

**Directions:** Read the questions carefully and choose the letter that corresponds to your answer.

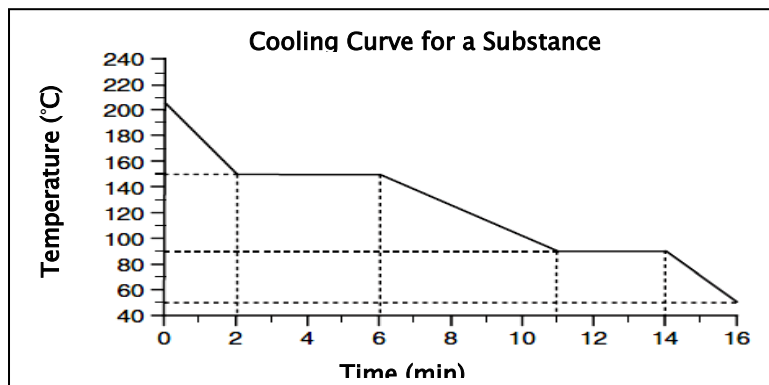
1. If Wes applies 100 newtons of force on a 2-meter wrench at a right angle to the wrench and parallel to the plane of rotation, how much torque, in newton-meters (N-m), is he applying to the bolt?

- A. 200 N-m
- B. 100 N-m
- C. 50 N-m
- D. 25 N-m

2. Gravitational potential energy is energy an object possesses because of its position in a gravitational field. Which of the following has the most gravitational potential energy?

- A. A truck at the top of a hill
- B. A truck speeding down the hill
- C. A man on top of the hill
- D. A man on his mountain bike speeding down the hill

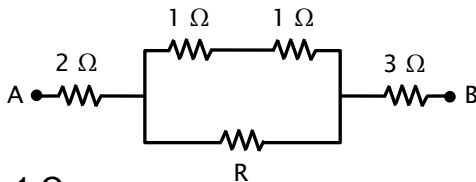
3. Starting as a gas at  $206^{\circ}\text{C}$ , a sample of a substance is allowed to cool for 16 minutes. This process is represented by the cooling curve below.



What is the melting point of this substance?

- A. 206°C
- B. 150°C
- C. 90°C
- D. 50°C

4. The figure below shows resistors connected in series and parallel. If the total resistance from A to B is  $6\ \Omega$ , find the resistance of R.



- A.  $1\ \Omega$
- B.  $2\ \Omega$
- C.  $3\ \Omega$
- D.  $4\ \Omega$

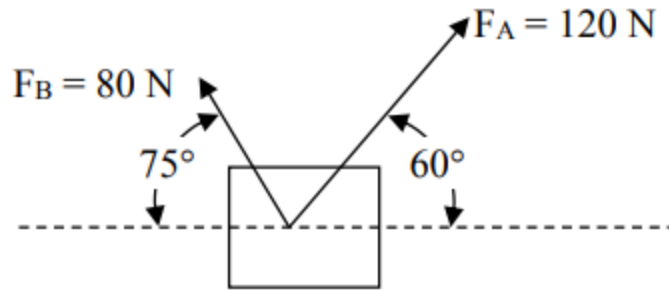
5. Which electromagnetic wave has the shortest wavelength?

- A. Radio
- B. UV
- C. Visible Light
- D. Gamma

6. Which factors are involved in Gay-Lussac's Law?

- A. Pressure and Temperature
- B. Pressure and Volume
- C. Temperature and Volume
- D. Volume and Moles

7. The tendency of an object to resist changes in motion is dependent on:
- A. Weight
  - B. Temperature
  - C. Speed
  - D. Mass
8. How much time should it take for a traveling bullet to hit the ground compared to a bullet dropped from rest? Assume the ground remains flat for the entire distance the bullet may travel.
- A. The traveling bullet will take longer to hit the ground than the bullet dropped from rest
  - B. The traveling bullet will hit the ground at the same time as the bullet dropped from rest
  - C. The traveling bullet will hit the ground before the bullet dropped from rest
  - D. The traveling bullet moves so fast that it will never hit the ground
9. Specific gravity is the ratio of the density of substance to the density of water. Suppose the specific gravity of liquid X is 1.2. Which of the following will not float in liquid X?
- A. Water
  - B. A 1000-cm<sup>3</sup> object whose mass is 750 g
  - C. A solid object whose specific gravity is 0.9
  - D. A liquid whose specific gravity is 1.3
10. Two forces are acting on an object as shown below. What is the magnitude of the resultant force?

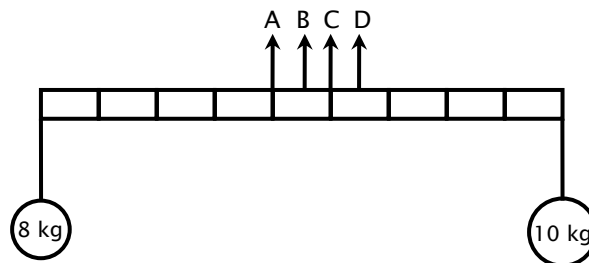


- A. 200 N
- B. 40 N
- C. 66.7 N
- D. 185 N

11. Torque is the product of the force and the lever arm. In symbols,

$$\tau = F_{\perp} \times l$$

Refer to the diagram below. Two masses, 8 kg and 10 kg, are hung at both ends of a 90-cm stick. The stick has markings every 10 cm. If the mass of the stick is negligible, where should the stick be suspended by means of a cord to remain the stick horizontal?



- A. A
- B. B
- C. C
- D. D

12. A neutral atom in the ground state contains 16 electrons. What is the total number of electrons in the 3p sublevel?

- A. 2
- B. 4
- C. 6
- D. 8

13. A graduated cylinder is used to measure liquid volume. The correct way of reading the level of mercury in a graduated cylinder is

- A. read from the top of the meniscus.
- B. read from the bottom of the meniscus.
- C. use the lowest point of the mercury in the cylinder.
- D. take the average of the highest and the lowest points.

14. Suppose a cold steel bar (at  $10^{\circ}\text{C}$ ) and a hot iron block (at  $70^{\circ}\text{C}$ ) are placed inside the same room at the same time. With time, the steel bar and the iron block are brought to thermal equilibrium with the room. The final temperature of the room is  $25^{\circ}\text{C}$ . What are the final temperature of the steel bar and the iron block?

- A. Steel bar (at  $40^{\circ}\text{C}$ ), iron block (at  $25^{\circ}\text{C}$ )
- B. Steel bar (at  $25^{\circ}\text{C}$ ), iron block (at  $40^{\circ}\text{C}$ )
- C. Steel bar (at  $40^{\circ}\text{C}$ ), iron block (at  $40^{\circ}\text{C}$ )
- D. Steel bar (at  $25^{\circ}\text{C}$ ), iron block (at  $25^{\circ}\text{C}$ )

15. Which of the following cases is/are NOT a uniformly accelerated motion?

- (1) A feather falls from a certain height inside a vacuum tube.
- (2) A ball rolls along a frictionless plane at uniform speed.
- (3) A coin falls from a certain height in air but air resistance is negligible.

- A. (1) only
- B. (2) only
- C. (1) and (2) only
- D. (2) and (3) only

16. A stone is thrown into the air at an angle. Neglecting air resistance, what is the stone's velocity upon reaching its maximum height?

- A. zero
- B. equal to the horizontal component of its initial velocity
- C. equal to the vertical component of its initial velocity
- D. equal to the acceleration due to gravity

17. How many star/s is/are there in our solar system?

- A. 1
- B. 1 million
- C. 1 billion
- D. infinitely many

18. If the volume of a gas at a certain pressure is halved, \_\_\_\_\_.

- A. its temperature is halved
- B. its temperature is doubled
- C. its temperature remains constant
- D. its temperature increases according to a geometric progression

19. The reason why we see eclipses of the Moon more often than solar eclipses, even though solar eclipses happen more frequently is that

- A. lunar eclipses are visible over more than half of Earth compared to less than 20% of Earth's surface for partial solar eclipses.
- B. the weather is more cloudy during the new moon.

- C. a lunar eclipse lasts longer than a solar eclipse.
- D. people are not so interested in the solar eclipse.

20. Specific gravity is the ratio of the density of substance to the density of water. Suppose the specific gravity of liquid X is 1.2. Which of the following will not float in liquid X?

- A. Water
- B. A 1000-cm<sup>3</sup> object whose mass is 750 g
- C. A solid object whose specific gravity is 0.9
- D. A liquid whose specific gravity is 1.3

21. Newton's first law of motion states that "Every object remains at rest or in motion in a straight line at constant speed unless acted upon by an unbalanced force." What is the net force acting on an airplane in level flight at 500 kph due north?

- A. 100 N
- B. 490 N
- C. 980 N
- D. 0

22. Coulomb's law and Newton's law of gravitation both involve which of the following?

- A. the inverse square law.
- B. the charge on the particle.
- C. the mass of the particle.
- D. permeability

23. A 7-m rope is stretched between two poles, which are 6-m apart. A boy is holding on to the middle of the rope and hanging down. If the boy weighs 300 N, what is the tension in the rope on the right-hand side?

- A. 183 N

- B. 291 N
- C. 425 N
- D. 291 N

24. Excluding the sun, what is the brightest star in the sky?

- A. Sirius
- B. Venus
- C. Betelgeuse
- D. The Big Dipper

25. Boyle's law states that *"If the temperature remains constant, the volume of a gas varies inversely as the pressure."* The volume of the gas is 204 mL at 840 mm pressure. Calculate the volume of the same gas at 765 mm if the temperature is held constant.

- A. 112 mL
- B. 224 mL
- C. 288 mL
- D. 336 mL

26. A student holds a hand mirror to observe the back of her head while standing in front of and looking into a wall mirror. If she is standing 4 feet in front of the wall-mirror and she holds the hand-mirror 1 foot behind her head, she will see the back of her head how far behind the wall-mirror?

- A. 6 feet
- B. 5 feet
- C. 4 feet
- D. 3 feet

27. The magnetic needle of a compass always points to the north because



- A. the needle touches the north pole.
- B. the earth has a magnetic north pole.
- C. compasses are used for finding direction.
- D. the earth's magnetic field is strongest at the south pole.

28. The translational speed of the center of mass of a bowling ball that rolls without slipping along the horizontal section of the ball return is 3.50 m/s. It then moves through a vertical rise of 0.760 m on the way back to the ball rack. If you neglect frictional losses and assume that the mass of the ball is distributed uniformly, then what is the translational speed of the ball at the top of the rise?

- A. 1.27 m/s
- B. 1.52 m/s
- C. 1.52 m/s
- D. 4.78 m/s

29. Which one of these is *not true*?

- A. All planets revolve in the same direction.
- B. All planets rotate in the same direction.
- C. The orbits of the planets are all ellipses.
- D. The orbits of the planets are nearly in the same plane.

30. As the drops of water that leak from a dripping faucet fall, they

- A. get closer together.
- B. get farther apart.
- C. the pattern of their motion can't be determined.
- D. remain at a relatively fixed distance from one another.

31. An astronaut orbits the earth in a space capsule whose height above the earth is equal to the earth's radius. How does the weight of the astronaut in the capsule compare to her weight on the earth?

- A. Her weight is equal to her weight on earth.
- B. Her weight is equal to one-fourth her weight on earth.
- C. Her weight is equal to one-half of her weight on earth.
- D. Her weight is equal to one-third of her weight on earth.

32. Air cools at the dry adiabatic rate of  $10^{\circ}\text{C}$  for each kilometer it rises. If a parcel of dry air initially at  $0^{\circ}\text{C}$  expands adiabatically while flowing upward alongside a mountain, what is its temperature when it has risen 8 km?

- A.  $-80^{\circ}\text{C}$
- B.  $-40^{\circ}\text{C}$
- C.  $40^{\circ}\text{C}$
- D.  $80^{\circ}\text{C}$