Answers

Quiz 1

Closed Book: No calculators or aids of any kind are permitted on this test. The time allowed for Part A plus Part B in total is 70 minutes. ***Answers are to be written on the answer sheets given.***

PART A

1. The average intensity of energy the Earth receives from the Sun peaks (reaches its maximum) in what month? (a) March (b) April (c) July (d) September (e) January — obviously when closest

2. A rocket ship moving toward the Sun notes that the direct solar insolation has increased to 12 kW/m^2. Approximately how far is the rocket from the Sun in millions of km? (a) 150 (b) 30 (c) 50 (d) 75 (e) 100 — ≈ 9 times usual value ∴ 1/3 distance

3. At the equinox, the sun at solar noon is 75° degrees above the south horizon? What is your current latitude? (a) 30°N (b) 15°N (c) 5°S (d) 15°S (e) 30°S

4. The mean distance from the Earth to the Sun in thousands of km is: (a) 1,500 (b) 150,000 (c) 1,500,000 (d) 150 (e) 15,000 — 150,000,000 km

5. How long does it take for light to travel from the Moon to the Earth? (a) 0.1 s (b) 0.6 s (c) 2.3 s (d) 5 s (e) 1.3 s — $\frac{400\,000}{300\,000} = 1.3$

6. How many times further away is the Sun from the Earth than the Moon is from the Earth? (a) 150 (b) 300 (c) 450 (d) 100 (e) 375 — $\frac{150}{0.4} = 375$

7. A blackbody at a temperature of 100 K has a radiation output (in W/m^2) of (a) 5.7 (b) 57 (c) 1 (d) 570 (e) 300 — $5.67\left(\frac{T}{100}\right)^4 = 5.67$

8. The specific heat of air in kJ/m^3/K is (a) 1200 (b) 300 (c) 1.2 (d) 4.2 (e) 4200 — 1200 J/m^3/K ∴ 1.2 kJ/m^3

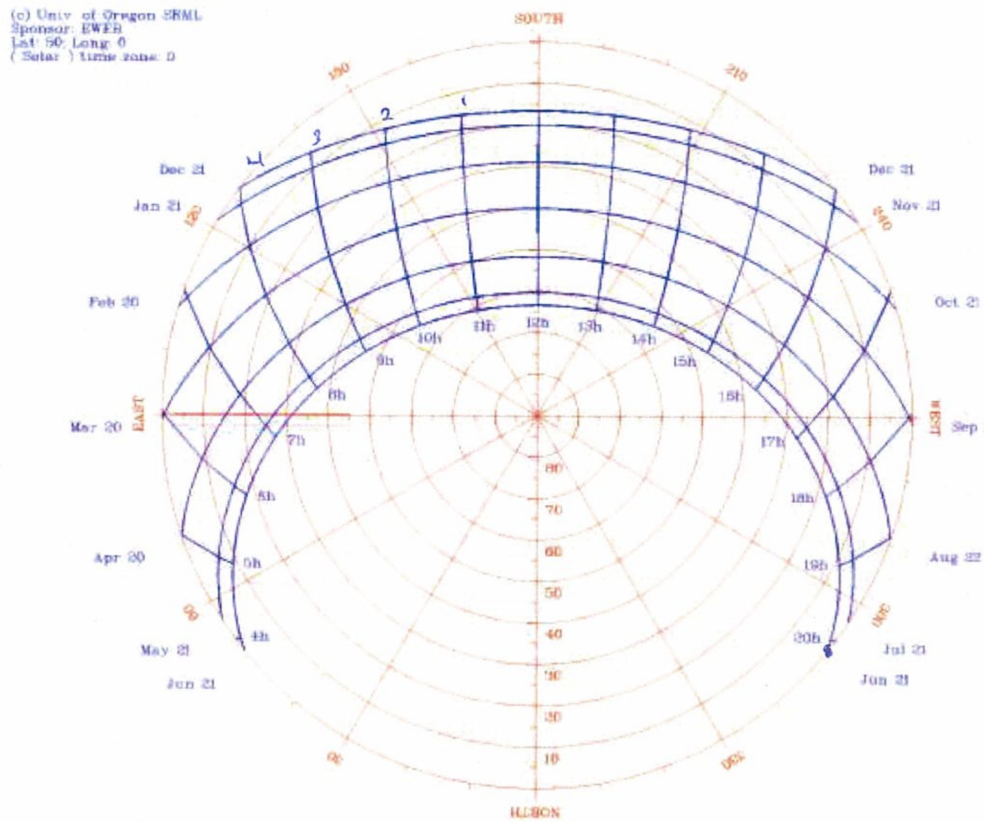
9. You are approaching the coast of Greenland which is famous for having cliffs that tower 400 m above its rocky shore. You are a lookout on a boat at 9 m above the water surface and have caught your first glimpse of these cliffs. How far are you from the coast (in km): (a) 25 (b) 46 (c) 60 (d) 82 (e) 104 — $3.6(\sqrt{400}+\sqrt{9}) = 3.6(23) \doteq 82$

10. How close to the shore (in km) will the ship in question 9 have to be before the same observer can see the waves breaking at the base of the cliffs? (a) 6 (b) 11 (c) 18 (d) 24 (e) 43.5 — $3.6\sqrt{9} = 3.6(3) = 11$

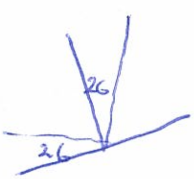
11. For any spherical planet with no atmosphere, the ratio of average surface energy received to the intensity perpendicular to the beam is (a) 0.1 (b) 0.25 (c) 0.5 (d) 1.0 (e) 0.75

12. Using the distance of a planet to the sun, the length of its year, and Newton's law of gravitation, allows one to determine: (a) the speed of light (b) the curvature of space (c) the mass of the planet (d) the mass of the sun (e) none of the above.

The next three questions relate to the solar sun plot on the next page. This plot is a little hard to read, but that is OK: it is in standard orientation and you should be able to see the plot well enough to answer the following questions.



13. The duration of daylight on the shortest day of the year (in hours) is (a) 4 (b) 10 (c) 14 (d) 0 (e) 8



14. On the longest day of the year, a solar collector facing south would have to be at what angle from the horizontal to collect the largest amount of energy at solar noon?
(a) 26° (b) 0° (c) 8° (d) 16° (e) 32°

15. Approximately at what compass direction does the sun set June 22? (a) N (b) W (c) SW (d) NW (e) Impossible to say from the data given.

PART B (Each question except question four is worth 3 marks)

1. When radiant energy in the form of photons is received at a surface of a lake, three things can happen. Describe these three things and explain why each of them is significant.

2. If an average energy of 250 W/m^2 is converted to "latent heat" by evaporating water, what depth of water can be evaporated in 10 hours?

3. When considering the Earth's energy balance, we often speak of long wave and short wave radiation. How do these terms come about and why is the distinction helpful?

4. Why does the sky appear blue and the setting sun often appear red? **(2 marks)**

5. In this course, we write the overall balance of energy for the earth as a radiation balance that essentially pictures the earth as a "giant photon exchange machine". What motivates such a conception? Moreover, how do we know the energy content of the photons the earth receives must be roughly balanced by the energy of the photons the planet emits?