

Directions: Choose the letter that corresponds to the correct answer.

1. Which of the following describes the process by which energy is transmitted from one region of space to another through molecular collisions?

- A. radiation
- B. latent heat
- C. convection
- D. conduction

2. A transducer is used to convert mechanical vibrations into electrical waves. The power output of the transducer is of the order of several microwatts. A scientist would like to increase this value so the signal can be recorded to magnetic tape. A circuit based primarily on which of the following components would be most appropriate for this purpose?

- A. capacitors
- B. diodes
- C. transformers
- D. transistors

3. The displacement of an object starting from rest and moving with constant acceleration

- A. is proportional to its velocity
- B. is proportional to the square of its speed
- C. is proportional to the square root of its speed
- D. is inversely proportional to its velocity

4. Which of the following describes the primary significance of Rutherford's alpha-scattering experiments?

- A. They developed the concept of the half-life of a radioactive element.

- B. They created new radioactive isotopes by nuclear bombardment.
- C. They changed one atomic element into another through nuclear reactions.
- D. They demonstrated the existence of a small, dense, positively charged atomic nucleus.

5. The dimensions of a rectangular solid block are given below.

- length = 1.55 cm
- width = 4.2 cm
- height = 0.87 cm

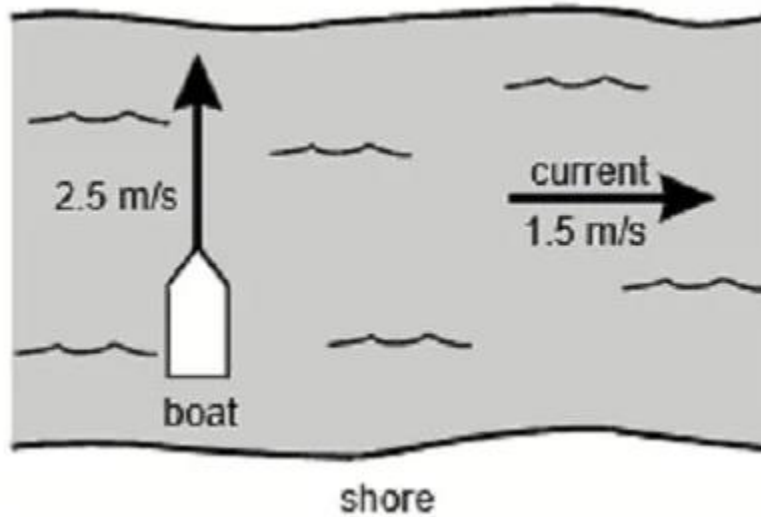
Which of the following values expresses the volume of the block using the correct number of significant figures?

- A. 5.7 cm³
- B. 5.66 cm³
- C. 5.67 cm³
- D. 5.664 cm³

6. Which of the following best describes the microscopic interpretation of the concept of entropy?

- A. the distribution of energy per degree of freedom of a molecule
- B. the amount of randomness or disorder in a system
- C. the average time required for a system to reach equilibrium
- D. the lowest temperature a quantum mechanical system can reach

7. Use the diagram below to answer the question that follows.



A boat that moves in still water with a speed of 2.5 m/s now heads north across a river that has a current of 1.5 m/s east, as shown in the diagram above. What is the boat's velocity relative to an observer on the shore?

- A. 2.9 m/s at 31° north of east
- B. 2.9 m/s at 59° north of east
- C. 4.0 m/s at 31° north of east
- D. 4.0 m/s at 59° north of east

8. The acceleration of a particle is given by the following equation:

$$a(t) = 6t^2$$

Given that $v(0) = 4$ m/s, what is the velocity of the particle at $t = 3$ s?

- A. 36 m/s
- B. 50 m/s
- C. 54 m/s

D. 58 m/s

9. Which of the following can be concluded about a region of space where the rate of change of the magnetic field is non-zero?

- A. An electric field will be produced.
- B. A harmonic electromagnetic wave will be produced.
- C. Electromagnetic waves in the visible spectrum will be produced.
- D. Magnetic material is present in the vicinity of the region.

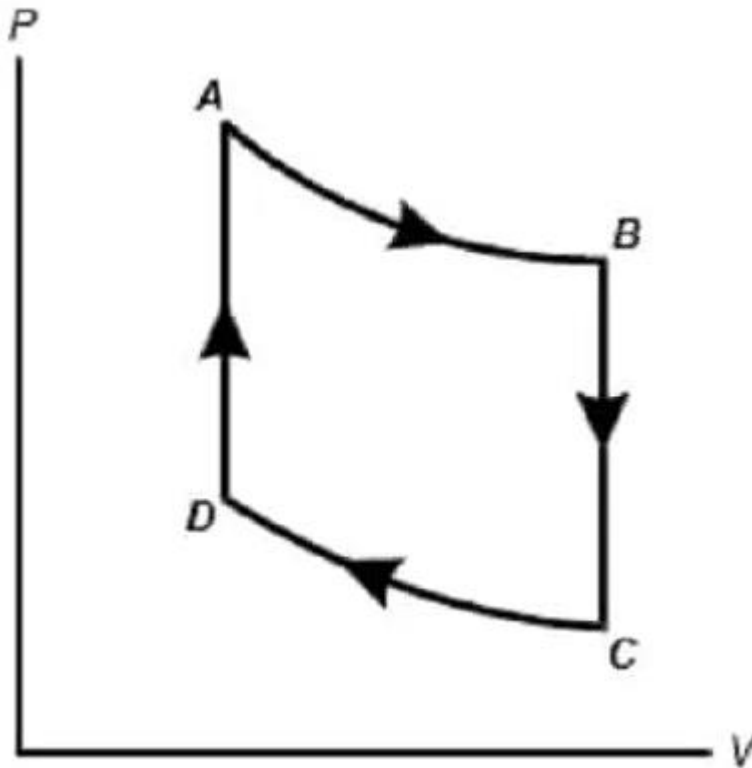
10. A person holds a spinning bicycle wheel while sitting stationary on a chair that is free to rotate about a vertical axis. As the person changes the axis of the spinning bicycle wheel, the chair begins to rotate about its axis. The chair's rotation is a result of:

- A. conservation of angular momentum
- B. a torque due to the force of gravity
- C. conservation of rotational kinetic energy
- D. the mechanical advantage of a double-axis rotational system

11. Which of the following best describes why temperatures of the order of 10⁸ K are necessary for a fusion reaction to occur?

- A. The reactants must be stripped of all electrons to form a plasma before they can fuse together.
- B. The reactants must be separated into nucleons before the reaction can take place.
- C. The reactants must be confined in a strong magnetic field produced by thermally active nucleons.
- D. The reactants must have sufficient kinetic energy to overcome the Coulomb barrier.

12. Use the diagram below to answer the question that follows.



The diagram above represents the pressure (P) and volume (V) of an ideal gas. If AB is an isothermal process, which of the following must be true?

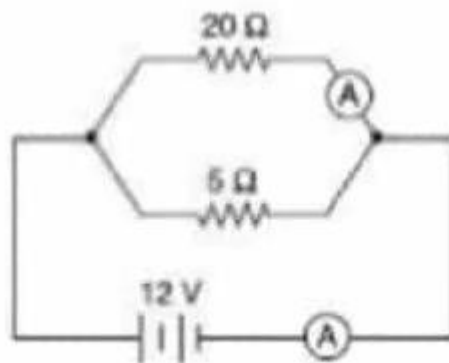
- A. No work is done in going from state A to state B .
- B. Curve AD represents an isobaric process.
- C. The product of the pressure and the volume is constant along AB .
- D. Curve CD represents an adiabatic process.

13. An object is observed to have zero acceleration. Which of the following statements is correct?

- A. The object may be in motion.
- B. The object must be at rest.

- C. The object must have zero net force acting on it.
- D. Both (A) and (C) are correct.

14. What is the value of the current flowing in the circuit?



- A. 48 A
- B. 3 A
- C. 12 A
- D. 5 A

15. In chemistry, the enthalpy is defined as the heat energy change of a reaction. It is most closely related to which of the following concepts in physics?

- A. the area under a force versus displacement graph
- B. the slope of the line tangent to a velocity versus time graph
- C. the area under a force versus time graph
- D. the slope of the line tangent to a momentum versus time graph

16. According to electromagnetic theory, Lenz's law can be explained best by which of the following laws of physics?
- A. Law of conservation of linear momentum
 - B. Law of conservation of angular momentum
 - C. Law of conservation of energy
 - D. Law of universal gravitation
17. The displacement per second of an object in equilibrium
- A. is proportional to its velocity
 - B. is proportional to the square of its speed
 - C. is proportional to the square root of its speed
 - D. is inversely proportional to its velocity
18. The amplitude of a sound wave is detected as its
- A. wavelength
 - B. frequency
 - C. resonance
 - D. loudness
19. Which of the following is (are) true of an object starting from rest and accelerating uniformly?
- I. Its kinetic energy is proportional to its displacement.
 - II. Its displacement is proportional to the square root of its velocity.
 - III. Its kinetic energy is proportional to the square of its speed.
 - IV. Its velocity is proportional to the square of elapsed time.
- A. I, II, and III only

- B. I and III only
- C. II and IV only
- D. IV only

20. A student would like to measure the electric power used by a laptop computer when placed in the low-power mode. Which of the following pairs of meters should be selected for this measurement?

- A. galvanometer and ammeter
- B. galvanometer and ohmmeter
- C. voltmeter and ammeter
- D. ohmmeter and voltmeter