

StraighterLine Physics Practice Test (Sample)

Study Guide



Everything you need from our exam experts!

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SAMPLE

Questions

SAMPLE

1. What is the resultant gravitational force acting on a 100 kg mass from the diagram provided?
 - A. 1.56 N
 - B. 9.81 N
 - C. 0 N
 - D. 15.0 N
2. In a binary star system where one star has mass M and the other has mass $3M$, which expression describes the speed of the larger star?
 - A. $(GMr_a)^{1/2} / (r_a + r_b)$
 - B. $(GMr_b)^{1/2} / (r_a + r_b)$
 - C. $(3GM)^{1/2} / (r_a + r_b)$
 - D. $(GM)^{1/2} / (r_a - r_b)$
3. For two identical masses connected by a rod, about which point is the moment of inertia smallest?
 - A. The midpoint of the rod
 - B. At one mass
 - C. At the center of mass
 - D. At the end of the rod
4. In a closed system, which physical quantity is always conserved during an interaction?
 - A. Energy
 - B. Work
 - C. Force
 - D. Mass
5. A roller coaster train starts from rest at a height of 47.5 m. What is the speed of the train at 30.0 m below this height?
 - A. 10.0 m/s
 - B. 24.3 m/s
 - C. 15.5 m/s
 - D. 8.0 m/s

6. When two objects slide down an incline, will the heavier object always accelerate faster than the lighter one?
- A. True
 - B. False
 - C. Only if friction is present
 - D. Only if the incline is steep
7. What is the average speed of a cat whose position function is described by $\mathbf{r} + (1.2\text{m/s})t\mathbf{i} + (0.7\text{m} + (0.5\text{m/s}^2)t^2)\mathbf{j}$ between $t = 0.0\text{s}$ and $t = 4.0\text{s}$?
- A. 1.5 m/s
 - B. 2.0 m/s
 - C. 2.3 m/s
 - D. 2.5 m/s
8. What is the number of molecules in an 80 L gas with a gauge pressure of 2 atm at 300 K?
- A. 2.93×10^{24}
 - B. 5.87×10^{24}
 - C. 1.25×10^{24}
 - D. 4.00×10^{24}
9. What type of result do you obtain when multiplying vectors A, B, and C in the order $(\mathbf{A} \times \mathbf{B}) \times \mathbf{C}$?
- A. Scalar
 - B. Point
 - C. A vector
 - D. Matrix
10. What is the ratio of the area of the piston on Jerry's side to the area of the piston under Tricia's bed?
- A. 1/10
 - B. 1/20
 - C. 2/1
 - D. 20/1

Answers

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1. A
2. B
3. B
4. A
5. B
6. B
7. C
8. B
9. C
10. B

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Explanations

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1. What is the resultant gravitational force acting on a 100 kg mass from the diagram provided?

A. 1.56 N

B. 9.81 N

C. 0 N

D. 15.0 N

To determine the resultant gravitational force acting on a 100 kg mass, we can use the formula for gravitational force, which is given by Newton's law of gravitation: $F = m \cdot g$ where F is the gravitational force, m is the mass, and g is the acceleration due to gravity. On the surface of Earth, g is approximately 9.81 m/s^2 . For a 100 kg mass, the gravitational force would be calculated as follows: $F = 100 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 981 \text{ N}$. This value represents the force acting on the mass due to gravity. However, in the context of the choices provided, it seems there might have been a miscalculation or misunderstanding in interpreting the situation, as none of the options reflect this correct calculation. The correct answer should reflect the gravitational force most contextually expected under standard conditions on Earth, which leads to the conclusion that the gravitational force on a 100 kg mass is approximately 981 N, not

2. In a binary star system where one star has mass M and the other has mass $3M$, which expression describes the speed of the larger star?

A. $(GMra)^{1/2} / (ra + rb)$

B. $(GMrb)^{1/2} / (ra + rb)$

C. $(3GM)^{1/2} / (ra + rb)$

D. $(GM)^{1/2} / (ra - rb)$

In a binary star system, the gravitational forces and the resulting motion of the stars are governed by their masses and the distance between them. In this case, you have a smaller star with mass M and a larger star with mass $3M$. To determine the speed of the larger star, it is important to apply the concept of gravitational dynamics and center of mass. The key concept is that both stars orbit their common center of mass. The speed of either star in a binary system can be derived from the gravitational force acting between them and is influenced by their distance from the center of mass. The larger star's speed is influenced not only by the gravitational pull from the smaller star but also by the distances of both stars from the center of mass. The gravitational potential energy in this system can be expressed using the formula involving the gravitational constant G , the mass of the stars, and the distance between them (in terms of ra and rb , where ra is the distance from the smaller star to the center of mass and rb is the distance from the larger star to the center of mass). The total distance between the two stars is the sum of these distances, so we can denote the total distance as $ra + rb$. The expression that correctly describes the speed of

3. For two identical masses connected by a rod, about which point is the moment of inertia smallest?

A. The midpoint of the rod

B. At one mass

C. At the center of mass

D. At the end of the rod

The moment of inertia of a system quantifies how difficult it is to change its rotational motion about a given axis. For the scenario with two identical masses connected by a rod, the moment of inertia varies depending on where the rotation axis is located. When considering the point at one of the masses, this location becomes pivotal. The moment of inertia about this axis accounts for the mass located at that point contributing zero to the moment of inertia since it is at the axis of rotation. In contrast, the other mass, which is a distance equal to the length of the rod away from the axis, contributes to the overall moment of inertia. However, the benefit here is that the contribution of that single mass (which is at one end) is minimal compared to when you account for added distances at other rotational axes. At other suggested locations, like the midpoint or the center of mass, the mass distribution contributes more significantly, resulting in a higher moment of inertia due to the larger distances from the axis. Thus, when the rotation occurs about the point of one mass, the system exhibits the least resistance to rotational motion, leading to a smaller moment of inertia compared to other configurations.

4. In a closed system, which physical quantity is always conserved during an interaction?

A. Energy

B. Work

C. Force

D. Mass

In a closed system, energy is the physical quantity that is always conserved during an interaction. This principle is rooted in the law of conservation of energy, which states that energy cannot be created or destroyed; it can only be transformed from one form to another. In any interaction, whether it involves kinetic energy, potential energy, thermal energy, or other forms, the total energy of the system before and after the interaction remains constant, provided there are no external forces or energy losses. While mass is also conserved in closed systems according to the conservation of mass principle, it is important to note that in modern physics, especially in contexts involving relativistic speeds or nuclear reactions, mass can be converted to energy and vice versa, as described by Einstein's famous equation $(E=mc^2)$. Therefore, energy conservation encompasses mass conservation when considering rest mass energy. Work, on the other hand, refers to the transfer of energy and is not a conserved quantity by itself; it is the process that can alter the energy of a system. Force is related to the interactions and changes in velocity or acceleration but is not a quantity that gets conserved in the same sense as energy during interactions. Thus, energy is the fundamental quantity that remains conserved in a closed system during interactions

5. A roller coaster train starts from rest at a height of 47.5 m. What is the speed of the train at 30.0 m below this height?
- A. 10.0 m/s
 - B. 24.3 m/s**
 - C. 15.5 m/s
 - D. 8.0 m/s

To determine the speed of the roller coaster train at a height of 30.0 m below its starting height of 47.5 m, we can utilize the principle of conservation of energy, specifically the conversion between gravitational potential energy and kinetic energy. Initially, at the height of 47.5 m, the train has gravitational potential energy given by the formula: $PE = mgh$ Where: - m is the mass of the train, - g is the acceleration due to gravity (approximately 9.81 m/s^2), - h is the height above the reference point. At the initial height of 47.5 m, the potential energy is: $PE_{\text{initial}} = mg \times 47.5$ When the train descends to a height of 30.0 m, its height relative to the reference point is reduced. The potential energy at this height is: $PE_{\text{final}} = mg \times 30.0$ As the train moves down, the potential energy lost will be converted into kinetic energy, which is given by the formula: $KE = \frac{1}{2}mv^2$

6. When two objects slide down an incline, will the heavier object always accelerate faster than the lighter one?
- A. True
 - B. False**
 - C. Only if friction is present
 - D. Only if the incline is steep

When discussing the motion of objects sliding down an incline, it is essential to understand the forces at play, particularly gravity and any friction that might be present. On a frictionless incline, both the heavier object and the lighter object experience the same gravitational force per unit mass, which results in the same acceleration for both objects. In the absence of friction, according to Newton's second law of motion, the mass cancels out when calculating the acceleration due to gravity. This means that all objects, regardless of their mass, will accelerate at the same rate when rolling down an incline. Thus, heavier objects do not necessarily accelerate faster than lighter ones in this situation. This reasoning leads to the conclusion that the statement is false. Factors such as the angle of the incline or the presence of friction can influence the objects' motions, but they do not change the fundamental principle that, without friction, weight does not affect acceleration. Therefore, it is accurate to say that the correct answer is that the heavier object does not always accelerate faster than the lighter one.

7. What is the average speed of a cat whose position function is described by $\mathbf{r} + (1.2\text{m/s})t\mathbf{i} + (0.7\text{m} + (0.5\text{m/s}^2)t^2)\mathbf{j}$ between $t = 0.0\text{s}$ and $t = 4.0\text{s}$?

A. 1.5 m/s

B. 2.0 m/s

C. 2.3 m/s

D. 2.5 m/s

To find the average speed of the cat over the given time interval from $(t = 0.0)$ seconds to $(t = 4.0)$ seconds, we start by determining the displacement of the cat using the provided position function. The position function given is $(\mathbf{r} + (1.2 \text{ m/s})t\mathbf{i} + (0.7\text{m} + (0.5\text{m/s}^2)t^2)\mathbf{j})$. We can break this down: 1. The (x) component, from the term $((1.2 \text{ m/s})t\mathbf{i})$, indicates linear motion at a constant speed of (1.2 m/s) . 2. The (y) component, from $((0.7\text{m} + (0.5\text{m/s}^2)t^2)\mathbf{j})$, shows that the cat's (y) position is influenced by both a constant displacement of (0.7m) and a quadratic term $(0.5\text{m/s}^2 t^2)$, indicating that the cat accelerates in the (y)

8. What is the number of molecules in an 80 L gas with a gauge pressure of 2 atm at 300 K?

A. 2.93×10^{24}

B. 5.87×10^{24}

C. 1.25×10^{24}

D. 4.00×10^{24}

To determine the number of molecules in an 80 L gas at a gauge pressure of 2 atm and a temperature of 300 K, the ideal gas law can be utilized, which is expressed as: $[PV = nRT]$ In this equation: - (P) is the absolute pressure, - (V) is the volume, - (n) is the number of moles, - (R) is the ideal gas constant (approximately $0.0821 \text{ L}\cdot\text{atm}/(\text{K}\cdot\text{mol})$), - (T) is the temperature in Kelvin. First, it's important to convert the gauge pressure to absolute pressure. Since gauge pressure measures pressure above atmospheric pressure, we add the atmospheric pressure (approximately 1 atm): $[P = 2 \text{ atm} + 1 \text{ atm} = 3 \text{ atm}]$ Now substituting the values into the ideal gas law gives us: $[(3 \text{ atm})(80 \text{ L}) = n(0.0821 \text{ L}\cdot\text{atm}/(\text{K}\cdot\text{mol}))(300 \text{ K})]$ Calculating

9. What type of result do you obtain when multiplying vectors A, B, and C in the order $(A \times B) \times C$?

- A. Scalar
- B. Point
- C. A vector**
- D. Matrix

When you multiply vectors A and B using the cross product, denoted as $A \times B$, the result is another vector that is orthogonal (perpendicular) to both A and B. This outcome is fundamental to vector multiplication in three-dimensional space and is essential in understanding the behavior of vectors in physics. Next, when you take the resultant vector from the cross product (let's call it $D = A \times B$) and then perform the cross product with vector C (i.e., $D \times C$), you again get another vector. The properties of the cross product ensure that this new vector is also orthogonal to both D and C. Thus, the entire operation $(A \times B) \times C$ yields a vector as a result. The correct answer is therefore that the final result is a vector.

10. What is the ratio of the area of the piston on Jerry's side to the area of the piston under Tricia's bed?

- A. 1/10
- B. 1/20**
- C. 2/1
- D. 20/1

To determine the correct ratio of the area of the piston on Jerry's side to the area of the piston under Tricia's bed, it's important to consider how the mechanics of pistons work. In hydraulic systems, the pressure transmitted through the fluid is consistent throughout the system. According to Pascal's principle, the pressure applied to a confined fluid is transmitted undiminished in every direction. Assuming that the two pistons operate under equal pressure conditions, we can use the formula for pressure, which is defined as force per unit area ($P = F/A$). If we want to maintain the same pressure while having different forces applied, the areas of the pistons must be different. In this scenario, if the ratio of the areas of the pistons results in a smaller area for Jerry's piston compared to Tricia's bed, the ratio could be effectively expressed in terms of their areas. Thus, if Tricia's bed piston has a significantly larger area than Jerry's, resulting in a ratio of 1:20 where Jerry's area is the smaller part, then we have a realistic interpretation of the hydraulic system operating under the given conditions. Thus, the ratio of the area of Jerry's piston to the area of Tricia's would