

Quiz 4- ASTRO-2 Fall 2019 YOUR NAME: _____

1. Based on our current data and models, what is the most likely long-term fate of the Universe? (select one)

- Increasing expansion rate and increase of the temperature of the background radiation
- Eventual slowing of the expansion to stop as time reaches infinity
- All matter converted to iron, the most stable atom, and continuous cooling
- Increased expansion rate, decreased star formation to zero, cooler and darker

2. Which of the following are fundamental particles? (check any that are)

- Proton
- Electron
- Hydrogen atom
- Up quark

3. Which of the following describe the large-scale distribution of matter in the Universe? (select any that do)

- Dark matter is uniform in all directions, visible matter is highly clumped
- Dark and visible matter is highly non-uniform with clusters, filaments and voids
- Matter is uniformly distributed except for small density variations at the level of 10^{-5}
- Quantum fluctuations before inflation produced galaxies that are moving away at a speed that is proportional to their distance

4. The theory of cosmic inflation was originally motivated to understand why magnetic monopoles were so rare in the Universe. What other cosmological puzzles does inflation resolve? (select any that apply)

- The "horizon" problem that prevents us from seeing past the nearest super cluster of galaxies
- The "Dark Energy" problem that creates acceleration of the expansion
- the origin of fluctuations that became the seeds of galaxy and structure formation is quantum fluctuations that grew via inflation
- Inflation allows us to understand what existed before the Big Bang

5. Which of the following are true (T) and which false (F) regarding the cosmic microwave background?

- It is radiation that originated about 380,000 years after the Big Bang
- It is seen as microwave radiation in every direction on the sky
- It is the relic radiation from the first stars that formed after the Big Bang, redshifted by a factor of ~ 1100
- It has the spectrum of a $\sim 3000\text{K}$ ionized plasma redshifted to appear like a 2.75K plasma

6. Dark Matter has been invoked to explain observations on very different spatial scales. Which of the following indicate the need for Dark Matter?

- inhomogeneities in the cosmic microwave background at the 10^{-5} level
- the “flat” rotation curves of the Milky Way Galaxy and other galaxies
- the formation of large scale structure in the Universe
- the acceleration of the expansion of the Universe

7. Which of the following provide supporting evidence for the Hot Big Bang (HBB) model? (select any that do)

- The abundances of elements formed via the R-Process match HBB predictions
- The predicted abundances for He^4 , He^3 , H^2 , and Li^7 at the time of “element freezeout” around 300 seconds after the Big Bang match observations
- The presence of a ubiquitous background radiation characteristic of that from a 3K solid
- The requirement of Dark Matter to explain the development of large-scale structure

8. Which of the following techniques are used to detect planets orbiting stars other than the Sun? (select any that do)

- measuring small periodic radial velocity variations in the exoplanet host stars
- measuring a small reduction in brightness when a planet passes in front of a parent star
- using parallax measurements of the nearest planets outside the solar system
- using the largest radio telescopes to beam radar signals to all the stars in the solar neighborhood to identify objects too faint to be seen with optical telescopes

9. Which of the following are true (T) which false (F) regarding what we know about exoplanets as of 2019?

- the majority of stars have at least 10 exoplanets in orbit
- The most common type of exoplanet discovered to date is approximately the mass of Jupiter
- most exoplanets discovered to date are very close to or in the “habitable zone” of their host stars
- based on observations to date, it is estimated that there are more planets in the Galaxy than there are stars in the Galaxy

10. Which of the following are true (T), which false (F)?

- the total star formation rate in the Universe has been relatively steady since about 1 billion years after the Big Bang
- Quasars are more common now than at any time in cosmic history
- the merger rate of galaxies has been steadily decreasing over time as the Universe expands
- Dark Matter is much more common than the type of matter that makes up stars, planets and humans