

Yale Undergraduate Science Olympiad 2017

Dynamic Planet

Answer Key

1. Mark questions that are incorrect. You do not need to write the correct answer in.
2. **Letter answers can be in any order other than those that are labelled “oldest” to “youngest.”**
3. Underlined portions are the essential parts to earn credit for questions with one phrase answers.
4. If there are any questions regarding how to grade an answer, refer to the Exam Questions. If that fails, contact Kento Tanaka, (808) 554-9183, kento.tanaka@yale.edu. I will be around all day and I will also check my phone frequently.

Score: 100/100

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|------|------|
| 1. T | 11.C |
| 2. F | 12.A |
| 3. T | 13.C |
| 4. F | 14.E |
| 5. F | 15.D |
| 6. F | 16.B |
| 7. T | 17.D |
| 8. A | 18.B |
| 9. B | 19.D |
| 10.D | 20.F |

21. C
22. A
23. E
24. F, G (2 points)
25. E (also accept B as long as they have E)
26. D
27. C
28. G
29. B
30. F
31. E
32. A (also accept C and/or D as long as they have A)
33. D
34. A
35. A
36. D
37. C
38. D
39. A, C (2 points- 1 point for each correct answer; subtract 0.5 points for each incorrect answer)
40. oldest D, C, B, A, E youngest (3 points for entirely correct, 2 points for 1 letter misplaced or 2 letters switched, 1 point for a couple of letters in the general correct place, 0 points for completely wrong or blank)
41. Acadian orogeny
42. Taconic orogeny
43. Andrija Mohorovičić
44. Arthur Holmes
45. Harry Hess
46. Xenolith
47. Decompression melting
48. Flux melting
49. Hawaii, Yellowstone (any order) (2 points)
50. Mantle plumes
51. Foreland basin
52. Forearc
53. Accretionary wedge or accretionary prism
54. Fractional crystallization
55. Felsic
56. Soil liquefaction
57. Tuned mass damper or harmonic absorber
58. Brittle strength
59. Ductile strength
60. Brittle-ductile transition zone

61. Alfred Wegener (1 point); any three of the following (3 points):

- Shape of continents fit like jigsaw puzzle
- Correlation of fossils (same types of fossils found across multiple continents)
- Types of fossils did not match modern climates (e.g. tropical plants in cold climates)
- Glacial deposits (evidence of glacial activity in modern low-latitude tropical areas)
- Correlation of mountain ranges across both sides of the Atlantic

62. (6 points, Tiebreaker 1) Award points if drawings convey the same information.

Detailed answers below, full credit as long as they get the general idea correct and word it precisely/accurately.

Ridge push: Lithosphere slopes away from ridge because it is newer, thinner, warmer, and less dense. (or ridge is higher than surrounding plate/lithosphere), because it is higher, the force of gravity pushes down on the surrounding older, colder, denser areas.

(2 points)

Slab pull: Subducted portions of the plate are colder and denser than the underlying mantle; once they are subducted, their weight helps pull the rest of the plate along. (2 points) (Slab pull should be labelled with a star or other visible marking, 1 point)

Trench suction: Subducted plate drives convective flow in surrounding mantle, which pulls the plate even more. (1 point)

63. The changing positions of continents can interrupt ocean currents that distribute heat from low to high latitudes. (2 points, Tiebreaker 3: 1 point for something about continent positions and 1 point for ocean currents distributing heat)

64. oldest D, E, N, X, S, G, M, F, Z, B, T youngest (6 points)

65. A

66. B

67. Extensional

68. $\left(\frac{2.9 \frac{g}{cm^3}}{3.3 \frac{g}{cm^3}}\right)(100 \text{ km}) = 88 \text{ km}$ (1 point for equation, 1 point for answer, 1 point for units)

69. (7 points, Tiebreaker 2)

Pre-erosion height: $200 \text{ km} - \left(\frac{2.7 \frac{g}{cm^3}}{3.3 \frac{g}{cm^3}}\right)(200 \text{ km}) = 36.\overline{36} \text{ km}$ (2 points; intermediate

answer not required)

Post-erosion height: $198 \text{ km} - \left(\frac{2.7 \frac{g}{cm^3}}{3.3 \frac{g}{cm^3}}\right)(198 \text{ km}) = 36 \text{ km}$ (2 points; intermediate

answer not required)

$36.\overline{36} - 36 \text{ km} = 0.4 \text{ km or } 400 \text{ m}$ (1 point for subtracting, 1 point for correct answer,

1 point for proper rounding and unit labelling)

70. (4 points) Order of answers matters

$\left(\frac{4900 \text{ km}}{220 \text{ Ma}}\right)\left(\frac{100,000 \text{ cm}}{\text{km}}\right)\left(\frac{\text{Ma}}{1,000,000 \text{ year}}\right) = 2.2 \frac{\text{cm}}{\text{year}}$ (1 point for equation, 1 point for

answer, 1 point for units)

$\frac{2.2 \frac{\text{cm}}{\text{year}}}{2} = 1.1 \frac{\text{cm}}{\text{year}}$ (1 point)