

1. Why do we say that the Earth is older than the Moon yet the oldest rock found in the Earth (Gneiss Complex near Great Slave Lake - 4.03b.y.) is younger than the Moon (4.47b.y.)?

- A. Because the Moon has craters in its surface while the craters in the Earth have long been erased. This means that the Moon must have been formed long after the Earth.
- B. Because the Earth was formed after a Mars-sized bolide hit the Moon about 4.5b.y. This means the Moon must have been formed before it was hit.
- C. Because the Moon was formed after a Mars-sized bolide hit the Earth about 4.5b.y. This means the Earth must have been formed before it was hit**
- D. All of above

2. What is the main mechanism that drives Plate Tectonics?

- A. Centrifugal force: plates are accelerated by the rotation of the Earth.
- B. Gravity: cooling lithosphere thickens and becomes more dense with age. The lithosphere then slides under its own weight down the top of the asthenosphere.**
- C. Heat: lithosphere is moved along by underlying convection currents in the deeper mantle. This is something like a ferry full being dragged along by currents.
- D. None of above

3. We divide the Earth into areas known as crust, mantle and core based on:

- A. Mechanical properties.
- B. Chemical and Mineral Composition.**
- C. Temperature gradient.
- D. None of above

4. Why do we say that the Earth's magnetic field is fossilized in the rocks that form oceanic crust?

- A. Because the magnetic minerals present in the rocks that form oceanic crust record the current magnetic field.
- B. Because the magnetic minerals in the rocks of the oceanic crust record the magnetic field present at the time they cooled below their Curie temperature.**
- C. Because the magnetic minerals in the rocks of the oceanic crust record the magnetic field present at the time they heat above their Curie temperature.
- D. None of above

5. What happens if we subtract one electron from an atom?

- A. It becomes negatively charged and we call it an anion
- B. It becomes positively charged and we call it a cation**
- C. It becomes positively charged and it is converted into a cation of the next element in the periodic table
- D. None of above

6. The location and ages of volcanoes within a volcanic island chain that is the product of a hot spot, (e.g. Hawaiian Island Chain) tell us about

- A. **The history of the plate movement on which the island chain is located**
- B. The history of the hot-spot movement on which the island chain is located
- C. All of above
- D. None of above

7. The Big Bang hypothesis says that:

- A. There was a big explosion in our solar system that created all the planets
- B. **13-14 billion years ago, all matter and energy was concentrated into a single, inconceivably small (and very dense) point**
- C. 4.56 billion years ago, all the mater and energy in our solar system was concentrated into a single, inconceivable small (and very dense) point
- D. None of above

8. Soon after the Big Bang, why did the interstellar cloud begin to contract to form our solar system?

- A. **Because of the gravitational attraction of the protosun**
- B. Because the interstellar cloud began to cool down
- C. Because the interstellar cloud began to heat up
- D. Because of the magnetic attraction of the protosun

9. Why did the interstellar cloud that eventually became our solar system, spin faster as it contracted?

- A. Because particles in the cloud where more intensely attracted to the sun and 'fell' faster.
- B. Because the particles in the cloud where heated by the sun and used this energy to spin faster.
- C. **Because of the same effect that we see the when ice skaters pull their arms closer to their bodies: in order to conserve their angular momentum they naturally start to spin faster.**
- D. None of above.

10. We say that geology, unlike many other sciences, has the concept of "deep time" which means

- A. Geology works in a time frame of hundreds of millions of years.
- B. It takes time to go deep inside the Earth
- C. Because in the Earth processes occur at very low rates and over very long periods of time
- D. **A and C.**

11. Why did NASA's Stardust mission collect interstellar dust?

- A. Because they are removing pollution that obscures the vision of the Hubble telescope
- B. Because the dust contains materials that are not found anywhere else in our solar system

**C. Because the dust is made of the same particles as the ones found in the early solar system, at the time of its creation.**

D. All of above

12. Why is the Hubble telescope important to our understanding of the universe?

**A. Because the Hubble telescope is in orbit around the earth and therefore does not experience the same atmospheric distortion and attenuation as land-based telescopes do, and so it is able to look farther away at more distant and ancient stars.**

B. Because the Hubble telescope is in orbit around the earth and therefore experiences greater atmospheric distortion and attenuation, so it is able to look farther away at more distant and ancient stars.

C. Because the Hubble telescope is in orbit around the earth and therefore can move fast due to the lower gravity in outer space

D. None of above

13. What is (are) the major difference(s) between the terrestrial planets and the outer planets in our solar system?

A. Terrestrial planets are denser and hence closer to the Sun

B. Terrestrial planets were built up by multiple collisions and accretion of planetesimals by gravitational attraction

C. The outer planets grew by mainly by gas accretion

**D. All of above**

14. On the surface of terrestrial planets such as Venus, Mars and the Earth we can see very large relief, i.e. high and low lands instead of a uniformly elevated surface. Why?

A. Because several meteorite impacts on the surface of these planets generated the relief

B. Because these planets have always had this shape since the time of their creation

**C. Because of some internal process that builds mountains, volcanoes, etc., called Plate Tectonics**

D. None of above

15. Why is Aluminum not a main chemical component of the Whole Earth and yet Aluminum a main chemical component of the Earth's crust?

A. Because when the Earth was formed Al was scarce but now Al is abundant at the surface because it has since been brought in by many meteorites

B. Because Aluminum, although has been extensively mined by our civilization, has always been recycled.

**C. Because Aluminum is lighter than the average composition of the whole Earth, and remained primarily in the lighter crust when the Earth was fluid enough to permit global chemical differentiation.**

D. All of above

16. What is the difference between crust and lithosphere?

A. The crust contains the lithosphere and solid mantle.

B. The crust contains the lithosphere and asthenosphere.

- C. The lithosphere contains the crust and ductile mantle.  
**D. The lithosphere contains the crust and rigid mantle.**

17. Why does ridge push exist?

**A. Because the hotter, more buoyant and elevated lithosphere located closer to the ridge, slides down under its own weight and pushes the colder, less buoyant lithosphere located farther away from the ridge.**

B. Because the colder, denser lithosphere that has been subducted under a trench gravitationally pulls the less dense lithosphere located farther away from the trench.

C. All of above

D. None of above

18. Why does trench pull exist?

A. Because the hotter, more buoyant lithosphere located closer to the ridge, gravitationally pushes the colder, less buoyant lithosphere located farther away from the ridge.

**B. Because the colder, denser lithosphere that has been subducted under a trench gravitationally pulls the less dense lithosphere located farther away from the trench.**

C. All of above

D. None of above

19. Why does the ancient magnetic field, recorded in oceanic rocks, change direction as we move in a direction perpendicular to the mid-oceanic ridges?

A. Because the Earth's magnetic field experiences magnetic reversals, meaning that the magnetic north and south poles switch and these reversals are recorded in the oceanic crust.

B. Due to the spreading of oceanic crust and the magnetization of its rocks at the time of cooling, the reversals and normal periods of the Earth's magnetic field are recorded as alternating bands of normal and reverse magnetization parallel to the ridges.

**C. All of above**

D. None of above

20. Why we do not find a banded pattern of normal and reverse magnetization in continental crust as we do in oceanic crust?

**A. Because continental crust is not being produced at volcanic oceanic ridges**

B. Because the continental crust is generated at hot spots

C. Because the rocks of the continental crust do not have magnetic minerals that can record the Earth's magnetic field when they cool through their Curie temperature.

D. None of above

21. Why is the magnetic field recorded in oceanic crust symmetrically about mid-oceanic ridges?

A. Because the magnetic field produced in the mid-oceanic ridges is pushed away at the same rate on both sides of the ridges.

**B. Because the material produced along mid-oceanic ridges is pushed away at the same rate on both sides of the ridges.**

C. Because the Earth's magnetic field is also symmetric about mid-oceanic ridges.

D. None of above

22. What is the thickness of the lithosphere at a divergent boundary?

A. It is about 5-7 km, close to the average oceanic-crust thickness after the magma has cooled to form oceanic crust.

B. It is about 100 km, close to the average oceanic-lithosphere thickness.

C. It is zero when at the mid-oceanic ridges there is only magma, before the magma cools to form oceanic crust.

**D. A and C**

23. Where do we expect to find the oldest oceanic crust?

A. Close to Hot-spots because Hot-spots heat the rocks above them, resetting their geologic age.

B. Close to oceanic ridges because oceanic crust is created in oceanic ridges and pushed away from them, making the younger crust to move away from the ridges.

C. Away from Hot-spots because Hot-spots heat the rocks above them, resetting their geologic age to a younger one.

**D. Away from the oceanic ridges because oceanic crust is constantly created in oceanic ridges and pushed away from them, making older crust move away from the ridges.**

24. Why is the presence of a magnetic field in a terrestrial planet a good sign that the planet is tectonically active?

A. Because the magnetic field can be recorded in the oceanic crust, permitting us to infer the movement of the tectonic plates.

**B. Because it means that the planet has enough heat left in its interior to have a moving liquid metallic core (Fe) that produces the magnetic field, and this same energy might be able to support a kind of plate tectonics.**

C. Because the rotation of the planet produces the magnetic field and the movement of the tectonic plates (Alfred Wegener's continental drift).

D. None of above

25. Why is the Pacific "Ring of Fire" located at the boundaries of the plates within the Pacific Ocean?

A. Because in general these are transform boundaries where subduction occurs and volcanism is produced

B. Because in general these are divergent boundaries where subduction occurs and volcanism is produced

**C. Because in general these are convergent boundaries where subduction occurs and volcanism is produced**

D. None of above

26. Is the ice from a glacier a mineral?

**A. Yes, because it is a naturally occurring, inorganic, crystalline solid with a definite composition**

B. No, because it does not show a definite shape like a quartz crystal

C. All of above

D. None of above

27. Is coal a mineral?

A. Yes, because it is an inorganic, crystalline solid with a definite composition

B. No, because it does not show a definite shape like a quartz crystal

**C. No, because it is organic**

D. None of above

28. Is water a mineral?

A. Yes, because it is naturally occurring

**B. No, because does not show a definite shape like a quartz crystal**

C. All of above

D. None of above

29. Two atoms with the same number of protons but different number of neutrons in their nucleus are called

**A. Isotopes**

B. Cations

C. Ions

D. Anions

30.  $\text{Na}^+$  and  $\text{Cl}^-$  combine to form Halite (salt) through what type of bonding?

**A. Ionic bonding**

B. Covalent bonding

C. Van der Waals

D. Metallic bonding

31. What is the dominant type of bonding in crustal minerals?

A. Covalent bonding

**B. Ionic bonding**

C. Metallic bonding

D. None of above

32. In order to become electrically neutral, the cation  $\text{Si}^{4+}$  combines with the anion  $\text{O}^{2-}$  and form:

A.  $\text{SiO}_3$

B.  $\text{SiO}_4$

C.  $\text{Si}_2\text{O}_6$

**D.  $\text{SiO}_2$**

33. How can you distinguish a soil coming from a wet environment and a soil coming from an arid environment?

- A. The wet soil has less oxygen available to oxidize the Fe contained in the soil, only making  $\text{Fe}^{2+}$  cations, and making the soil darker (gray)
- B. The arid soil has more oxygen available to oxidize the Fe contained in the soil, producing  $\text{Fe}^{3+}$  cations and making the soil reddish (rust color)

**C. All of above**

D. None of above

34. How do we know the structure of a mineral?

**A. By using X-ray diffraction**

B. By using mass spectrometry

C. By measuring its electrical conductivity

D. All of above

35. To what mineral group does the “fool's gold” mineral belong?

A. Silicate

B. Sulfate

**C. Sulfide**

D. Carbonate

36. What is the importance of micas and clays?

A. They are the minor producers of clay

**B. They are the major producers of clay**

C. They are silicates

D. None of above

37. What is the importance of Hematite?

A. It is the major ore of Fe

B. It marks the time when  $\text{O}_2$  started to be abundant in the history of the earth's atmosphere

**C. All of above**

D. None of above

38. Which of the following minerals is most closely related to the mineral that makes your teeth so hard?

**A. Apatite**

B. corundum

C. Calcium

D. Fluoride

39. The hardest mineral known is \_\_\_\_\_ because it has four \_\_\_\_\_ bonds.

A. Diamond, ionic

**B. Diamond, covalent**

C. Quartz, ionic

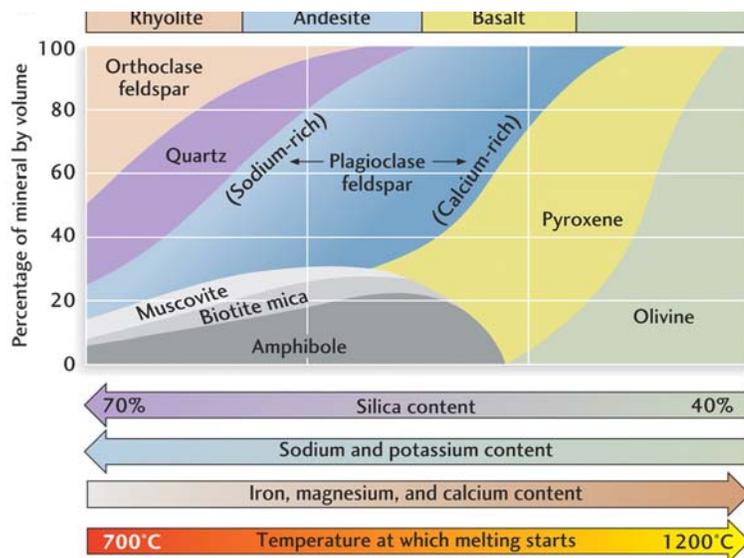
D. Quartz, covalent

40. If they try to sell you quartz for diamond, how could you tell the difference between these minerals?

- A. **By measuring their hardness, because diamond is harder than quartz**
- B. By using the dilute hydrochloric acid test
- C. All of above
- D. None of above

41. What is the dominant type of bonding in crustal minerals?

- A. Covalent bonding
- B. **Ionic bonding**
- C. Metallic bonding
- C. None of above



42. From figure 5.4 (above), gabbro is composed by:

- A. 0%-10% plagioclase feldspar, 0%-72% pyroxene, and 18%-100% Olivine
- B. 8%-25% quartz, 12%-50% orthoclase feldspar, 10%-33% plagioclase feldspar, 8% muscovite, 3% biotite, and 10% amphibole
- C. **10%-60% plagioclase feldspar, 10%-75% pyroxene, 0%-20% amphibole, 0%-15% olivine, and 5% biotite**
- D. None of above

43. We call the process by which different minerals in a rock melt at different temperatures:

- A. **Partial melting**
- B. Partial crystallization
- C. Fractional melting
- D. Fractional crystallization

44. When different minerals precipitate from magma at different temperatures we call this phenomenon

- A. Partial melting
- B. Partial crystallization
- C. Fractional melting
- D. Fractional crystallization**

45. Magmatic differentiation means:

- A. Due to partial melting the composition of magma changes as it cools
- B. Due to fractional crystallization the composition of magma changes as it cools**
- C. All of above
- D. None of above

46. A Dyke is originally formed by

- A. A magmatic intrusion that is concordant with the surrounding rocks
- B. A magmatic intrusion that is discordant with the surrounding rocks**
- C. All of above
- D. None of above

47. Order the three types of volcanoes according to their composition from most mafic to most felsic:

- A. Shield, volcanic dome and Composite
- B. Shield, Composite and volcanic dome**
- C. Composite, Shield and volcanic dome
- D. Composite, volcanic dome and Shield

47. Volcanism at convergent margins is possible because

- A. the high water content of subducted materials lowers the melting point of rocks and produces magma**
- B. the low pressure of subducted materials lowers the melting point of rocks and produces magma
- C. the low water content of subducted materials raises the melting point of rocks and produces magma
- D. the high pressure of subducted materials raises the melting point of rocks and produces magma

48. In a volcanic island chain produced by a hot spot, the island closest to a hot spot is

- A. the oldest
- B. the youngest**
- C. the nicest
- D. the ugliest

49. The lithification of ash and small pyroclastic debris forms a rock called:

- A. Metabasalt
- B. Migmatite

**C. Tuff**

D. Andesite

50. A volcanic dome has

**A. Very high viscosity lava**

B. Very low viscosity lava

C. Mafic lava

D. None of above