B - Fossils B - December 19 SO Practice - 12-19-2020

Welcome! The ID pictures referenced in this test may be found in the links below. To prevent too many people from being on the same doc, these have been duplicated and distributed according to team number. **All slideshows are identical, please view the one according to your team number.**
B1-B50: https://docs.google.com/presentation/d/1GOJvLNEY-lJMku-cxxKBvXk17heHwL70iL7xmE2mBD8/edit?usp=sharing (https://docs.google.com/presentation/d/1GOJvLNEY-lJMku-cxxKBvXk17heHwL70iL7xmE2mBD8/edit?usp=sharing)

B51-B100: https://docs.google.com/presentation/d/159HWwOHGPiXWtKuVHnodpm9zsN34LsfxsoAmLtCN9kI/edit?usp=sharing (https://docs.google.com/presentation/d/159HWwOHGPiXWtKuVHnodpm9zsN34LsfxsoAmLtCN9kI/edit?usp=sharing)

Everyone else: https://docs.google.com/presentation/d/1U0MEtwC80p0jvLlIKGfR5ZyJ3OKlPj_jGazNaC_4e-s/edit?usp=sharing (https://docs.google.com/presentation/d/1U0MEtwC80p0jvLlIKGfR5ZyJ3OKlPj_jGazNaC_4e-s/edit?usp=sharing)

- Each page has specimens labeled with letters. Make sure you're looking at the right page when you're answering questions! We recommend split screening.

- For ID questions asking for you to identify three of the letters, give your answers left to right in alphabetical order (i.e. leftmost box is your ID for specimen A, middle box is your ID for specimen B, etc.).

- Please **do not include** taxonomic rank in your actual answer, e.g. put "Otodus" instead of "Genus Otodus".

Good luck!

Page 1

Identify specimens A-I down to the lowest taxonomic level specified on the National Fossil List. Use the exact spelling as specified on the official list.

1. (1.00 pts) Identify A, B, and C.

Pentremites	Ophiuroidea	Fusulinida

2. (3.00 pts) Identify D, E, and F.

Rhombopora	Eurypterida	Elrathia

3. (3.00 pts) Identify G, H, and I.

Nucula	Mucrospirifer	Worthenia

4. (1.00 pts) Image A shows this specimen without their _____, features that indicate that they are _____.

- (●) A) Stems; sessile
- ( ) B) Stems; infaunal
- ( ) C) Venomous stingers; predatory
- ( ) D) Spines; slow moving

5. (1.00 pts) The mode of living of Specimen A most closely resembles which of the following present day organisms?

- ( ) A) Cone snails
- (●) B) Crinoids

C) Sea stars

D) Sea urchins

6. (1.00 pts) Which of the following best describes how well radiocarbon dating can be used to find the age of fossils in the taxon to which specimen B belongs?

A) Age cannot be determined using radiocarbon dating. All in the taxon are too old

B) Age cannot be determined using radiocarbon dating. All in the taxon are too young

C) Age may be determined this way. All in the taxon are young enough

D) Age may be determined this way. All in the taxon are old enough

E) Age may only be determined up to an upper limit

F) Whether or not age may be determined depends on fluctuations in the original amount of carbon-14 present

7. (1.00 pts) Identify all of the following environments that specimen E was/is thought to inhabit.

(Mark **ALL** correct answers)

A) Freshwater

B) Brackish water

C) Marine

D) Beach berms

8. (1.00 pts) Specimen E features what feeding appendages, whose counterparts may also be seen on modern spiders?

Chelicerae

9. (1.00 pts) Specimen F is notable in its temporal range for:

A) Appearing earlier than other genuses in the same class

B) Having the greatest temporal range of other genuses in the same class on the Fossil List

C) Disappearing from the fossil record, then reappearing

D) Surviving the Cambrian extinction

10. (2.00 pts) Select all of the following that can be used to distinguish the classes of G and H.

(Mark **ALL** correct answers)

A) Number of valves

B) Valve symmetry

C) Pedicle opening

D) Presence of growth lines

E) Concavity/convexity

11. (1.00 pts) Which specimen is considered a trace fossil? Give your answer as a single letter, or "none" if there are none.

none

12. (2.00 pts) Which of the following best explains why fossils of C may be used as a proxy for paleotemperature?

- ○ A) Their shells are composed of silica, which has a very temperature-dependent dissolution
- ◉ B) Their shells are composed of calcite, which records the historic oceanic oxygen isotopic ratio
- ○ C) Their shells expand significantly with increased temperature and thus their shell size can be used to infer ocean paleotemperature
- ○ D) Their reproduction rate is significantly suppressed in higher temperatures, so their relative abundance in strata may be used to infer ocean paleotemperature

13. (1.00 pts) Fossils of specimen C are also useful for correlating rocks of similar age.

◉ True ○ False

14. (2.00 pts) Pyritized specimens of G are common in the Upper Windom Shale in New York. Select all of the following statements that this may indicate:

(Mark **ALL** correct answers)

- ☐ A) The environment of fossilization was oxygen-rich
- ☐ B) The Windom Shale was deposited in a lake bed
- ☑ C) The environment of fossilization contained abundant sulfate-reducing bacteria
- ☑ D) The sediments of the Windom Shale were relatively low in organic matter

Page 2

Identify specimens A-I down to the lowest taxonomic level specified on the National Fossil List. Use the exact spelling as specified on the official list.

15. (3.00 pts) Identify A, B, and C.

Latimeria | Knightia | Dunkleosteus

16. (3.00 pts) Identify D, E, and F.

Basilosaurus | Pliosaurus | Crustacea

17. (3.00 pts) Identify G, H, and I.

Diplocaulus | Testudines | Ichthyosauria

18. (1.00 pts) How many known species of A are there?

2

19. (2.00 pts) The fossil in Photo A is perimetered by dark dendrites. What is the major composition of these structures?

- ○ A) $CaCO_3$
- ○ B) SiO_2

- C) Fe_2O_3
- D) MnO_2
- E) FeO_4

20. (1.00 pts) Specimens of B are particularly abundant in the ___ formation, which is a ___ lagerstatten.

- A) Solnhofen, conservation
- B) Green River, conservation
- C) Burgess Shale, concentration
- D) Mazon Creek, concentration

21. (1.00 pts)
Which (if any) of these specimens are bony fish (superclass Osteichthyes)? Give your answer as a letter or series of letters in alphabetical order (e.g. A, ABG, BCE, etc.). Pu "none" otherwise.

B

22. (1.00 pts)
Which (if any) of these specimens are mammals? Give your answer as a letter or series of letters in alphabetical order (e.g. A, ABG, BCE, etc.). Put "none" otherwise.

D

23. (1.00 pts) E is thought to be endothermic despite being a reptile.

- True
- False

24. (2.00 pts) Select all of the following statements that are thought to be true about the mass extinction event that led to the extinction of specimen C.

(Mark **ALL** correct answers)

- [ ] A) It can be identified by a layer of Ir-rich sediment
- [x] B) It is divided into two extinction pulses, known as the Kellwasser and Hangenberg Events
- [ ] C) It occurred while Pangaea was breaking apart
- [x] D) It significantly affected reef-building organisms, while most land plants did not go extinct

Page 3

Identify specimens A-F down to the lowest taxonomic level specified on the National Fossil List. Use the exact spelling as specified by the official list.

25. (3.00 pts) Identify A, B, and C.

Spinosaurus | Triceratops | Dimetrodon

26. (3.00 pts) Identify D, E, and F.

Megacerops | Dracorex | Ankylosaurus

27. (1.00 pts) Which of the specimens are classified as dinosaurs?

(Mark **ALL** correct answers)

- [x] A) A
- [x] B) B
- [ ] C) C
- [ ] D) D
- [ ] E) E
- [x] F) F

28. (1.00 pts) Which of the specimens can be classified as piscivores?

(Mark **ALL** correct answers)

- [x] A) A
- [ ] B) B
- [x] C) C
- [ ] D) D
- [ ] E) E
- [ ] F) F

29. (1.00 pts) Which specimen is hypothesized to actually represent a juvenile version of a different head-butting dinosaur? Give your answer as a letter.

E

30. (1.00 pts) Which specimen had adapted neural spines that may have functioned in thermoregulation, display, and/or intimidation? Give your answer as a letter.

A

31. (1.00 pts) Which of the following is NOT true regarding specimen B?

- ( ) A) It lived during the Late Cretaceous
- ( ) B) It formed groups similar to modern plain animals
- ( ) C) It can be found in the Hell Creek Formation
- (•) D) Its overhanging upper jaw is adapted for slicing through prey
- ( ) E) It had a single row of teeth

32. (2.00 pts) Which of the following is true regarding specimen D?

- ( ) A) It exhibited sexual dimorphism, with females being larger than males
- (•) B) It preferred to consume soft foliage over tough vegetation
- ( ) C) Predation was the predominant factor that led it to extinction

D) Males had an odd number of toes and females had an even number of toes

E) It lived in swamps and coastal environments

33. (1.00 pts) Which of the following is true regarding specimen F?

A) It had a tail with a set of spikes known as a thagomizer

B) It was one of the earliest herbivorous dinosaurs

C) It was covered in armor-like osteoderms

D) It was commonly hunted by Allosaurus

E) Its distribution is restricted to one present-day continent

Page 4

Identify specimens A-F down to the lowest taxonomic level specified on the National Fossil List. Use the exact spelling as specified by the official list.

34. (3.00 pts) Identify A, B, and C.

Psaronius	Stromatolites	Nummulites

35. (3.00 pts) Identify D, E, and F.

Lepidodendron	Annularia	Crinoidea

36. (2.00 pts) Choose all of the following that are stem or stem-like parts of the specimen.

(Mark **ALL** correct answers)

A) A

B) B

C) C

D) D

E) E

F) F

37. (1.00 pts) Which of the following is a trace fossil?

(Mark **ALL** correct answers)

A) A

B) B

C) C

D) D

E) E

F) F

38. (1.00 pts) Specimen B is likely made up of which of the following?

- A) Chert
- B) Limestone
- C) Shale
- D) Sandstone

39. (2.00 pts) Which of the following could be found in shallow marine environments?

(Mark **ALL** correct answers)

- A) A
- B) B
- C) C
- D) D
- E) E
- F) F

40. (1.00 pts) Individuals from the taxon of which specimen from above, if any, may also inhabit deeper water? Answer “none” if applicable.

F

41. (1.00 pts) The dark pattern in specimen D is the result of:

- A) Bioturbation from benthic organisms
- B) Leaf prints on its surface
- C) Vascular tissue in cross section
- D) Irregular weathering processes

42. (1.00 pts) In Specimen F, what is the function of the hollow in the center of the lower left object?

- A) It housed the organisms’s organs
- B) It transported water and nutrients from bottom up
- C) It was the main feeding structure
- D) It stored a starchy substance for food retention

General theory section

43. (2.00 pts) As bones are fossilized, how are the original components of bone altered?

- A) Hydroxyapatite is replaced by another mineral
- B) Collagen and other parts of the organic bone matrix is replaced by minerals
- C) Pores within bones are permineralized
- D) All of the above

E) A and C only

F) B and C only

44. (1.00 pts) Konservat lagerstatten are named for the preservation of:

A) Organisms near the time of their extinction

B) Organisms that are typically destroyed before fossilization

C) Organisms in large quantities

D) Organisms over a longer period of time than other lagerstatten

45. (1.00 pts) The Mesozoic Marine Revolution led to all of the following except:

A) Increased prevalence of infaunal modes of living

B) Diversification of epifaunal benthic organisms

C) Greater shell-crushing abilities of marine predators

D) Free-swimming crinoids

46. (1.00 pts) What would make radiocarbon dating no longer a feasible way to determine the absolute age of a fossil?

A) If Carbon-14 is created from interactions between the atmosphere and cosmic rays

B) If it is discovered that carbon-14 concentrations have differed significantly over geologic time

C) If living organisms maintain a constant amount of carbon-14 in their lifetimes

D) If the fossil is older than approximately 5,730 years old

47. (3.00 pts)
An important advancement made in the field of geochronology within the past twenty years was the radiometric dating of sedimentary rocks using diagenetic xenotime, a mineral with chemical formula YPO_4.

What does diagenetic mean in this context, and why is it important to the dating of sedimentary rock? Why might this be important for paleontology? (3 pts)

Expected Answer: Diagenetic xenotime refers to the formation during diagenesis, or the general compaction and lithification processes of sedimentary rock formation (1). This allow us to accurately date the time of sedimentary rock formation, rather than the times of individual sediment grain formation, which can significantly vary based on source (1). Accept reasonable justifications for why this is significant in paleontology. For one, for zones where xenotime is present in measurable quantity, this allows direct dating of the sedimentary rock in which fossils are usually situated, rather than an indirect method using bounding igneous/metamorphic units (1).

48. (5.00 pts)
In xenotime, the yttrium is occasionally replaced by uranium. Given very low initial concentrations of lead, this makes xenotime a great geochronometer!

45 xenotime crystals are sampled within a sandstone and the following data is gathered. Assuming there is no introduction of new uranium after crystallization and that initial lead concentration is zero, calculate the age of the sandstone. Describe your work process for full points. (5 pts)

Total uranium mass	$2.35 * 10^{-6}$ kg
Total Pb-206 mass	$3.36 * 10^{-7}$ kg
U-235/U-238 ratio	1/137.9
Half life of U-238 to Pb-206	$4.47 * 10^{9}$ years
Half life of U-235 to Pb-207	$7.10 * 10^{8}$ years

Expected Answer: We are only given the mass of Pb-206, so we should use the U-238 to Pb-206 pathway (1). Since we are given the total uranium mass, we must calculate the mass of U-238 by using the U-235/U-238 ratio (U-234 is negligible). We find the U-238 mass is 2.33 * 10-6 kg (1). Because the only source of Pb-206 is U-238 decay, we know the original mass of U-238 must be 2.33 * 10-6 kg + 3.36 * 10-7 kg, which is 2.67 * 10-6 kg (1). Now, we can divide the current mass by original mass and take the base 1/2 logarithm of that to find the number of half lives passed (1). Lastly, multiplying by the half life of the U-238 to Pb-206 pathway, we find the age of the sandstone is 8.69 * 108 years old, or 869 million years old (1).

49. (2.00 pts) Given the atomic numbers of U-238 and Pb-206 are 92 and 82 respectively, how many alpha and beta-minus decays are in the full decay chain? (2 pts)

Expected Answer: 8 alpha, 6 beta-minus (1 for each)

Thank you for participating, we hoped you enjoyed! If interested in further pursuing Earth science, we encourage you to take a look at the US Earth Science Olympiad (https://www.useso.org/) for an opportunity to meet others with similar interests and deepen your Earth science skills. This test was written by USESO/IESO alumni.