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# SESSIONAL EXAMINATIONS: FALL 2010

Course number: EOSC 114 Section number: 101, 102 & Distance Ed.
Course name: The Catastrophic Earth: Natural Disasters
Duration: 1.5 Hours

## Candidate information

Candidate name

Student number

Candidate signature

Special instructions No notes, no calculators. Make sure to write your NAME and STUDENT ID on this cover AND your scantron (both in letters and by filling in the bubbles)

This examination consists of 63 questions (including this cover sheet). Check to ensure it is complete.

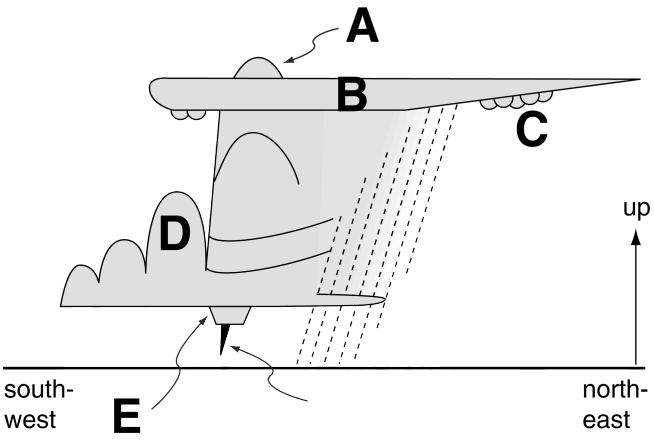
**Instructions:** Closed book. No calculator. Indicate all your answers on the Scantron sheet. Only the Scantron sheet will be marked, but turn in both the Scantron (answer) sheet and this question packet. Put your name and student number on both the Scantron sheet and the question packet. There is only one best answer to each question. Don't leave any questions unanswered (if you don't know the answer, then guess). Good luck!

## Rules governing formal examinations

1. Each candidate must be prepared to produce, upon request, a UBCcard for identification;
2. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions;
3. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination;
4. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action:
   - Having at the place of writing any books, papers or memoranda, calculators, computers, sound or image players/recorders/transmitters (including telephones), or other memory aid devices, other than those authorized by the examiners;
   - Speaking or communicating with other candidates;
   - Purposely exposing written papers to the view of other candidates or imaging devices. The plea of accident or forgetfulness shall not be received.
5. Candidates must not destroy or mutilate any examination material; must hand in all examination papers; and must not take any examination material from the examination room without permission of the invigilator.
6. Candidates must follow any additional examination rules or directions communicated by the instructor or invigilator.

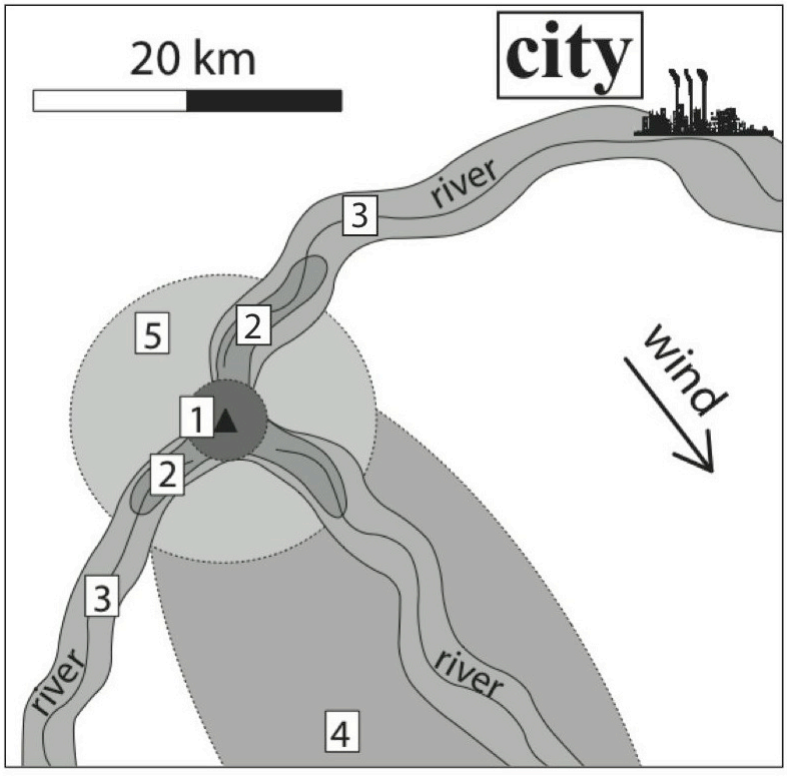
**This is "Test Form" (A). Please indicate (A) in the "Test Form" column on your Scantron sheet.**

1. In the diagram to the right, which of the labels correctly identifies a thunderstorm component?
   A) anvil cloud
   B) mammatus cloud
   C) wall cloud
   D) flanking line
   E) tornado funnel




2. Supercell thunderstorms are characterized by
   A) an exceptionally large number of cells in different stages of their life cycles
   B) a very short life span, which concentrates the destructiveness, thereby increasing its intensity
   C) mammatus clouds, which are a clue to the strong intensity of the storm
   D) rotation of the whole thunderstorm, as can be seen by eye
   E) a mesocyclone

3. Which hazard is denoted by the number 4 on the volcanic hazard map shown to the right?
   A) Volcanic bombs
   B) Lava flows
   C) Pyroclastic flows
   D) Lahars
   E) Volcanic ash




4. Most lahars fall into which category of mass movement?
   A) Falls
   B) Slides
   C) Flows
   D) Spreads
   E) Lahars are not landslides because they are a volcanic process.

5. Which phrase will make this statement TRUE?
   To forecast tsunamis, the DART buoy system measures ____.
   A) pressure changes
   B) thermal expansion
   C) gravitational forces
   D) current direction
   E) wind strength and speed

6. Which statement is TRUE?
   A) Lahars are hotter than pyroclastic flows
   B) Pyroclastic flows travel faster than lahars
   C) Pyroclastic flows can travel greater distances than lahars
   D) Lahars only occur at snow-capped volcanoes.
   E) Lahars and pyroclastic flows usually occur during cinder cone eruptions.

7. Asteroids are ____.
   A) primarily composed of ice
   B) generally found in the Oort cloud
   C) composed of sedimentary rocks
   D) generally found inside the orbit of Jupiter
   E) all composed of objects larger than Jupiter

8. Which phrase will make this statement TRUE? After a groin is installed, the coastline will ____.
   A) not change
   B) accrete (deposit) on both sides of the groin
   C) erode on both sides of the groin
   D) accrete (deposit) on the up-current (up-drift) side, and erode on the down-current (down-drift) side
   E) erode on the up-current side, and erode on the down-current side

9. Which phrase will make this statement TRUE? The west coast of Vancouver Island is exposed to ____.
   A) large, wind-driven waves
   B) tsunami
   C) rogue waves
   D) surf
   E) all of the above

10. The modified Mercalli scale indicates ____.
   A) the magnitude of an earthquake
   B) the amount of energy released by an earthquake
   C) the intensity of an earthquake
   D) the amount of the slip on a fault
   E) the magnitude and the intensity of an earthquake

11. What characteristics of hurricanes are NOT also associated with individual thunderstorms?
   A) updrafts
   B) chance of tornadoes
   C) anvil clouds
   D) heavy rain showers
   E) storm surges

12. What is thought to be the source of the sulfur dioxide that was released into the atmosphere following the impact at Chicxulub?
   A) vaporized comet
   B) burning dinosaurs
   C) combining elements in the atmosphere after the initial blast
   D) limestones
   E) evaporites

13. Concerning the Cretaceous-Tertiary (K/T) extinction, which of the following was a probable contributory factor?
   A) Volcanism in Siberia
   B) Impact in Siberia
   C) The formation of the supercontinent Pangea
   D) Volcanism in India
   E) Glaciation

14. Which of the following would be about the same size as the object that impacted the Earth at the end of the Cretaceous?
   A) The North American continent
   B) UBC campus
   C) Mount Everest
   D) The 99 B-line bus
   E) British Columbia

15. Which phrase will make this statement TRUE? Rogue waves form by ____.
A) destructive interference between tsunami and salinity currents
B) constructive interference between strong currents and wind-driven waves
C) constructive interference caused by the gravitational pull from the moon and sun
D) water displacement from earthquakes and landslides
E) destructive interference within enclosed bodies of water

16. Which of the following sequence of events BEST describes the possible conditions on Earth following the impact at Chicxulub? (➔ indicates "is followed by")
A) Hot house conditions (1 – 2 days) ➔ Cold house conditions (3 – 4 years)
B) Initial inferno and vaporization of all close to impact ➔ Cold house conditions (3 – 4 years) ➔ Hot house conditions (1 – 2 days)
C) Initial inferno and vaporization of all close to impact ➔ Cold house conditions (2 months) ➔ Hot house conditions (5 years)
D) Hot house conditions (1 – 2 days) ➔ Cold house conditions (3 – 4 years) ➔ Glaciation (2 – 3 million years)
E) Initial inferno and vaporization of all close to impact ➔ Cold house conditions (3 – 4 years) ➔ Glaciation (1 – 2 decades)

17. Which of the following is TRUE?
A) A tsunami event ends after the first wave reaches the shore
B) The first wave of a tsunami is always the largest
C) Scientists can accurately forecast tsunami arrival time
D) Scientists can accurately forecast tsunami inundation height
E) All of the above

18. In preparation for an exceptionally intense earthquake to hit Vancouver, you should
A) accept your fate and prepare to die
B) keep your cell phone charged so you can call all your friends
C) remember to call 911, because the rescue organizations probably won't know that the earthquake has happened
D) prepare for the disaster ahead of time so you can be confident that you have a greater likelihood of survival
E) not plan for the disaster ahead of time because you are confident that everyone else will focus their efforts on rescuing you

19. The risk of tornadoes in North America is greatest ____.
A) near noon in Florida, USA
B) during winter in mountainous regions
C) near sunset in Ontario, Canada
D) near noon in Alberta, Canada
E) near sunset in Oklahoma, USA

20. Rain associated with individual thunderstorms ____.
A) covers broad regions with light drizzle
B) can last for days and cause widespread flooding
C) is strongest in the updraft regions of storms
D) is strongest when they also produce the most hail that reaches the ground
E) can be heavy and cause localized flash floods

21. Why has no crater associated with the Tunguska event ever been found?
A) The object fell into the deep ocean
B) The object exploded in mid air before it hit the ground
C) The object impacted into marshy ground and as a result left no crater
D) The crater was covered by sediments
E) The crater was quickly eroded by advancing glacial ice sheets

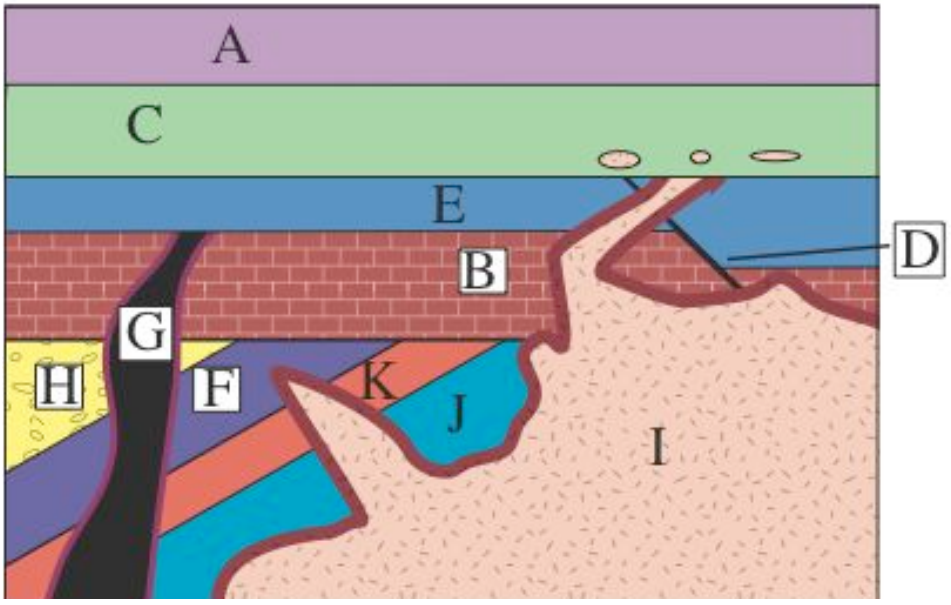
22. Which of the following would NOT be considered a “steady-state orbit adjustment” of an asteroid?
A) Exploding a large nuclear warhead in the path of the asteroid
B) Attaching a solar sail to the asteroid
C) Ablating the surface of the asteroid using a large mirror
D) Attaching a nuclear engine to the asteroid
E) Excavating large chunks of the asteroid and throwing them off the surface

23. Which statement is FALSE?
A) Rayleigh waves are the most destructive seismic waves
B) S-waves are surface waves
C) P-waves can move through fluids
D) Surface waves travel slower than body waves
E) P-waves are the fastest body waves

24. Which of the following techniques and/or instruments are used to monitor volcano deformation?
A) COSPEC, tiltmeters, InSAR
B) Tiltmeters, COSPEC, FTIR
C) GPS, tiltmeters, FTIR
D) InSAR, COSPEC, GPS
E) GPS, tiltmeters, InSAR

25. In which of the following continental configurations would you expect the highest biodiversity?
A) Supercontinent configuration in the southern hemisphere
B) Supercontinent configuration centered around the equator
C) Two large supercontinents separated by an equatorial ocean
D) Moderately fragmented continental configuration
E) Highly fragmented continental configuration

26. Refer to the figure below: A hypothetical geological section exposed in a highway road cut. Rocks I and G were magmatic igneous intrusions that are now crystalline igneous rocks. The diagonal bold line is a geological fault. Which of the following statements is TRUE?



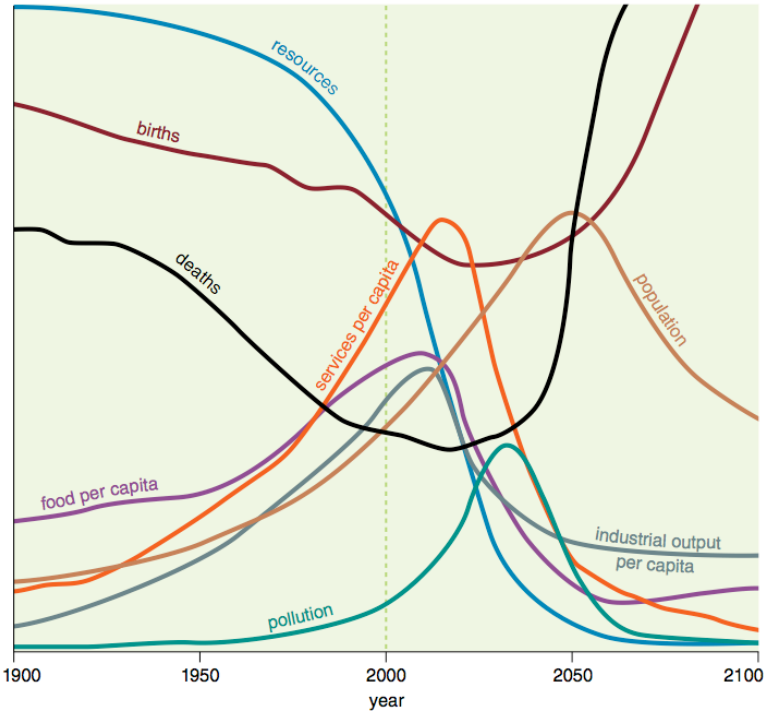

A) D is older than I but younger than E
B) G is younger than I
C) F is older than G but younger than B
D) I is the oldest feature on this figure
E) G is the oldest feature on this figure

27. Why are ammonites useful fossils for biostratigraphy?
A) Because they were present on many different land masses
B) Because many of them have very long geological ranges
C) Because they are especially common in rocks where dinosaurs are found
D) Because they evolved rapidly with many short ranging forms
E) Because they are found from the Cambrian all the way through geological time to the Tertiary

28. Which phrase will make this statement TRUE? As waves shoal _____.
A) waves speed up
B) wavelengths lengthen
C) wave height increases
D) wave period decreases
E) wave amplitude stays the same

29. Which phrase will make this statement TRUE? Overpopulation _____.
A) applies to limited areas (such as countries) or environments, but NOT to the whole Earth
B) is NOT a concern anymore, because population growth has slowed
C) is NOT an issue that should be addressed by cultural, religious, and political leaders
D) can be addressed only by societies or governments, NOT by individuals such as you
E) is already occurring in some areas and is affecting the whole Earth

30. Regarding population growth, the graph at the right suggests that
A) population begins decreasing when deaths start increasing
B) pollution starts decreasing at the same time that industrial output per person starts decreasing
C) during the next 30 years of your life, population will increase while food available per person decreases
D) quality of life (food per capita, services per capita) will increase over the next 100 years
E) as population decreases in future years, resources will become more abundant




31. Suppose a new order-of-magnitude disaster scale was invented, and named after you. If disaster X was intensity 10 on this scale, and disaster Y was intensity 1 on this scale, then:
A) X is 10 times stronger than Y
B) X is 1 times stronger than Y
C) X is 9 times stronger than Y
D) X is $10^9$ times stronger than Y
E) X is $10^{10}$ times stronger than Y

32. All of the following are direct or indirect effects of the production of flood basalts. Which would probably have the LEAST effect on the generation of a mass extinction event?
A) acid rain
B) ozone depletion
C) greenhouse gases
D) atmospheric cooling effects
E) flowing or ponded lava

33. Suppose a comet that is speeding through space hits a stationary asteroid. If we assume that neither object changes its shape or temperature but both change their direction and speed, the energy conversion during this collision is: (Hint: assume that these two objects act like billiard balls when one hits the other)
A) kinetic energy to kinetic energy
B) kinetic energy to potential energy
C) kinetic energy into sensible heat
D) kinetic energy into latent heat due to the flash boiling of the asteroid
E) potential energy to potential energy

34. What is the Torino Scale?
A) A scale that assesses the risk of impact from near Earth objects
B) A scale that considers the severity of mass extinction events during the Phanerozoic
C) A scale that is used to measure the length of time a fossil species has existed on the planet
D) A scale that compares the severity of disasters between earthquakes, tsunami and impacts from space
E) A scale for estimating the relative fragmentation of continents through geological time

35. Which of the following extinction events bracket the Mesozoic?
A) Ordovician and the Cretaceous-Tertiary
B) Late Devonian and the Ordovician
C) Permo-Triassic and the Cretaceous-Tertiary
D) Permo-Triassic and the end Triassic
E) Late Devonian and the Cretaceous-Tertiary

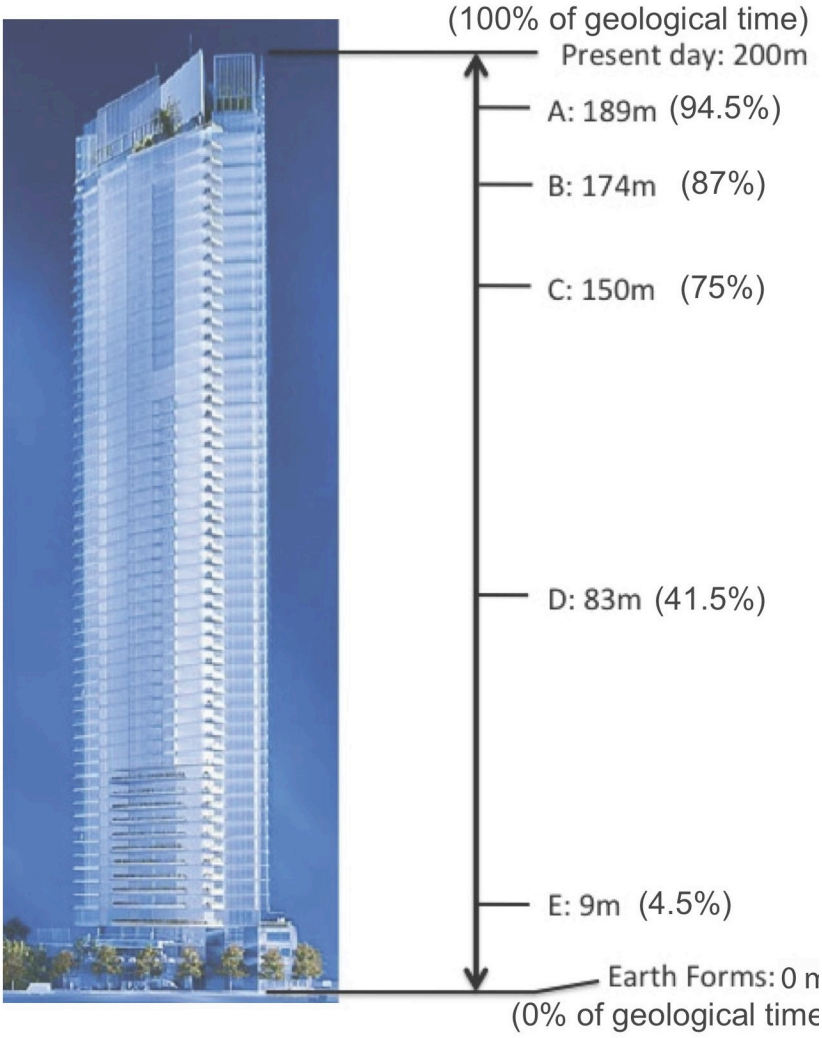
36. The slopes of stratovolcanoes are _____ because they erupt _____ viscosity magma of mostly _____ composition.
A) Steep, high, mafic
B) Shallow, high, felsic
C) Steep, high, intermediate
D) Shallow, low, intermediate
E) Steep, low, felsic

37. Why does an increase in volcanic seismicity suggest a possible eruption?
A) It indicates that the volcano is inflating
B) It indicates that magma is moving below the volcano
C) It indicates that pyroclastic material is accumulating in the volcano
D) It indicates that the tectonic plate is beginning to move
E) It indicates that a sector collapse is beginning

38. Which statement is TRUE?
A) A gas is very compressible and very fluid
B) A liquid is very fluid and very compressible
C) Air has greater viscosity than magma
D) "Condensation" is the name for phase change from liquid to solid
E) Power is energy times time

39. How many earthquakes of magnitude 3 would be needed to release the same amount of energy as one earthquake of magnitude 8?
A) 10
B) 100
C) 1,000
D) 10,000
E) 100,000

40. Refer to the figure to the right. At around 200m, the Shangri-La Hotel is currently downtown Vancouver's tallest building. Using the height of the Shangri-La as an analogy for geological time, at what point would you place the base of the Cambrian?
A) A
B) B
C) C
D) D
E) E




41. The 1980 eruption of Mount St Helens measured 5 on the VEI scale. The eruption of Yellowstone 600,000 years ago measured 8 on the VEI scale. How much more material was erupted at Yellowstone than at Mount St Helens?
A) 10
B) 100
C) 1,000
D) 10,000
E) 100,000

42. Generally, on land what was the upper size limit of creatures that survived the Cretaceous-Tertiary (K/T) extinction?
A) 10 kg
B) 25 kg
C) 60 kg
D) 1500kg
E) 1.5 tons

43. Which phrase will make this statement TRUE? In the Northern Hemisphere, storm surges are highest ____.
A) a day before hurricane landfall
B) at the location of hurricane landfall
C) a day after hurricane landfall
D) to the left of hurricane landfall
E) to the right of hurricane landfall

44. The stability state of a slope (Factor of Safety) is measured as the ratio of ____.
A) resisting forces to driving forces
B) frictional forces to cohesive forces
C) driving forces to resisting forces
D) frictional forces to gravity forces
E) gravity forces to resisting forces

45. Tensioning a rock anchor helps to stabilize a slope by _____.
A) using the strength of the steel to hold up the slope
B) preventing rain water from infiltrating into the slope and reducing the effective stresses
C) breaking the rock, allowing it to be easily removed
D) increasing the normal stress thus increasing the frictional strength
E) increasing the tensile strength of the slope

46. Which of the following statements is FALSE?
A) A landslide may be stabilized by applying a resisting force at the toe of the slope
B) Stabilization of a landslide prone area may be achieved by clearing bushes and low vegetation from the slope
C) The rapid infiltration of rainfall is the trigger for most shallow landslides that occur during storms
D) Landslides may occur without a trigger because of processes that gradually bring the slope to failure
E) Water can both stabilize and adversely affect slope stability

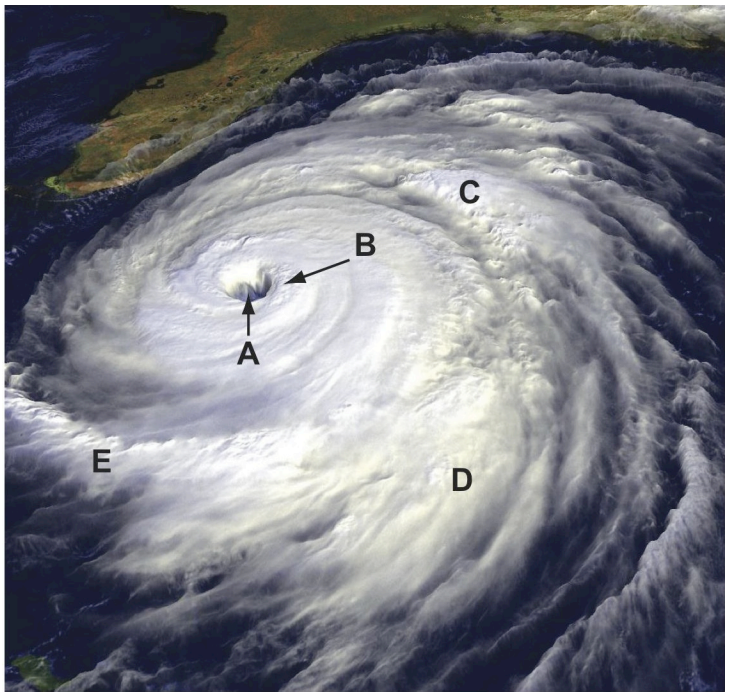
47. Which factor of safety represents the MOST stable slope?
A) 0.5
B) 0.75
C) 1.0
D) 1.5
E) 2.5

48. Which of the following is TRUE?
A) Slope angle has only minor consequences for the factor of safety
B) Undercutting a slope increases the shear stress on that slope
C) Overloading a slope decreases the shear strength of that slope
D) Seasonal change in climate can affect either shear strength or shear stress
E) Vegetation always decreases the shear stress of soil

49. What type of landslide is depicted in the image below?

A) Rock Flow B) Debris Flow C) Soil Flow D) Rock Slide E) Debris Slide

50. In this satellite photo of a hurricane, which label indicates the eye wall?
A) A
B) B
C) C
D) D
E) E




51. An earthquake is ____.
A) an accumulation of stress due to strain
B) a release of energy as seismic waves
C) a collision between two tectonic plates
D) a fracture on which movement has occurred
E) a large-scale tectonic force

52. Which of the following about the Ordovician biosphere is TRUE?
A) Dinosaurs were a common component of the oceanic ecosystem
B) The creatures present in the Ordovician had evolved from forms that existed in the Cretaceous
C) Most of the creatures became extinct (either directly or indirectly) due to the poisoning of the oceans by acid rain
D) Ice would have a major role to play in causing mass extinction in the biosphere
E) The question does not make sense. There was no biosphere during the Ordovician as life had yet to evolve

53. The geological feature shown in the photograph to the right is a ____.
A) reverse fault
B) fold
C) convergent boundary
D) normal fault
E) transform boundary

54. Which natural disaster does NOT have a strong and direct connection with landslides?
A) storms
B) earthquakes
C) waves
D) volcanoes
E) droughts

55. Seismic recording station A is located 30km from the epicenter of an earthquake. Seismic recording station B is located 100km from the epicenter. Which statement is TRUE?
A) The time between the arrival of the P-waves and the S-waves will be greater at B than at A
B) The time between the arrival of the P-waves and the S-waves will be greater at A than at B
C) The surface waves will arrive at B before they will arrive at A
D) The P-waves, S-waves and surface waves will arrive at the same time at A
E) The P-waves will arrive at the same time at A and B

56. Which statement is TRUE?
A) More intense disasters happen more frequently
B) More intense disasters have a shorter return period
C) More frequent disasters have a longer return period
D) More intense disasters have longer-return period
E) There is no significant relationship between disaster intensity and return period

57. *Removed due to content change*

58. If you have data from three earthquake recording stations you can determine
A) when the next earthquake will occur
B) only the distance from the station to the epicenter
C) two places where the earthquake might have occurred
D) if a tsunami was triggered
E) the latitude and longitude of the epicenter

59. When you place the continents in their Late Triassic locations, the Manicouagan crater lines up with which of the following?
A) The Chicxulub impact crater and the Saint Martin crater in Manitoba
B) The Deccan Traps
C) The Siberian Traps
D) The Rochechouart Crater in France
E) Crater of the comet Shoemaker Levy 9

60. "Nemesis" has been used to explain which of the following?
A) Gravity
B) Raup-Sepkoski periodicity
C) The existence of the Oort cloud outside the orbit of Pluto
D) Gravitational kicks from the densest part of the galactic plane
E) The existence of black holes

61. Your chance of dying as a result of an extraterrestrial impact is ____.
A) 1: 2000
B) 1: 300 000
C) 1: 100 000 000
D) greater than your chance of dying in a car related incident
E) about the same risk as dying in an aircrash

62. Under the conditions defined in the lecture notes, which of the following could be described as a MASS extinction event?
A) Extinction of 55% of Earth's species over a 20 million year period
B) Extinction of all species of daisy
C) Extinction of 40% of species in a coral reef environment
D) Extinction of 35% of species over a 50,000 year period
E) Extinction of 20% of species over a 10,000 year period

63. Which of the following statements is TRUE about the Cretaceous-Tertiary (K/T) extinction event?
A) The event was geologically instantaneous. Starting with the impact it probably took less than a year to cause a 50% drop in the biosphere
B) All dinosaurs and their close relatives would be driven into extinction due to them being far too specialized
C) In sediment cores covering the K/T boundary, iridium is always present below the tsunami layer
D) "Burning" nitrogen in the atmosphere may have generated acid rain
E) The accelerated formation of Pangea was causing many environmental problems

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Equations for Fragile Systems Section:

$$\rho = m/Vol \qquad Power = J/s \qquad \Delta Q_E = L \cdot \Delta m \qquad F = m \cdot g$$

$$\Delta Q_H = m \cdot C \cdot \Delta T \qquad KE = 0.5\, m \cdot \nu^2 \qquad W = F \cdot d \qquad PE = g \cdot m \cdot z$$

$$RP = \frac{T}{Number\ of\ Cases} \qquad DT = \frac{70}{annual\ growth\ rate\ \%}$$

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Equation for Landslide Section: $F_s = \frac{\tau_f}{\tau}$

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Equations for Storms Section:

$$\Delta T/\Delta t = (0.338\, K/mm) \cdot RR \qquad F = m \cdot a \qquad P = F/A$$

$$V_{new} = V_{old} + [F/m] \cdot \Delta t \qquad a = \Delta V/\Delta T$$

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Equations for Waves Section:

$$c_{deep} = \frac{L}{T} \qquad c_{shallow} = \sqrt{gd} \qquad T = \frac{1}{f} \qquad A = \frac{H}{2} \qquad S = \frac{H}{L}$$

T : period, A : amplitude, S : steepness, L : wavelength, g : gravity, d : depth, f : frequency, H : height, $c_{deep}$: velocity of deep waves, $c_{shallow}$: velocity of shallow waves.