# Jerusalem Science Contest 5786
# Astronomy
# Test 3
# Form A- Answer Key

1) Nuclear fusion is a process in which
   a) two large nuclei split into two smaller nuclei, and the reaction releases energy.
   b) one large nucleus splits into two smaller nuclei, and the reaction releases energy.
   ***c) two small nuclei stick together to make one larger nucleus, and the reaction releases energy.***
   d) two small nuclei stick together to make one larger nucleus, and the reaction absorbs energy.

2) A planetary nebula
   a) is an interstellar cloud that surrounds a planet.
   ***b) is the material that has been lost to space by a star in the red giant phase.***
   c) is an interstellar cloud in which red giants form.
   d) is the term astronomers use for the cloud of planets and rings around giant planets like Saturn.

3) Which of the following is **NOT** a reasonable way of expressing in words the meaning of Einstein's equation $E = mc^2$ ?
   a) Energy is equivalent to mass.
   b) Mass can be converted to energy.
   c) Mass is a storage device for energy.
   ***d) Energy is the same as mass.***

4) Nuclear fission is a process in which
   a) two large nuclei split into two smaller nuclei, and the reaction releases energy.
   ***b) one large nucleus splits into two smaller nuclei, and the reaction releases energy.***
   c) two small nuclei stick together to make one larger nucleus, and the reaction releases energy.
   d) two small nuclei stick together to make one larger nucleus, and the reaction absorbs energy.

5) Nuclear reactors on Earth generate energy through the process of
   a) the proton-proton cycle.
   b) gamma radiation.
   c) nuclear fusion.
   ***d) nuclear fission.***

6) When the Sun starts to die and becomes a red giant, It will expand until it is as big as

***a) Earth's orbit.***

b) Jupiter's orbit.

c) Saturn's orbit.

d) Pluto's orbit.

7) When four protons combine to form one helium nucleus, about what percentage of the mass of the four protons is converted to energy?

***a) Just a bit less than 1%***

b) Just a bit less than 10%

c) About 50%

d) 100%

8) A brown dwarf

a) can't generate any energy through nuclear fusion

b) can stop the force of gravity from making it smaller by using proton degeneracy pressure.

***c) can't create more deuterium but can fuse deuterium into helium.***

d) has a mass of more than 8% and less than 10% the mass of the Sun.

9) A red giant star

a) is a dead star because all the fusion reactions inside the star have stopped.

b) is not actually red, but looks red because the star is spinning so fast.

c) is the phase of life for a star after the brown dwarf phase.

***d) has fused all the hydrogen in its core into helium.***

10) White dwarfs

a) are small stars that are white hot because they generate so much energy from nuclear fusion.

***b) are the cores of red giants left behind after these stars die and puff off and lose their outer layers.***

c) are dead stars that have lost so much mass that gravity no longer squeezes them.

d) turn into cool red dwarfs as they start to run out of fuel.

11) When a star with a mass between 1.4 and 3.0 times the mass of the Sun dies, it will end up as a

***a) neutron star***

b) black hole

c) white dwarf

d) supergiant

12) A pulsar is a

a) spinning white dwarf that emits light from its north and south magnetic poles.

b) white dwarf that emits light in pulses.

***c) spinning neutron star that emits light from its north and south magnetic poles.***

d) neutron star that emits light in pulses.

13) Stars that die as black holes have masses

a) of less than 1.4 solar masses.

b) of between 1.4 and 3.0 solar masses.

***c) of more than 3.0 solar masses.***

d) of more than 30 solar masses.

14) A black hole is

a) a dead star that spins to fast that light cannot escape.

***b) an object whose gravity is so strong that light cannot escape.***

c) a neutron star with a Schwarzschild Radius that blocks light from escaping.

d) a star that emits such a small amount of light that it is impossible to see.

15) The life of a star could be described as a competition between the inward force of gravity and

***a) the outward pressure from heat generated by nuclear fusion reactions.***

b) electron degeneracy pressure.

c) neutron degeneracy pressure.

d) proton-proton chain pressure.

16) Is it important to prove that the Jewish Sages were always aware of the scientific reality of heliocentrism?

a) It is very important to prove that the Sages were aware that the earth orbits the sun (and not vice versa), because that knowledge significantly affects Halachah, such as the calculations for the times of prayer.

b) It is very important to prove that the Sages agreed with heliocentrism, in order to establish their credentials and reliability.

***c) It would be nice to find that the Sages had knowledge of astronomical facts that would be established only many centuries later, but it is not relevant at all in practice.***

d) Heliocentism is merely a theory and not a fact, and therefore it is not important to determine that the Sages followed that theory.

17) When the Torah describes the creation of the sun and moon, what purpose(s) does it ascribe to them?

a) The Torah says that the sun and moon were created as symbols of Hashem's infinite power.

b) The Torah says that their purpose is to test mankind to see if they will worship Hashem, or instead worship the powerful creations of Hashem.

c) The Torah says that their purpose is to serve as navigational guides for travelers and sailors.

***d) The Torah says that their purpose is provide light/energy to the world, to form a division between day and night, and to serve as the basis for seasons, days, and years.***

18) Which of the following statements is correct:

***a) The definition of an hour is 1/24th of a day.***

b) The definition of a day is a period of 24 hours.

c) The definition of an hour is 60 minutes.

d) The definition of a day is 1/7th of a week.

19) In January, your family goes on a winter-break trip to the kosher mountain resort in Whitefish, Montana. There is no cell-phone or internet reception there. You manage to find the times for sunrise (8:20am) and sunset (5:16pm) for January 19 for Whitefish. What is the length of one Halachic hour (שעה זמנית)?

***a) 44 minutes and 40 seconds***

b) 52 minutes and 30 seconds

c) 60 minutes and 00 seconds

d) 76 minutes and 15 seconds

20) In the case in the previous question, what is the latest time to recite the Shema (end of the 3rd Halachic hour) in Whitefish, Montana, on January 19, and what is the proper time to recite the Shemoneh Esreh of Shacharit by (end of the 4th Halachic hour), and if that time has passed, what is the absolute latest time for Shemoneh Esreh of Shacharit (midday)?

a) Shema: 11:20am. Latest Shacharit: 12:20am. Midday: 12:48pm.

***b) Shema: 10:34am. Latest Shacharit: 11:18am. Midday: 12:48pm.***

c) Shema: 10:30am. Latest Shacharit: 11:10am. Midday: 12:00pm.

d) Shema: 11:34am. Latest Shacharit: 12:18pm. Midday: 1:48pm.