

Name \_\_\_\_\_

## **BEP 210 – Epic of Evolution**

### **Midterm Exam - March 17, 2009**

This exam is closed-book and closed-note.

**Part 1: Short Answer (50 points): Answer 10 of the following 12 short questions. Please cross out the 2 that you do not do. Each of these questions is worth 5 points. Please *do not* feel obligated to use all of the space provided.**

1) Explain why the temperature of deep space is not absolute zero, and what this has to do with the Big Bang.

Everywhere in the universe, even in deep space, has a background microwave radiation with a temperature of about 2.7K. This radiation is leftover from the Big Bang.

2) Explain how Earth's moon formed.

A large Mars-sized proto-moon impacted with the early Earth, ejecting material out into orbit around Earth which pulled together by gravity to make the moon. Earth captured the proto-moon's core in the process, which explains why Earth has a large core but the moon has almost no core.

3) What is special about Jupiter's moon Europa?

Europa has a liquid salt-water ocean beneath an icy crust. This ocean is liquid due to tidal forces from Jupiter. This is important because a salt-water ocean is a good candidate for the presence of life.

4) Why is it the case that your body is made of "stardust?"

Almost all elements other than hydrogen and helium form during the supernova process of a dying star. So, the hydrogen atoms from the water in your body is from the Big Bang, but everything else is leftover star material.

5) Why do igneous rocks form with many different minerals?

Different minerals crystallize at different temperatures, and have particular compositions. This means that when magma cools and solidifies, you don't just get one mineral. You get lots of different minerals forming at different temperatures and at different compositions as it cools.

6) Why do volcanoes form above subduction zones?

Water. Water comes down into the subduction zone along with the subducting ocean lithosphere. This water lowers the melting point of rock by hundreds of degrees, allowing magma to form, which rises up to the surface to form volcanoes.

7) If you were to start up a wind power business, what part of this country would you do it in, and why?

The answer is any place that has strong winds. This could be the mid-west, mountainous regions, or coastal regions.

8) Why are mid-ocean ridges a likely place for life to have first evolved on Earth?

They have a right conditions for life to start: energy (heat from thermal vents), source of food (minerals coming out of thermal vents), water, and protection from the harmful ultraviolet radiation at the surface.

9) How can you tell if a valley was made by a glacier and not by a river? Why is this so?

River valley is V-shaped because the water just flows at the bottom and then debris falls down the sides of the valley into the river maintaining a roughly constant angle of repose. A glacial valley is U-shaped because the ice carves away the sides of the valley all along the valley.

10) What do Long Island and Cape Cod have in common?

They are both part of the same large terminal moraine system left over from previous ice ages when rock of Canada and New England was scraped off and dragged southward by the glaciers.

11) Explain the causes of global climate changes on the order of 10s-100s of thousands of years?

They are due to changes in Earth's orbital parameters called the milankovitch cycles: changes in Earth's elliptical orbit shape, rotation axis tilt, and orientation of axis.

12) If global temperatures increase by about one degree, why is it likely that temperatures on the continents will rise much more than that?

The latent heat of water is about 5 times greater than for rock (that means that it takes about 5 times as much energy to increase the temperature of water than of rock). So as global temperatures go up, the land surface will warm about 5 times faster than the ocean water.

**Part 2: Multiple Choice (30 points): Answer all of the following multiple-choice questions. Each is worth 2 points.**

- 1) The region of the Earth where rock flows enough to let the tectonic plates slowly move overhead is the:
 

(a) mesosphere	(b) asthenosphere	(c) troposphere
(d) stratosphere	(e) lithosphere	
  
- 2) The region of the atmosphere where ozone resides, protecting Earth's surface from ultraviolet radiation, is the:
 

(a) mesosphere	(b) asthenosphere	(c) troposphere
(d) stratosphere	(e) lithosphere	
  
- 3) What Earthlike characteristic is observed on Saturn's moon Titan?
 

(a) rivers and lakes	(b) tectonic plates	(c) desert sand dunes
(d) a large magnetic field	(e) eukaryotic life	
  
- 4) The reason that volcanoes occur at mid-ocean ridges is due to
 

(a) pressure release	(b) very hot rock there	(c) the presence of CO <sub>2</sub>
(d) the location of hot spots	(e) the subducted sediment	
  
- 5) Rocks on Earth are primarily made of what two minerals?
 

(a) iron and silicon	(b) iron and magnesium	(c) iron and carbon
(d) silicon and oxygen	(e) nitrogen and carbon	
  
- 6) Which of these is not a source of human-usable energy?
 

(a) rivers	(b) wind	(c) tides
(d) biomass	(e) hydrogen fuel cells	
  
- 7) A period of intense glaciation about 72,000 years ago, when humans likely died off in large numbers, is likely the result of a
 

(a) decrease in solar output	(b) meteorite impact	(c) passing comet
(d) large volcanic eruption	(e) sudden change in ocean circulation	
  
- 8) The Little Ice Age, during about 1600-1850, is likely the result of a
 

(a) decrease in solar output	(b) meteorite impact	(c) passing comet
(d) large volcanic eruption	(e) sudden change in ocean circulation	
  
- 9) The largest use of water in the U.S. is for
 

(a) electricity generation	(b) growing crops	(c) raising cattle
(d) processing garbage	(e) running factories	
  
- 10) The reason that protons stay together in the nuclei of atoms is due to
 

(a) nucleosynthesis	(b) covalent bonds	(c) gravity
(d) the strong nuclear force	(e) the weak nuclear force	

11) Humans have brought about the end of the Cenozoic Era and started a new geologic epoch called the Anthropocene, based upon

- (a) the amount of land that is now paved
- (b) the amount of rivers and streams that have been channeled with levees
- (c) an increase in land erosion rates
- (d) the number of species that are going extinct**
- (e) the rapid change in the hydrologic cycle

12) The reason that the actual universe is larger than the visible universe is a result of

- (a) the period of cosmic inflation**
- (b) gravity
- (c) the strong nuclear force
- (d) the weak nuclear force
- (e) quantum fluctuations at the time of the Big Bang

13) The source of Earth's heat, which keeps plate tectonics going, is

- (a) the core dynamo
- (b) radioactive decay**
- (c) solar radiation
- (d) tidal forces from the sun and moon
- (e) leftover heat from Earth's formation

14) Which of these was not a source of the increase in Earth's temperature early in its history?

- (a) impacts of planetesimals
- (b) radioactive decay
- (c) nucleosynthesis**
- (d) collapse of Earth's core
- (e) gravitational compression

15) Venus is not likely to ever be a site for future human colonization. Which of these is NOT a reason why we will likely never live there?

- (a) its gravity is so much more than Earth's**
- (b) it is very hot -- 460°C
- (c) there is no water on the planet
- (d) the atmosphere rains out sulfuric acid
- (e) the pressure at the surface is 90 times that of Earth

**Part 3: Orders of Magnitude (10 points): Answer all of the following multiple-choice questions.**

1) Going up in the atmosphere, you reach a point where half of the air is below you when you go up how many kilometers?

- (a) 0.35 km
- (b) 3.5 km**
- (c) 35 km
- (d) 350 km
- (e) 3500 km

2) All of the hydrogen and helium of the universe was formed how soon after the start of the Big Bang?

- (a) 20 minutes**
- (b) 20 days
- (c) 20 years
- (d) 20 thousand years
- (e) 20 million years

3) How old is the Atlantic Ocean? (i.e., How long ago could you have walked from New York to West Africa?)

- (a) 2 million years
- (b) 20 million years
- (c) 200 million years**
- (d) 2 billion years
- (e) 20 billion years

- 4) The percentage of carbon dioxide in the atmosphere is now:  
(a) 0.0039% (39 parts per million)    (b) 0.039% (390 parts per million)  
(c) 0.39% (3.9 parts per thousand)    (d) 3.9% (39 parts per thousand)  
(e) 39% (390 parts per thousand)
- 5) The height that the sea level would rise if all glacial ice melted is?  
(a) 0.023 feet    (b) 0.23 feet    (c) 2.3 feet    (d) 23 feet    (e) 230 feet

**Part 3: Name That Process (10 points): Answer all of the following multiple-choice questions.**

- 1) The process by which geologic activities occur slowly and gradually over very long periods of time is:  
(a) erosion    (b) entropy    (c) sedimentation    (d) uniformitarianism    (e) accretion
- 2) The process by which ocean sea floor gets recycled into the mantle is:  
(a) subduction    (b) accretion    (c) solifluction    (d) orogenesis    (e) sedimentation
- 3) The process by which heat is transferred by its flow through rock is:  
(a) convection    (b) radiation    (c) conduction    (d) thermodynamics    (e) connection
- 4) Soils are made by the process of  
(a) ablation    (b) weathering    (c) sedimentation    (d) cementation    (e) orogenesis
- 5) The 6 different bands of Earth's atmospheric circulation are the result of a process called  
(a) El Nino    (b) the Coriolis Effect    (c) Hadley cell generation  
(d) evapotranspiration    (e) orographic lifting