

Thermodynamics of the Universe

Thermodynamics · Answer Key · 20 Questions

1. What is the primary mechanism by which the Sun loses energy to the vacuum of space?

- A) Conduction
- B) Convection
- C) Radiation**
- D) Advection

2. Which law of thermodynamics states that the entropy of a perfect crystal at absolute zero is zero?

- A) Zeroth Law
- B) First Law
- C) Second Law
- D) Third Law**

3. What is the approximate temperature of the Cosmic Microwave Background radiation?

- A) 2.7 K**
- B) 15 K
- C) 273 K
- D) 3000 K

4. In a star, what thermodynamic process primarily balances the inward gravitational pressure?

- A) Thermal expansion
- B) Nuclear fusion pressure**
- C) Conduction of heat
- D) Phase change

5. Why do gas giants like Jupiter possess higher internal temperatures than their surface exposure suggests?

- A) Friction from moons
- B) Gravitational contraction**
- C) Radioactive decay
- D) Internal nuclear fusion

6. What happens to the temperature of a gas cloud as it collapses under gravity, according to the adiabatic process?

- A) Decreases
- B) Remains constant
- C) Increases**
- D) Fluctuates randomly

7. Which thermodynamic state is characterized by the absence of net energy flow between a planet and its environment?

A) Thermal equilibrium

B) Adiabatic expansion

C) Entropy maximum

D) Isochoric process

8. The Stefan-Boltzmann law relates the total energy radiated by a black body to which property?

A) Mass

B) Volume

C) Temperature

D) Density

9. Which fundamental thermodynamic quantity measures the degree of disorder or randomness in the universe?

A) Enthalpy

B) Entropy

C) Internal energy

D) Gibbs free energy

10. What is the state of a vacuum in terms of thermal conductivity?

A) Highly conductive

B) Moderately conductive

C) Non-conductive

D) Superconductive

11. What determines the color of a star based on Wien's Displacement Law?

A) Surface temperature

B) Chemical composition

C) Mass

D) Distance from Earth

12. Energy transfer in the radiative zone of the Sun occurs primarily through which particles?

A) Protons

B) Photons

C) Electrons

D) Neutrons

13. According to the Second Law of Thermodynamics, what happens to the total entropy of the universe over time?

- A) It decreases
- B) It remains constant
- C) It increases**
- D) It resets periodically

14. Which phenomenon describes the cooling of an expanding universe?

- A) Adiabatic cooling**
- B) Isobaric cooling
- C) Convective cooling
- D) Radioactive cooling

15. Heat transfer by conduction is negligible in outer space because space is a:

- A) High-pressure environment
- B) Dense plasma
- C) Near-perfect vacuum**
- D) Supercooled liquid

16. The 'Heat Death' of the universe is a theoretical scenario based on the maximization of which thermodynamic property?

- A) Pressure
- B) Volume
- C) Entropy**
- D) Temperature

17. What is the source of the high temperatures found in the solar corona compared to the photosphere?

- A) Nuclear fusion
- B) Magnetic reconnection**
- C) Radioactive decay
- D) Gravitational collapse

18. Which thermodynamic cycle describes the theoretical behavior of heat engines, relevant to power generation in space probes?

- A) Carnot cycle**
- B) Diesel cycle
- C) Otto cycle
- D) Rankine cycle

19. What is the primary form of heat transfer from the Sun to the Earth?

- A) Conduction
- B) Convection
- C) Radiation**
- D) Evaporation

20. How does the density of a star's core affect its thermodynamic pressure?

- A) Higher density increases pressure**
- B) Higher density decreases pressure
- C) Density is independent of pressure
- D) Pressure is solely dependent on volume