes, volcanism, motion, heat f good way to consolidate info.

Score: 1.9992/3.5

34.

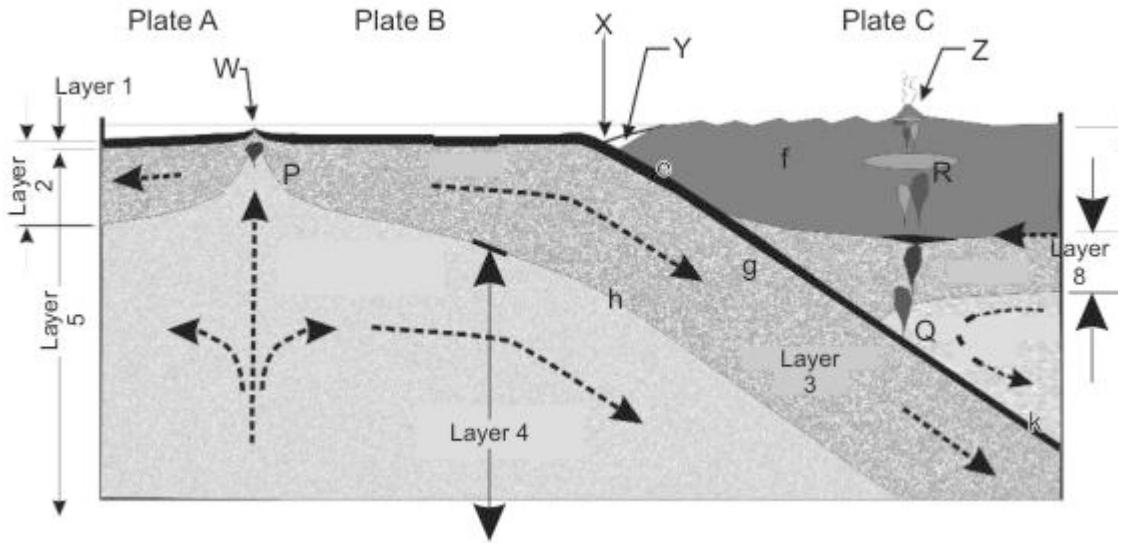
This is a cross-sectional sketch of the Cascadia area. Compare this with the many different simila figures in the pdf notes to make sure you are oriented as to what the layers are. The dashed arro indicate the motion of the plates and of the asthenosphere.

I'd prefer to get you to sketch this yourself but this is quicker to mark. [I suggest you sketch out

plate boundaries and label them up - good for pulling together information and for the final exam

The sketch isn't exactly to scale but is reasonable.

Match 'em up:



Name of location X	20-25 km
Name of feature shown by Y	strike-slip
Thickness of Layer 1 (black layer)	normal
Thickness of Layer 6	~7 km
Fault type most likely to occur at e (see below Y, on the interface between the black/grey)	thrust
Fault type most likely to occur at f	30-35 km
Fault type most likely to occur near W	accretionary wedge
	trench
	50-75 km

Statement	Response	Value	Correct I
Name of location X	trench	14.28%	trench
Name of feature shown by Y	accretionary wedge	14.28%	accretion wedge
Thickness of Layer 1 (black layer)	~7 km	14.28%	~7 km

Statement	Response	Value	Correct I
Thickness of Layer 6	30-35 km	14.28%	30-35 km
Fault type most likely to occur at e (see below Y, on the interface between the black/grey)	thrust	14.28%	thrust
Fault type most likely to occur at f	strike-slip	0.0%	thrust
Fault type most likely to occur near W	normal	14.32%	normal

General Feedback: Layer 6: You would only get super thick continental crust (close to 70-75 km thick) in continental-continental collision like you see in the Himalaya. So, when you see the nu of 20-70 km given for continental crust, that spans the range, but it isn't correct for ev location. You need to think about where you are. Typical thickness is 35 km. That woul decent standard answer unless you KNEW you were looking at a continent-continent c Here under Vancouver the crust is about 30 km thick. The continental crust thins close edge of the plate (to even less than 20 km)

e: megathrust interface

f: convergent boundary - compression - thrust faults dominante.

W: ridgecrest - tension - normal faults.

Score: 3.0002/3.5

35.

Which of the following events has a similar physical mechanism to the rupture that causes an 'earthquake'?

	Student Response	Value	Correct Answer	Feedback
1.	A broken elastic snapping back.	100%	✓	Yes, the crust deforms elastically, and then breal (brittle deformation). But the earthquake is associated with the vibrations from the release o stored elastic energy.
2.	A glass breaking when you drop it.		✓	
3.	Tearing a sheet of paper.			
4.	The recoil of a gun.			

Score: 1/1

36.

The most complete and meaningful way of characterizing the size of an earthquake is the *momen magnitude*. It requires more time to calculate than the simpler methods (e.g., Local (or Richter) magntiudes) as several parameters must be determined.

Which of the following are necessary to calculate the moment magnitude?
(There are several correct answers)

	Student Response	Value	Correct Answer	Feedback
A.	the area of the rupture zone along the fault	34%	✓	
B.	the distance the fault plane slipped along the rupture	33%	✓	
C.	maximum ground motion measured at the surface			
D.	the physical properties of the fault zone rocks (e.g., rigidity, compressibility)	33%	✓	
E.	the gradient of damage moving away from the epicentre			
F.	the focal mechanism of the earthquake			

General Feedback: Moment magnitudes depend on: the area of the fault that ruptured (length/depth), the distance it slid, and the strength of the rocks that broke. (1, 2, 4)

The maximum surface motion or vibration is what is used to determine local magnitud Richter magnitudes in California).

The amount of damage is used to calculate the Mercalli index

The focal mechanism simply relates to whether it is a normal fault, thrust fault or strik fault.

Score: 1.5/1.5

37.

On September 30th, there was a M5.8 quake beneath Chile.

For more information, see:
http://neic.usgs.gov/neis/bulletin/neic_bvad.html

There are maps and other information (like depth) on those pages (including historical seismicity maps).

From the location of the earthquake and its depth (see the map, you could plug the coordinates i Google Earth if you like), it was most likely related to:

	Student Response	Value	Correct Answer	Feedback
	A. Ridgecrest spreading (normal faulting)			
	B. Subduction thrusting on the plate interface	100%	✓	Possible... The depth is 37 km which is getting little deep for the plate interface, but it is still possible... this would be a tie for my second ch
	C. Subduction thrusting in the overriding plate.		✓	
	D. Transform motion (strike-slip faulting)			
	E. Subduction-related faulting within the downgoing plate		✓	

General Feedback: From looking at the region and plate maps, it is clearly a subduction zone. The Nazca is moving towards South America. The Historic Seismicity maps show the dipping earthquakes beneath Chile. And some of the largest earthquakes ever measured have occurred there (one in early 2010).

This one is tough to nail down. It is 37 km deep. A little bit deep for it to be on the pla

interface - but still possible. It is on the edge - almost too deep (too warm) to have a
rupture occur. It is pretty deep to be in the overriding plate - but still possible. And it c
be just below the plate interface in the downgoing oceanic crust. Any of those will wor
Better yet, if you were explaining it, you'd do as I did - suggest all of the above.

Other earthquakes you can clearly say which one of those options it is.

Score: 2/2

38.

On September 26th, there was a M5.7 quake beneath the Aleutian Islands.

For more information, see:
http://neic.usgs.gov/neis/bulletin/neic_brbn.html

There are maps and other information (like depth) on those pages (including historical seismicity maps).

From the location of the earthquake and its depth (see the map, you could plug the coordinates i
Google Earth if you like), it was most likely related to:

	Student Response	Value	Correct Answer	Feedback
A.	Subduction thrusting on the plate interface			
B.	Transform motion (strike-slip faulting)	0%		
C.	Subduction-related faulting within the downgoing plate		✓	
D.	Ridgecrest spreading (normal faulting)			
E.	Subduction thrusting in the overriding plate.			

Score: 0/2

39.

On September 18th, there was a M4.9 quake out in the middle of the Atlantic Ocean basin.

For more information, see:
http://neic.usgs.gov/neis/bulletin/neic_bia7.html

There are maps and other information (like depth) on those pages (including historical seismicity maps).

From the location of the earthquake and its depth (see the map, you could plug the coordinates i Google Earth if you like), it was most likely related to:

	Student Response	Value	Correct Answer	Feedback
	A. Subduction-related faulting within the downgoing plate			
☑	B. Ridgecrest spreading (normal faulting)	100%	✓	Yep. Mid-ocean ridge. Spreading centre. New h crust cooling and contracting and under tension is pulled away from the ridge. Relatively shallo focus depth for the earthquake to start - and actually 10km is likely a rough calculation - it w probably shallower.
	C. Subduction thrusting in the overriding plate.			
	D. Transform motion (strike-slip faulting)			
	E. Subduction thrusting on the plate interface			

Score: 2/2

40.

On November 17th, there was a M6.6 quake near the southern Haida Gwaii (Queen Charlotte) Isl

For more information, see:
http://earthquake.usgs.gov/earthquakes/eqinthenews/2009/us2009pcaq/#details

There are maps and other information (like depth) on those pages (including historical seismicity maps).

From the location of the earthquake and its depth (see the map, you could plug the coordinates i Google Earth if you like), it was most likely related to:

	Student Response	Value	Correct Answer	Feedback
A.	Ridgecrest spreading (normal faulting)			
B.	Subduction-related faulting within the downgoing plate	0%		
C.	Subduction thrusting on the plate interface			
D.	Transform motion (strike-slip faulting)		✓	
E.	Subduction thrusting in the overriding plate.			

General Feedback: Note that the USGS website has a very simple plate boundary labelling system that is generally correct, but it is completely wrong in some area. Wherever there is a ridgecr with offseting transform faults - the transforms don't show up at all (like on the Juan d Fuca ridge offshore of southern BC). And, in some cases, very large transform faults li the Queen Charlotte fault do not show up properly. However, as noted in the Quiz2 questions - the correct plate boundaries are noted in the text and pdfs....

Score: 0/2

41.

Which of the following points are TRUE?

[there may be more than one correct answer, penalty for wrong answers]

When oceanic lithosphere is subducted into the asthenosphere and lower mantle, _____.

	Student Response	Value	Correct Answer	Feedback
A.	the entire lithospheric plate eventually melts and is reincorporated back into the convecting mantle			
B.	the seawater-saturated oceanic crust melts a little and releases water into the mantle above, which can in turn cause melting which can generates a volcanic arc on the surface above.		☑	
C.	the subducting lithosphere gradually heats up to the temperature of the surrounding mantle and is reincorporated back into the lower mantle.	34%	☑	true.
D.	earthquakes can occur within the		☑	

	Student Response	Value	Correct Answer	Feedback
	downgoing lithospheric plate down to the base of the transition zone (~660-670 km depth)			
E.	Earthquakes commonly occur on the interface between the upper surface of the downgoing plate and the asthenosphere and lower mantle. These earthquakes define the Wadati-Benioff zone.	-25%		No. By that point, temperatures are too hot a the mantle (asthenosphere and lower mantle) too ductile to 'break'. So once the downgoing plate gets that deep - the only earthquakes th occur are within the downgoing lithosphere.

General Feedback: One of the main points here is that the downgoing plate doesn't really melt when it is 'recycled' back into the mantle. Remember, the mantle isn't liquid - it is solid. And alm all of the subducting lithosphere is mantle rock. So.... for the most part it simply just h up. Only a small portion of the downgoing plate melts - the upper portion of the crust has a lot of water incorporated into it. A little of it melts - and it also releases a lot of v into the mantle above the subducting plate. That water decreases the melting tempera there and causes melting in the mantle itself. That is going on where the subducting p roughly 100 km beneath the surface - the line of volcanoes (like Mt. baker and Mt.Garibaldi) mark that position nicely.

Score: 0.18/2

42.

Continental and island arc volcanism are quite similar, but have a few important differences. Whic the following points are **true** (more than one may be correct, points deducted for wrong answers)

	Student Response	Value	Correct Answer	Feedback
1.	Continental arc			

	Student Response	Value	Correct Answer	Feedback
	volcanoes are subduction related, island arc volcanoes are caused by plumes (or hotspots).			
	2. Many islands in the Caribbean are island arc volcanoes (look at a map of plate boundaries to decide)		☑	
	3. Hawaii is an island arc volcano.			
☑	4. Island arc and continental arc volcanoes are both related to subduction.	33%	☑	Yup.
☑	5. One main difference is that island arc volcanoes tend to be more mafic in composition that continental arc volcanoes. Island are are more mafic>>intermediate while continental volcanoes would be more intermediate>>felsic.	34%	☑	Yup

General Feedback: Many people get hotspot volcanoes confused with island arcs.

There are two types of volcanism:
1) Arc volcanism caused by subduction.
This includes continental arcs (oceanic plate subducting under continental plate) and is
arcs (oceanic plate subducting under oceanic plate). In both cases you have a subduct
zone with active volcanoes scattered all the way along the chain. For example, here in
Cascadia. In the Andes in South America, The Aleutians in Alaska, the Philippines, etc.

2) Hotspot or plume volcanism.
This doesn't require plate tectonics (e.g., Mars, Venus). However, **if** the plate above is
moving, you end up with a chain of volcanoes. Only one volcano is active - the one rig
the tip - the others in the chain are extinct. Of course, the classic example is Hawaii. E

there are many others (e.g., Yellowstone).

Score: 1.34/2

43.

Subducting plates produce a chain of volcanoes called a volcanic arc. Approximately how deep is t upper surface of a subducting plate beneath the volcanoes.

	Student Response	Value	Correct Answer	Feedback
	A. 10 km			
	B. 50 km			
	C. 100 km	100%	✓	Yup.
	D. 200 km			
	E. 660 km			
	F. Anywhere from 0 to ~660 km			

General Feedback: About 100 km. It depends a bit on the age of the plate subducting (i.e., how cool it is older, the cooler) and the dip that it subducts at (which also depends on its age/temperature). But 100 km is a pretty good average.

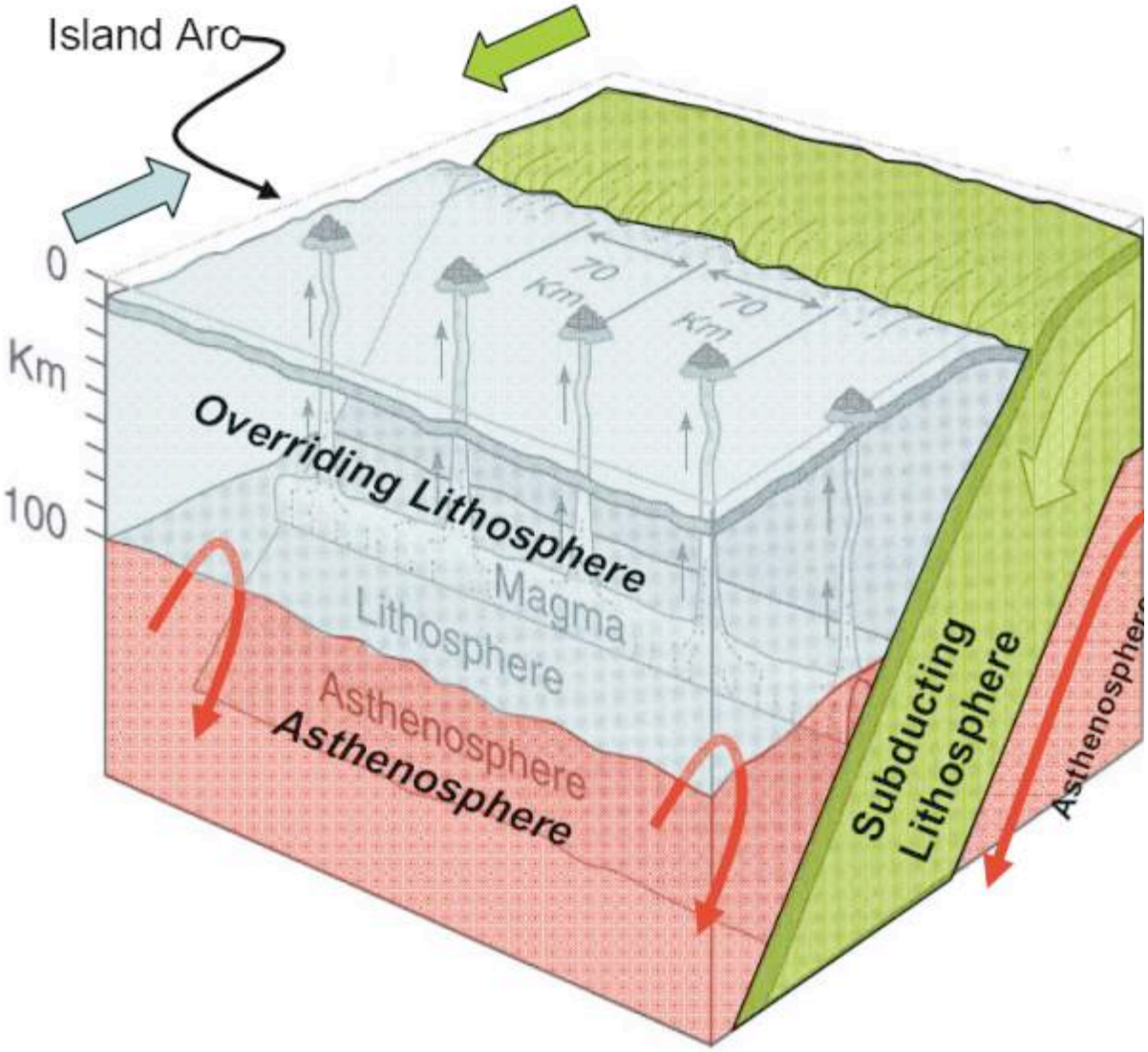
Score: 1/1

44.

The image below is a cartoon of a younger island arc. I say 'young' in that there are just individua volcanoes built on top of the overriding oceanic plate - it hasn't developed into larger islands with thickened crust yet (like say the Philippines or some of the Indonesian islands like Java and Suma well developed, older island arcs). So perhaps only 5-10 million years along in development?

Which of the points below are **correct** for island arc volcanoes.

[More than one answer may be correct. Marks deducted for wrong answers.]



	Student Response	Value	Correct Answer	Feedback
A.	lavas intermediate to mafic	20%	✓	Island arc, so intermediate (and this is a young one, so ok, low-intermediate)
B.	lavas mostly felsic			
C.	lavas very high in silica (SiO2)			

	Student Response	Value	Correct Answer	Feedback
	content: 75%			
D.	lavas mid-low Silica (SiO2) content: ~60%	20%	✓	Ya, typical island arc. Perhaps a bit lower for a young island arc.
E.	lavas very low silica content: < 50%			
F.	Moderately viscous magma and gas in the magma, possibility for water to get into magma, potential to be quite explosive	20%	✓	
G.	Very fluid magma, little gas, not explosive			
H.	Volcano age (the age of the youngest lava erupted) gets progressively older from left to right down the chain.			
I.	Very gently sloped, shield volcanoes			

	Student Response	Value	Correct Answer	Feedback
J.	Composite volcanoes - steeper and built from layers of lava and ash on the exposed parts of the volcanoes (above water).	20%	☑	
K.	Melt feeding the volcanoes formed in the lower mantle (hot spot plume)	-10%		No - these are island arc volcanoes. Subductio
L.	Melt feeding the volcanoes formed by melting in the mantle just above the subducting plate.		☑	

Score: 1.75/2.5

45.

Which of the following statements about lava are **FALSE**?
[Note: several answers may be possible]

	Student Response	Value	Correct Answer	Feedback
A.	The viscosity of a lava increases as the silica content		☑	

	Student Response	Value	Correct Answer	Feedback
	decreases. Note: high viscosity = thick, low viscosity = fluid			
B.	High temperature lavas are more fluid (less viscous) than low temperature lavas.	-50%		This is correct, in general. Increasing temperat will make a melt more fluid. Also, mafic rocks r at higher temperatures - and they are more flu well (both because they have less silica). In contrast, high silica and very viscous felsic mag forms at much lower temperatures.
C.	The more gas a lava contains, the less violent the eruption		☑	
D.	Mafic lavas are very explosive	33%	☑	no, mafic lavas are so fluid that any gas can ea escape. So pressure doesn't build up.
E.	A lava or magma can contain solids (unmelted minerals) and gas.			

Score: 0/2

46.

Mt Baker (just southeast of Vancouver) and Mt. Garibaldi (just south of Whistler and close to Squamish) are examples of: (more than one choice is possible)

	Student Response	Value	Correct Answer	Feedback
A.	a cinder cone			

	Student Response	Value	Correct Answer	Feedback
B.	a stratovolcano (composite volcano)	50%	✓	
C.	a shield volcano			
D.	plume (or hotspot) volcanism			
E.	continental arc	50%	✓	
F.	island arc			

Score: 2/2

47.

You live 15 km away from the base of a glacier-covered stratovolcano (perhaps Mt. Baker, or Mt. Rainier, or Mt. Fuji in Japan). Your house is in a lovely, scenic river valley (the river formed by dra from the runoff and snow/ice melt from the volcano). And, just because of the prevailing wind patterns, your house is generally downwind from the volcano.

Which order of hazards (from extremely hazardous to not very) correctly describes the situation

Statement	Response	Value	Correct Mat
most hazardous:	Lahar	25.0%	Lahar
a likely problem, but not extremely hazardous:	Pyroclastic flow	0.0%	Tephra (ash)
hazardous but not that likely:	Tephra (ash) fall	0.0%	Pyroclastic flc
not a problem:	Lava flow	25.0%	Lava flow

General Feedback: Lahars can travel very far and they flow down existing river valleys. Therefore, you are prime place for lahar risk.

Pyroclastic flows are extremely dangerous. However, they don't necessarily follow valle beds, and it would be uncommon for one to run 15km. So possible, but unlikely.

Stratovolcanoes can produce a voluminous amount of ash (which, by the way, increase risk of lahars). They are the most common problem, but generally aren't extremely hazardous unless it is a massive eruption. And even then, if you aren't too stubborn ar remain in a house that is slowly getting covered by a lot of ash, you're likely to be out the way when the roof collapses. There are respiratory problems associated with ash f but a good wet cloth in front of your mouth will save you from the worst.

As for lava flow, generally stratovolcano don't produce much lava and it is viscous eno

won't flow for 15 km. It would also be very slow-moving flow, so even if you were clos
likely wouldn't ben issue.

Score: 1/2

48.

The Cascade volcanoes present many hazards. Mt. Rainier is the largest of the Cascade volcanoes
it is located just east of Seattle/Tacoma and there is a very large population living to the west of t
mountain.

Like all the Cascade volcanoes, it is potentially explosive (and has explosively erupted in the past
that hazard is always there. However, lahars present a very different hazard - and one that also h
very long, well-documented geological record. Which of the following statments are true?
(Mark all correct answers, marks deducted for wrong answers). least at present)?

	Student Response	Value	Correct Answer	Feedback
A.	Lahars are mudflows that have quite a low percentage of water (so very high density).		☑	
B.	One of the big problems with a lahar is that they flow too quickly to warn people in its path.			
C.	Lahars are potentially dangerous for the entire area around the mountain within about 40 km.	0%		No. They follow existing drainages (flowing dov river channels). So they are only really danger in confined channels. However, they can flow m further than 50 km. Large Lahars from Mt. Rai have flowed several hundred kilometers, all the to the ocean! Yes. Rainier has a long geologica history of major lahars, some of which have flo all the way to the ocean (through downtown Tacoma). It has all the ingredients.
D.	Mt. Rainier has the	50%	☑	yup!

	Student Response	Value	Correct Answer	Feedback
	ingredients required for lahars to form: glaciers (providing water), major rainfall/snow zone, highly unstable edifice.			
E.	As long as Mt. Rainier remains dormant (not erupting), then the people in the region don't need to be worried about lahars.			

General Feedback: Although Rainier poses the same eruption hazards as St.Helens in terms of potential explosive eruption and related ash fall, the big issue with Rainier are the repeated laha

These don't require an eruption at all. You have all the ingredients there:
* Steep, unstable slopes with unstable rock (ash, shattered lavas)
* Water from the glaciers on top, large snow and rainfalls
* Plus extra incentives from eruptions or hydrothermal flow melting ice or earthquakes triggering instability.

The result are quite frequent lahars that ooze down the river valleys, sometimes reach all the way to the coast (through downtown Tacoma). The map in the pdf slides (hazar slide 14) shows that very large flows certainly repeat with in 500-1000 years and som smaller ones that can still reach Tacoma occur within only a 100-500 recurrence perio too unlikely that we'll see one happen in our lifetimes!

Check out the amazing pictures of huge damage caused by them recently in the Philip and Indonesia. Here is a video (http://youtube.com/watch?v=xsslQXyBA6k) of destru in by a lahar after the typhoon triggered it to flow down from Mt. Mayon.

They are also interesting because of the battle that government needed to fight with developers east of Seattle. The river valleys there are lovely - and the developers wan

put in LOTS of houses. The US Geological Survey pushed the government to stop all development... So far development (in the high-hazard areas has stopped) but noone been moved out that has already been living there. Although I assume they have beer warned.

Score: 1/2

49.

Partial melting is a very important process for modifying the continental crust.

Think about what happens in a subduction zone environment. Look at what causes the melting, a how that process works in relation to the subducting lithosphere.

A range of magmas erupt from continental volcanoes (like Mt.Baker, Mt. Garibaldi, Mt. St.Helens) from quite mafic to quite felsic. It is the felsic lavas that are the most explosive.

When felsic lavas erupt where did the vast majority of that felsic lava form?

	Student Response	Value	Correct Answer	Feedback
A.	It represents melted oceanic crust (melted during subduction).			
B.	It represents the melted mantle rock above the subducting oceanic plate which was triggered to melt by water released by the subducting oceanic crust.			

	Student Response	Value	Correct Answer	Feedback
C.	It is a melt or partial melt of the continental crust (overriding plate).	100%	✓	Yup. The mafic magma rising from the mantle above the subducting plate causes substantial partial melting in the intermediate/felsic crust. Repeated partial melting generates more and m felsic magmas.
D.	It is a partial melt of the subducting continental crust.			

General Feedback: The key in this question is looking at how magmatism affects the composition of the cr Check out the pdf slides on this.

Partial melting of the asthenosphere produces mafic melt that forms the oceanic crust.

In subduction zones, you have that 'water-saturated' mafic oceanic crust sinking down the mantle as part of the oceanic plate. Some, but not much of it melts. It is currently thought that the water is forced from the plate (pressure and by chemical reactions) a the water causes more partial melting in the mantle above the subducting plate. So, ir case, that magma would be mafic. That magma rises (buoyant) into the overriding pla and up into the crust. There, the heat from the rising magma causes more partial melt Therefore, the magmas created there can have a HUGE range of composition! It all de on what the composition of the overriding crust is.

Score: 1/1

50.

Hot spot volcanism is caused by mantle plumes - relatively narrow columns of buoyant, hot ultrar mantle rock, rising up to the crust and when the pressure decreases enough, there is partial melt and basaltic magma rises up through the crust.

There are hot spot volcanoes on oceanic and continental crust.

Which of the following statements are true?
(more than one may be correct)

	Student Response	Value	Correct Answer	Feedback
1.	The type of volcano (stratovolcano)			

	Student Response	Value	Correct Answer	Feedback
	produced by a mantle plume is the same on both oceanic and continental crust			
2.	Hot spot volcanoes built on continental crust tend to be much more explosive than those on oceanic crust.	50%	✓	Yes. For example, Yellowstone vs. Hawaii. You have flood basalts (very mafic, fluid lava flow continental crust (as you normally get on oce crust). But places like Hawaii are not explosiv
3.	Mantle plumes or hotspots can generate felsic volcanism at both oceanic or continental volcanoes.			
4.	Mantle plumes or hotspots can generate mafic volcanism at both oceanic or continental volcanoes.		✓	

Score: 0.5/1

51.

A chain of volcanoes that exhibits a clear progression in eruption age from recent at one end to o and older along the chain is most likely a/an:

	Student Response	Value	Correct Answer	Feedback
A.	island arc	0%		
B.	continental arc			

	Student Response	Value	Correct Answer	Feedback
C.	hot spot track		☑	
D.	sequence of impacts			

General Feedback: Hotspot volcano chains form when a relatively stationary plume creates a volcano on t surface and the plate, moving over the top, gradually carries that volcano away. The p continues -an a new volcano is formed. That leads to a chain of volcanoes parallel to t direction of plate motion. They are youngest at the active end where the plume is. As move down the chain, they quickly become extinct and the age of the volcanoes increa steadily away from the active volcano at the end of the chain.

In contrast, subduction arcs (either continental or island arcs) are chains of volcanoes parallel to the plate boundary and there tends to be a wide range of ages all down the with many of them being active at the same time. For example: Mt.Garibalidi, Mt.Bake Rainier, Mt. St.Helens are all active now or have been active very recently.

Score: 0/1

52.

Which of the following statements about isostasy are true?

[Note: More than one answer may be possible]

	Student Response	Value	Correct Answer	Feedback
1.	Isostasy represents how an object will reach a state of buoyancy balance that depends on its density and that of the fluid (liquid or ductile solid) that it 'floats' in.	33.333%	☑	
2.	An object that is less dense than the material it is floating in will			

	Student Response	Value	Correct Answer	Feedback
	float completely on top of the fluid (no part will be submerged because it is less dense).			
3.	Normal continental crust, even when it is cold, is less dense than the ultramafic mantle rock. Therefore, it 'floats' in isostatic balance on/in the mantle and cannot subduct.	33.333%	✓	
4.	The lithosphere is rigid and therefore supports all loads without bending into the more ductile asthenosphere.			
5.	How the lithosphere bends under a load reveals information about its stiffness and about how ductile the asthensphere is below.		✓	

Score: 1.3333/2

53.

My friend Laurent is skiing below the beautiful granitic peak called Mt. Thiassi (about 30 km north Pemberton). Several of the following statements are **true**, which ones?

	Student Response	Value	Correct Answer	Feedback
A.	Granite is an igneous rock and because it is at the surface it is an extrusive rock.	-50%		Granite is an intrusive rock. It cooled within the and was later exposed at the surface.

	Student Response	Value	Correct Answer	Feedback
B.	The mountain is likely part of an old batholith or pluton that is now exposed at the surface.	50%	✓	
C.	Erosion from the top of the thickened crust results in the crust buoyantly rising in response (isostacy). This exposes rocks at the surface that were originally deeper in the crust.		✓	
D.	All the good powder skiing is in the Rockies, not the Coast Range (very important you get this one			

Student Response	Value	Correct Answer	Feedback
correct...).			

Score: 0/2

Completed