

# NCEA Level 2 Mechanics Practice Test (Sample)

## Study Guide



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**SAMPLE**

## **Questions**

1. What is the formula for centripetal force?
  - A. Centripetal force ( $F_c$ ) = (Mass ( $m$ )  $\times$  Velocity ( $v$ )) / Radius ( $r$ )
  - B. Centripetal force ( $F_c$ ) = (Mass ( $m$ )  $\times$  Velocity<sup>2</sup> ( $v^2$ )) / Radius ( $r$ )
  - C. Centripetal force ( $F_c$ ) = Mass ( $m$ )  $\times$  Acceleration ( $a$ )
  - D. Centripetal force ( $F_c$ ) = Force ( $F$ ) / Area ( $A$ )
2. What is the speed in m/s of a car travelling at 120 km/h?
  - A. 35 m/s
  - B. 40 m/s
  - C. 42 m/s
  - D. 24 m/s
3. What is impulse defined as?
  - A. The amount of energy transferred by a force
  - B. The change in momentum
  - C. The total force applied to an object
  - D. The velocity of an object over time
4. What is meant by the center of mass of an object?
  - A. The point where the object's weight is perfectly balanced
  - B. The physical center of an object
  - C. The point that represents the average position of all mass in the object
  - D. The area of the object where it is strongest
5. Which of the following correctly describes mass?
  - A. The force due to gravitational acceleration
  - B. The total amount of matter in an object
  - C. A variable measure that changes with location
  - D. The weight of an object on Earth
6. What is the formula to calculate impulse?
  - A. Impulse =  $F\Delta t$
  - B. Impulse =  $mv$
  - C. Impulse =  $a/t$
  - D. Impulse =  $d/t$

**7. What happens to the direction of force when using a pulley?**

- A. The direction of force remains the same**
- B. The direction of force is reversed**
- C. The force is eliminated**
- D. The force is multiplied**

**8. How is mechanical energy defined in a system?**

- A. It is the energy associated with motion only**
- B. It includes potential energy and kinetic energy**
- C. It is the total energy in a closed system**
- D. It refers to energy lost in a system**

**9. What is the approximate value of acceleration due to gravity on Earth's surface?**

- A. 9.8 N/kg**
- B. 9.8 m/s<sup>2</sup>**
- C. 10 N/kg**
- D. 10 m/s<sup>2</sup>**

**10. How is power defined in mechanical terms?**

- A. The amount of energy in a system**
- B. The total force applied to an object**
- C. The rate at which work is done**
- D. The distance an object moves**

## **Answers**

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

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## **Explanations**

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## 1. What is the formula for centripetal force?

A. Centripetal force ( $F_c$ ) = (Mass ( $m$ )  $\times$  Velocity ( $v$ )) / Radius ( $r$ )

**B. Centripetal force ( $F_c$ ) = (Mass ( $m$ )  $\times$  Velocity<sup>2</sup> ( $v^2$ )) / Radius ( $r$ )**

C. Centripetal force ( $F_c$ ) = Mass ( $m$ )  $\times$  Acceleration ( $a$ )

D. Centripetal force ( $F_c$ ) = Force ( $F$ ) / Area ( $A$ )

The correct formula for centripetal force expresses the relationship between mass, velocity, and radius in a circular motion context. Specifically, centripetal force ( $F_c$ ) is defined as the force required to keep an object moving in a circle and is dependent on the object's mass ( $m$ ), the square of its velocity ( $v^2$ ), and the radius ( $r$ ) of the circular path. When an object moves in a circle, it constantly changes direction, which means it is accelerating towards the center of the circle. The acceleration in this case is known as centripetal acceleration and can be formulated as  $a = \frac{v^2}{r}$ . Thus, when you combine this acceleration with the object's mass, you derive the centripetal force as  $F_c = m \times a = m \times \frac{v^2}{r}$ . This leads to the formula  $F_c = \frac{m \times v^2}{r}$ , which clearly highlights how both velocity and radius influence the required centripetal force. The choice of a formula that uses the velocity squared in its formulation emphasizes the fact that the force increases significantly with increases in speed, since velocity is squared, highlighting the non-linear relationship between

## 2. What is the speed in m/s of a car travelling at 120 km/h?

A. 35 m/s

B. 40 m/s

**C. 42 m/s**

D. 24 m/s

To convert the speed of a car from kilometers per hour (km/h) to meters per second (m/s), you can use the conversion factor that 1 km is equal to 1000 meters and 1 hour is equal to 3600 seconds. Starting with the speed of 120 km/h, you can break down the conversion as follows: 1. Convert kilometers to meters: 120 km = 120,000 meters 2. Convert hours to seconds: 1 hour = 3600 seconds 3. Now, to convert the speed to meters per second:  $\text{Speed in m/s} = \frac{120,000 \text{ meters}}{3600 \text{ seconds}} = \frac{120000}{3600}$  4. When you perform the calculation:  $\text{Speed in m/s} = 33.33 \text{ m/s}$  However, recalculating correctly gives:  $120 \text{ km/h} = \frac{120 \times 1000}{3600} = \frac{120,000}{3600} \approx 33$ .

### 3. What is impulse defined as?

- A. The amount of energy transferred by a force
- B. The change in momentum**
- C. The total force applied to an object
- D. The velocity of an object over time

Impulse is defined as the change in momentum of an object resulting from a force applied over a specific time interval. Mathematically, impulse can be expressed as the product of the average force and the duration of time for which the force acts. This relationship is rooted in Newton's second law, which states that force is equal to the rate of change of momentum. Therefore, when a force is applied to an object, it will cause a change in that object's momentum, which directly correlates to the concept of impulse. By understanding impulse as the change in momentum, we recognize that it accounts for both the magnitude of the force applied and the time duration over which that force acts. This concept is fundamental in mechanics, particularly in analyzing collisions or any situations where forces are applied to change the state of motion of an object.

### 4. What is meant by the center of mass of an object?

- A. The point where the object's weight is perfectly balanced
- B. The physical center of an object
- C. The point that represents the average position of all mass in the object**
- D. The area of the object where it is strongest

The center of mass of an object is defined as the point that represents the average position of all the mass in the object. It is a crucial concept in mechanics because it allows us to analyze the motion of complex objects by simplifying them to a single point. When a force acts on an object, it is the center of mass that behaves as if all of the mass were concentrated there. For instance, when calculating the motion of a jumping cat, the center of mass gives us a way to predict how the cat moves in the air. If the cat rotates mid-jump, the center of mass still follows a predictable parabolic path determined by the initial velocity and angle of the jump. This concept differs significantly from the other choices. The idea of a point where the object's weight is perfectly balanced does not encompass the distribution of mass throughout the entire object. The physical center of an object may not align with the center of mass, especially in irregularly shaped or asymmetrical objects. Lastly, the area where an object might be strongest does not relate to the distribution of mass, which is what the center of mass focuses on. Therefore, understanding the center of mass as the average position of all mass is vital for analyzing motion and stability in mechanics.

5. Which of the following correctly describes mass?

- A. The force due to gravitational acceleration
- B. The total amount of matter in an object**
- C. A variable measure that changes with location
- D. The weight of an object on Earth

Mass is defined as the total amount of matter in an object. It is a fundamental property that quantifies how much matter is present, irrespective of the object's location or the environment it is in. Unlike weight, which can vary based on gravitational force acting on the object, mass remains consistent no matter where the object is measured—in space, on Earth, or on another celestial body. Understanding mass as the amount of matter helps clarify why it is central to concepts such as inertia and the law of conservation of mass, since a greater mass denotes a greater resistance to changes in motion. This foundational concept is crucial in mechanics, especially when analyzing forces and motion, as it separates the intrinsic properties of an object from the external influences such as gravity or other forces acting on it.

6. What is the formula to calculate impulse?

- A. Impulse =  $F\Delta t$**
- B. Impulse =  $mv$
- C. Impulse =  $a/t$
- D. Impulse =  $d/t$

Impulse is defined as the change in momentum of an object when a force is applied over a certain period of time. The relationship between impulse and force can be expressed mathematically with the formula:  $\text{Impulse} = F\Delta t$ . In this formula,  $F$  represents the average force applied to the object, and  $\Delta t$  represents the time duration during which the force is applied. Thus, impulse quantifies the effect of a force acting over a time interval, and it is equal to the product of the force and the time period, which effectively gives us the change in momentum. The other options represent different physical concepts but do not accurately describe impulse. For instance, momentum can be calculated with mass and velocity ( $mv$ ), but this would not convey the relationship of force and time inherent in the concept of impulse.

**7. What happens to the direction of force when using a pulley?**

- A. The direction of force remains the same**
- B. The direction of force is reversed**
- C. The force is eliminated**
- D. The force is multiplied**

Using a pulley changes the direction of the applied force. When you pull down on a rope that runs over a pulley, the pulley changes the direction of that pull, allowing you to lift an object upwards. This characteristic is one of the primary functions of a pulley system. In practical terms, consider a situation where you want to lift a heavy load. By pulling down on one end of the rope that passes over the pulley, you effectively make it easier to lift the weight, because the pulley redirects your force upwards. This direction change is what allows a single person to lift heavy objects with more ease than if they were trying to lift the weight directly upwards without the aid of the pulley. Other options, such as suggesting that the direction of force remains the same or that force is eliminated, do not accurately describe the workings of a pulley. The notion of force being multiplied is also misleading in this context; while pulleys can provide mechanical advantage when used in combination (like in a block and tackle system), the basic function of a single pulley is primarily to alter direction rather than increase the amount of force applied.

**8. How is mechanical energy defined in a system?**

- A. It is the energy associated with motion only**
- B. It includes potential energy and kinetic energy**
- C. It is the total energy in a closed system**
- D. It refers to energy lost in a system**

Mechanical energy in a system is defined as the sum of potential energy and kinetic energy. Potential energy is associated with the position of an object, while kinetic energy is associated with its motion. This combined form of energy allows us to analyze various physical situations involving motion and force. For example, when an object is raised to a height, it gains potential energy, which can be converted into kinetic energy when the object falls. Similarly, a moving object possesses kinetic energy due to its speed and mass. The interplay between these two types of energy can be observed in systems like pendulums, roller coasters, and falling objects, where energy transitions from potential to kinetic and vice versa, while the total mechanical energy remains constant in the absence of external forces. This understanding of mechanical energy is essential in mechanics, enabling the prediction and analysis of motion and the effects of forces acting on objects. The idea that mechanical energy encompasses both forms highlights the importance of both position and motion in understanding energy within a system.

**9. What is the approximate value of acceleration due to gravity on Earth's surface?**

- A. 9.8 N/kg
- B. 9.8 m/s<sup>2</sup>**
- C. 10 N/kg
- D. 10 m/s<sup>2</sup>

The acceleration due to gravity on Earth's surface is commonly accepted as approximately 9.8 m/s<sup>2</sup>. This value represents how quickly an object accelerates towards Earth when it is in free fall, assuming no air resistance. The unit m/s<sup>2</sup> signifies that for every second an object falls, its velocity increases by approximately 9.8 meters per second due to the pull of Earth's gravity. This value is fundamental in physics as it provides a basis for calculations involving motion under the influence of gravity. It is often rounded to 10 m/s<sup>2</sup> for simplicity in some introductory physics problems, but the more precise value is 9.8 m/s<sup>2</sup>. Thus, B is accurately reflecting the standard measured value of gravitational acceleration, making it the correct choice.

**10. How is power defined in mechanical terms?**

- A. The amount of energy in a system
- B. The total force applied to an object
- C. The rate at which work is done**
- D. The distance an object moves

In mechanical terms, power is defined as the rate at which work is done. This means it quantifies how quickly energy is transferred or converted from one form to another during the performance of work. Mathematically, power can be expressed as the work done divided by the time it takes to do that work. This relationship highlights that if a large amount of work is done in a short time, the power is high, whereas if the same amount of work is done over a longer period, the power is lower. Understanding this concept is fundamental in mechanics, as it helps to analyze the efficiency and performance of various mechanical systems.