

SET-B

1. **How long does the main sequence phase typically last for a star like our Sun?**

A) About 1 billion years
B) About 10 billion years
C) About 100 billion years
D) About 500 million years

Answer: B) About 10 billion years

2. **What causes a star to transition from the main sequence to the red giant phase?**

A) Exhaustion of hydrogen fuel in the core
B) Increase in surface temperature
C) Collapse of the outer layers
D) Fusion of helium into heavier elements

Answer: A) Exhaustion of hydrogen fuel in the core

3. **Which phenomenon occurs when a blackbody is heated to high temperatures and begins to glow visibly?**

A) Radioactivity
B) Incandescence
C) Luminescence
D) Refraction

Answer: B) Incandescence

4. **What is the primary cause of the relativistic Doppler effect?**

A) The change in frequency of light due to gravitational fields
B) The relative motion of the source and the observer at significant fractions of the speed of light
C) The absorption and emission of light by atomic particles
D) The effect of the Earth's atmosphere on light

Answer: B) The relative motion of the source and the observer at significant fractions of the speed of light

5. **What is the Hubble Constant (H_0)?**

A) The speed of light in a vacuum
B) The rate of expansion of the universe
C) The distance between galaxies
D) The age of the universe

Answer: B) The rate of expansion of the universe

6. **What is the purpose of the astronomical unit (AU)?**

A) To measure time in astronomy
B) To quantify distances within the solar system
C) To measure the mass of celestial bodies
D) To calculate the temperature of stars

Answer: B) To quantify distances within the solar system

7. **What type of orbit do planets follow according to Kepler's laws?**

A) Circular
B) Parabolic

- C) Elliptical
- D) Hyperbolic

Answer: C) Elliptical

8. **At what Mach number is an object considered to be traveling at sonic speed?**

- A) Mach 0.5
- B) Mach 1.0
- C) Mach 1.5
- D) Mach 2.0

Answer: B) Mach 1.0

9. **Which of the following detectors uses water to detect neutrinos?**

- A) Super-Kamiokande
- B) IceCube Neutrino Observatory
- C) DUNE
- D) MINOS

Answer: A) Super-Kamiokande

10. **Which process primarily produces neutrinos?**

- A) Nuclear fission
- B) Nuclear fusion in stars
- C) Electron capture
- D) Alpha decay

Answer: B) Nuclear fusion in stars

11. **Which scientist first formulated the law of universal gravitation?**

- A) Albert Einstein
- B) Isaac Newton
- C) Galileo Galilei
- D) Johannes Kepler

Answer: B) Isaac Newton

12. **In a vacuum, if two objects with different masses are dropped, which will hit the ground first?**

- A) The heavier object
- B) The lighter object
- C) Both will hit at the same time
- D) It depends on their shape

Answer: C) Both will hit at the same time

13. **What is escape velocity?**

- A) The speed needed to leave Earth's atmosphere
- B) The speed required to break free from a planet's gravitational pull
- C) The speed at which an object falls to Earth
- D) The speed of sound in a vacuum

Answer: B) The speed required to break free from a planet's gravitational pull

14. **What happens during the interaction of a neutrino with a carbon nucleus in the MINOS detector?**

- A) It absorbs the neutrino completely
- B) It produces an electron and a muon

- C) It creates a new particle
- D) It does not interact at all

Answer: B) It produces an electron and a muon

15. What type of rocket engine uses liquid fuel and oxidizer?

- A) Solid rocket motor
- B) Hybrid rocket motor
- C) Liquid rocket engine
- D) Ion thruster

Answer: C) Liquid rocket engine

16. How does relativistic cosmology explain the redshift observed in distant galaxies?

- A) Through the Doppler effect due to their relative motion
- B) As a result of the expansion of space itself
- C) By the gravitational influence of nearby objects
- D) As a thermal effect due to cosmic background radiation

Answer: B) As a result of the expansion of space itself

17. What is a practical application of measuring redshift in astronomy?

- A) Determining the temperature of stars
- B) Measuring the distance to galaxies and the rate of the universe's expansion
- C) Identifying the composition of planetary atmospheres
- D) Calculating the mass of black holes

Answer: B) Measuring the distance to galaxies and the rate of the universe's expansion

18. In the context of the Friedmann Equation, what does the term "scale factor" ($a(t)$) represent?

- A) The temperature of the universe
- B) The distance between galaxies
- C) The relative size of the universe at a given time
- D) The mass of the universe

Answer: C) The relative size of the universe at a given time

19. What is the relationship between the speed of the source and the change in observed frequency in the relativistic Doppler effect?

- A) A higher speed always leads to a higher observed frequency
- B) The change in frequency is not affected by the speed of the source
- C) A higher speed leads to a greater redshift or blueshift, depending on the direction of motion
- D) The change in frequency is linear with speed

Answer: C) A higher speed leads to a greater redshift or blueshift, depending on the direction of motion

20. What is one consequence of the discovery of Hubble's Law regarding the age of the universe?

- A) The universe must be older than the light travel time to the farthest observed galaxies
- B) The universe is infinitely old
- C) The universe is younger than previously thought
- D) The age of the universe cannot be determined

Answer: A) The universe must be older than the light travel time to the farthest observed galaxies

21. What is the significance of the critical Mach number?

- A) It is the speed at which drag increases significantly
- B) It is the speed at which a shock wave forms
- C) It is the speed at which an object can no longer maintain altitude
- D) It is the maximum speed limit for commercial aircraft

Answer: B) It is the speed at which a shock wave forms

22. How does the drag force on an aircraft change as it transitions from subsonic to supersonic speeds?

- A) Drag decreases steadily
- B) Drag initially decreases, then increases sharply
- C) Drag remains constant throughout
- D) Drag increases without significant changes

Answer: B) Drag initially decreases, then increases sharply

23. What happens to the mass of a rocket as it ascends?

- A) It increases due to fuel consumption
- B) It remains constant
- C) It decreases due to fuel consumption
- D) It fluctuates randomly

Answer: C) It decreases due to fuel consumption

24. Which method do neutrino detectors often use to observe neutrinos?

- A) Cherenkov radiation
- B) X-ray emission
- C) Thermal radiation
- D) Magnetic resonance

Answer: A) Cherenkov radiation

25. What phenomenon explains why neutrinos can oscillate between different flavors?

- A) Quantum tunneling
- B) Quantum superposition
- C) Neutrino mixing
- D) Electroweak symmetry breaking

Answer: C) Neutrino mixing

26. Which of the following terms is included in the Friedmann Equation?

- A) Pressure and density of matter and energy
- B) Only the density of dark matter
- C) The gravitational force between galaxies
- D) The speed of light in a vacuum

Answer: A) Pressure and density of matter and energy

27. What is the primary limitation of the Friedmann Equation in modeling the universe?

- A) It does not account for the effects of dark matter
- B) It assumes homogeneity and isotropy on large scales
- C) It can only be applied to nearby galaxies

D) It does not incorporate quantum effects

Answer: B) It assumes homogeneity and isotropy on large scales

28. How does the presence of dark energy affect the expansion rate of the universe, according to cosmological models?

A) It decelerates the expansion

B) It accelerates the expansion

C) It causes the universe to remain static

D) It has no significant effect on expansion

Answer: B) It accelerates the expansion

29. What role does the Hubble Constant (H_0) play in determining the distance to faraway galaxies?

A) It is used to calculate the rate of acceleration of the universe's expansion

B) It relates the redshift of a galaxy to its distance

C) It determines the age of the universe

D) It is the inverse of the speed of light

Answer: B) It relates the redshift of a galaxy to its distance

30. What do cosmologists currently believe about the ultimate fate of the universe, based on current observations and models?

A) The universe will collapse back into a singularity

B) The universe will continue to expand forever at an accelerating rate

C) The universe will stop expanding and become static

D) The universe will undergo cyclic expansions and contractions

Answer: B) The universe will continue to expand forever at an accelerating rate