1. The temperature of the photosphere is about
   A) 3,200 K.
   B) 5,800 K.
   C) 11,000 K.
   D) one million K.
   E) ten million K.

2. Given that a large sunspot, about 100× smaller than the Sun, is about the same size as our planet, how many Earths could fit inside the Sun's vast volume?
   A) 100
   B) 1,000
   C) 10,000
   D) 100,000
   E) one million

3. What is the meaning of the solar constant?
   A) the stability of the Sun's luminosity for as long as life has existed on Earth
   B) the amount of energy the earth receives per unit area and unit time
   C) the fact that the amount of hydrogen turning into helium in the core is fixed
   D) the fact that features on the Sun appear to never change
   E) the regularity of the 11 year sunspot cycle

4. The Sun's average density is almost exactly the same as
   A) Jupiter.
   B) our Moon.
   C) the earth.
   D) Halley's Comet.
   E) Saturn.

5. Which of these are not associated with the active Sun?
   A) aurora
   B) flares
   C) sunspots
   D) prominences
   E) granulation

6. Typically a granule in the photosphere is about
   A) the size of Texas, about 1,000 km across.
   B) as big as Jupiter, around 100,000 km wide.
   C) the size of Earth, around 12,000 km across.
   D) the size of our Moon, about 3,000 km across.
   E) the size of a city, 20-30 kilometers across.

7. What two energy transport mechanisms, in order from outside the core to the surface, is found in the Sun?
   A) radiative diffusion, conduction
   B) convection, conduction.
   C) conduction, convection
   D) radiative diffusion, convection
   E) conduction, radiative diffusion

8. The outward pressure of hot gas in the Sun
   A) is increasing the Sun's diameter.
   B) is responsible for variations in the sunspot cycle.
   C) is balanced by the inward gravitational pressure.
   D) weakens the magnetic field.
   E) is cooling the photosphere.

9. When we glimpse the chromosphere at the start and end of totality, its color is
   A) green (the famous flash).
   B) white from the moonlight.
   C) red, due to ionized hydrogen at lower pressure.
   D) blue, due to the ionization of nitrogen by the magnetic fields.
   E) yellow, like the photosphere below it.

10. The solar winds blow outward from
    A) flares.
    B) the entire photosphere.
    C) coronal holes.
    D) sunspots.
    E) the Sun's poles only.

11. From inside out, which is in the correct order for the structure of the Sun?
    A) convective zone, radiative zone, granulation
    B) radiative zone, convective zone, chromosphere
    C) photosphere, radiative zone, corona
    D) core, chromosphere, photosphere
    E) core, convective zone, radiative zone

12. A loop of gas following the magnetic field lines between sunspots' poles is
    A) a ray.
    B) a flare.
    C) a coronal hole.
    D) a coronal mass ejection.
    E) a prominence.

13. How long does the average sunspot cycle last?
    A) about seven years
    B) about 76 years
    C) 365.25 days
    D) between 25 and 35 days
    E) about 11 years

14. Visible sunspots lie in the
    A) radiative zone.
    B) granulation in the photosphere.
    C) chromosphere.
    D) corona.
    E) transition zone.

15. As the Sun rotates, an individual sunspot can be tracked across its face. From eastern to western limb, this takes about
    A) 12 hours.
    B) a week.
    C) two weeks.
    D) a month.
    E) 5.5 years.

16. The most striking example of solar variability was the
    A) Sporer Minimum that doomed the Anasazi.
    B) the fall of Rome.
    C) Joseph's seven lean years in the Old Testament.
    D) Maunder Minimum from 1645-1715.
    E) Dust Bowl drought of the 1930s.

17. A maximum in solar activity should next occur about
    A) 2004. 2008. 2012. 2015. 2017.

18. Sunspots
    A) are always found close to the Sun's poles.
    B) are relatively constant in number every year.
    C) travel over the surface of the Sun from pole to pole.
    D) come in pairs, representing the north and south magnetic fields.
    E) were most numerous during the Maunder Minimum.

19. During a period of high solar activity, the corona
    A) disappears.
    B) is more irregular.
    C) becomes smooth and even.
    D) shrinks to half its normal size.
    E) cools almost to the temperature of the photosphere.

20. Sunspots are dark splotches on the Sun. Which statement is true?
    A) They are extremely cold objects, as cold as Pluto.
    B) They are extremely hot, but cooler than the surrounding areas of the Sun.
    C) They are solid bodies floating on the surface of the Sun.
    D) They are associated with areas of very low magnetic fields.
    E) They are hotter than the surrounding areas of the Sun.

21. Suppose a large flare is detected optically. How long until radio interference arrives?
    A) simultaneously
    B) no relation between the two
    C) about four days
    D) 8.5 minutes later
    E) about 12 hours

22. While observing the Sun, you note a large number of sunspots. What can you conclude?
    A) There are likely to be an above average number of flares and prominences.
    B) This is a period of low solar activity.
    C) The Sun's rotation is slower than average.
    D) The Sun is less luminous than usual.
    E) Earth's climate will be unusually cold.

23. What natural barrier must be overcome for two protons to collide and fuse together?
    A) the strong nuclear force
    B) dark energy
    C) the weak nuclear force
    D) gravity
    E) electromagnetic repulsion

24. The critical temperature the core must reach for a star to shine by fusion is
    A) 5,800 K.
    B) 11,000 K.
    C) 127,000 K.
    D) 10 million K.
    E) 100 million K.

25. In the proton-proton cycle, the helium atom and neutrino have less mass than the original hydrogen. What happens to the "lost" mass?
    A) It is converted to energy.
    B) It is recycled back into hydrogen.
    C) It is ejected into space.
    D) It is transformed into electrons.
    E) Conservation of mass dictates no mass can be lost.

26. The solution to the solar neutrino problem which won a Nobel Prize in 2002 was
    A) 2/3 of the neutrinos decay into a new form in the 8 minutes to Earth.
    B) the Sun's core is cooling down, producing less neutrinos that expected.
    C) our solar energy equations were just wrong, and needed much reworking.
    D) the corona is opaque to much of the neutrino radiation.
    E) the earth's ozone layer absorbs 2/3 of the neutrinos in transit.

27. Today, the primary source of the Sun's energy is
    A) the strong force fusing hydrogen into helium.
    B) gravitational collapse of the helium coreward.
    C) the weak force creating energy from uranium decay.
    D) oxidation of carbon in the core.
    E) dark energy.

28. In the proton-proton cycle, the positron is
    A) an anti-electron.
    B) intermediate between the proton and neutron in mass.
    C) a spin conservation particle.
    D) massless.
    E) the chief means energy reaches the photosphere.

29. Which is the net result of the proton-proton chain?
    A) 2 protons = deuterium + a positron + an antineutrino + x-rays
    B) 4 protons = 1 helium 4 + 2 neutrinos + gamma rays
    C) 6 protons = 2 heliums + 3 positrons + 3 neutrinos + gamma rays
    D) 4 protons = 1 helium 4 + a positron + a neutrino + gamma rays
    E) 4 protons = 2 helium 2 + 2 positrons + ultraviolet radiation

30. The speed of light is 3.00×10^8 m/s. If 2.00 kg of mass is converted to energy, how much energy will be produced?
    A) 1.80×10^{17} J
    B) 6.00×10^8 J
    C) 6.00×10^4 J
    D) 9.00×10^{16} J
    E) 1.50×10^8 J