Jerusalem Science Contest 5786
Astronomy
Test 5
Form A- Answer Key

1) Which of the following options is not a primary opinion as to when Halachic sunrise/sunset occurs?
   a) Sunrise/sunset is calculated based on when the observer actually sees the sun
   b) Sunrise/sunset is calculated based on when the sun actually rises or sets at the sea-level horizon from the observer's location, whether he can see it or not
   c) Sunrise/sunset is calculated based on when the sun is visible or disappears over the distan landscape horizon, even if the landscape causes some elevation above sea level.
   d) Sunrise/sunset is based on a predetermined time that is part of the fixed Jewish calendar.

2) When Rebbi Yosi said (in Shabbos 118b), "*May my portion be among those who bring in Shabbos in Teverya, and among those who end Shabbos in Tzipori*," what lesson was he intending to teach?
   a) It is commendable for one to be stringent in Shabbos observance by bringing in Shabbos early, when it is certainly before nightfall, and likewise to be stringent in ending Shabbos late, when it is certainly after nightfall.
   b) It is commendable for one to be stringent in Shabbos observance by celebrating Shabbos in multiple places, particularly in holy cities.
   c) The Halachic moment of sunset for the purpose of Shabbos observance is determined solely by the sun's disappearance from view over the local landscape.
   d) One's Shabbos observance is especially praiseworthy when one follows the local customs and practices (such as when to bring in Shabbos and went to end it), rather than being based on objective times of nightfall.

3) What is the main subject of what is known as "the Sugya of נברשת (Nivreshes)" (in Yoma 37b)?
   a) The main subject is when the ideal time is to recite the morning Shema.
   b) The main subject is when Halachic sunrise is considered to occur when mountains block the distant eastern horizon.
   c) The main subject is a discussion about gifts donated to the Beis ha'Mikdash by various High Priests and monarchs.
   d) The main subject is the layout, placement, and size of the various areas and parts of the Beis ha'Mikdash.

4) According to the Gemara's conclusion, the rays of sunlight that reflected off of the Nivreshes informed what group of people that the time to recite the morning Shema had arrived?

a) The Anshei Mishmar (the group of Kohanim on duty that day)

b) The Anshei Ma'amad (the group of Yisraelim assigned to watch the public offerings being brought)

c) The rest of the people in Jerusalem.

d) All of the above.

5) There seems to be a dispute about whether the Nivreshes (golden chandelier) was affixed to the very top of the Heichal, directly but high above the entranceway, or whether it was in the actual entranceway of the Heichal in the Beis ha'Mikdash, suspended from the top of the entranceway. On what does this dispute seem to depend?

a) Whether the Nivreshes was supposed to reflect the rays of the sun as they came over the distant Mountains of Moav far to the east of the Temple Mount, or whether it was supposed to reflect the rays of the sun as it came over the closer Mount of Olives directly to the east of the Temple Mount.

b) Whether the reflected rays of the sun were intended to reach the people throughout the entire city of Jerusalem, or whether they were intended to reach only those standing in the Azarah (the Courtyard of the Beis ha'Mikdash).

c) Whether the Nivreshes was designed to reflect the rays of the sun at the moment of sea-level horizon sunrise, or only when the sun had risen above the nearby eastern mountain.

d) Whether the Nivreshes was meant to reflect both the rays of sunrise and of sunset, or whether it was intended to reflect only the rays of sunrise.

6) Dark matter

a) is matter that is too small and cool to emit much light, so we can't see it.

b) is stuff that emits no light but that we can infer to exist from its influence on other objects.

c) is a different term for black holes.

d) is mostly hot (70 million degrees) gas that emits X-rays

7) The source of X-rays seen emerging from clusters of galaxies is

a) hot gas located inside the cluster but in between the galaxies.

b) hot gas inside the individual galaxies in the cluster.

c) cold dark matter inside the cluster but in between the galaxies.

d) cold dark matter inside the individual galaxies in the cluster.

8) To explain the flat rotation curve for the Milky Way galaxy, at least _____ percent of the mass of the galaxy must be cold dark matter.

a) 10

b) 25

c) 50

d) 80

9) If an object in a cluster of objects (e.g., a galaxy in a galaxy cluster or a star in a star cluster) is moving fast enough,
   a) it can cross the critical threshold of the speed of light.
   b) it becomes dark matter.
   c) it can escape the gravitational grasp of the cluster.
   d) it can generate extra gravity to hold the cluster together.

10) A flat rotation curve for a galaxy reveals that most of the mass of that galaxy is
   a) Keplerian.
   b) found outside of the part of the galaxy that emits visible light.
   c) concentrated near the center.
   d) broadly distributed throughout the galaxy.

11) Cold dark matter is dark matter that moves at speeds
   a) faster than the speed of light.
   b) close to but not greater than the speed of light.
   c) much less than the speed of light.
   d) such that it can escape from galaxy clusters.

12) In Kepler's Third Law, "a" represents the semi-major axis of the elliptical orbit and "P" represents
   a) the period of time needed for an object to travel from one end of its orbit to the other end.
   b) the semi-minor axis of the elliptical orbit.
   c) the mass of the star at the center of the orbit.
   d) the length of time for an object to complete one orbit.

13) In the Bullet Cluster, most of the mass
   a) is seen in X-ray emission from gas in between the galaxies.
   b) is detected via gravitational lensing in the locations of the visible galaxies.
   c) is identified from the light emitted by the galaxies.
   d) is found at the impact site where the two clusters collided.

14) For objects in the Milky Way, astronomers use Kepler's Third Law to measure
   a) the amount of mass at the center of the galaxy.
   b) the amount of mass inside an object's orbital path in the galaxy.
   c) the sum of the masses of the orbiting body and the black hole at the center of the galaxy.
   d) the amount of mass outside an object's orbital path in the galaxy.

15) In galaxy clusters, the amount of mass in the spaces in between galaxies is
   a) one-tenth of the amount of mass inside the individual galaxies.
   b) the same as the amount of mass inside the individual galaxies.
   c) greater than the amount of mass inside the individual galaxies.
   d) impossible to measure because it only emits X-rays.

16) X-ray telescopes

a) are placed in outer space because X-rays cannot penetrate Earth's atmosphere.

b) must be very small because X-rays are very small.

c) are dangerous because of the radioactivity generated by the X-rays.

d) were first invented in the 1990s.

17) In the 1930s, Fritz Zwicky deduced that in the Coma Cluster most of the mass was cold and dark because

a) he measured the temperature of most of the intracluster gas and found that it was very low.

b) the galaxy rotation curves were flat.

c) he could not detect enough light-emitting mass for gravity to hold the cluster together, yet the cluster is held together by gravity.

d) he found an overabundance of dead stars --- white dwarfs, neutron stars and black holes.

18) In 1784, Englishman John Michel

a) imagined a star so massive that not even light could escape from it.

b) discovered the planet Uranus.

c) discovered that Sirius had a dark companion.

d) calculated that the gravitational pull of an unseen planet was affecting the orbit of Uranus.

19) A plot of the orbital speeds of planets (y axis values) versus their distances from the Sun (x axis values) would reveal

a) a flat rotation curve

b) a Keplerian rotation curve

c) that most of the mass in the solar system is found at the center, in the Sun.

d) the existence of unseen dark matter in between the planets.

20) Cold dark matter is

a) normal matter (protons, neutrons, electrons) that is hard to see.

b) normal matter that is very cold.

c) normal matter that is trapped inside neutron stars and black holes.

d) a mystery; astronomers have no idea what it is.