NCEA Level 2 Physics Practice Exam (Sample)

Study Guide

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Questions

1. Torque is influenced by which of the following aspects?

A. The speed of an object

B. The angle at which force is applied

C. The mass of the object

D. The rotation frequency

2. Which unit represents electric current?

A. I

B. V

C. R

D. P

3. What describes a projectile's vertical motion?

A. Constant velocity

B. Uniform acceleration

C. Constant acceleration due to gravity

D. Zero acceleration

4. When does thermionic emission occur in an electron gun?

A. When the filament is exposed to magnetic fields

B. When the filament is heated by a DC supply

C. When the filament is cooled rapidly

D. When the filament is vibrating at low temperature

5. What does impulse define in terms of momentum?

A. Change in velocity

B. Change in energy

C. Change in acceleration

D. Change in momentum

6. Which statement about projectile motion is true?

A. Horizontal and vertical motions are independent

B. Vertical motion is not affected by gravity

C. Horizontal motion varies with time

D. All projectiles have the same maximum height

7. What unit is force measured in?

A. Kilogram

B. Pound

C. Newton

D. Joule

8. How is electric potential defined?

A. Force per charge

B. Work done per Coulomb

C. Power per unit of time

D. Energy per mass

9. What type of magnetic field lines are produced by a current going down a straight wire?

A. Straight magnetic field lines

B. Spiral magnetic field lines

C. Circular magnetic field lines

D. Conical magnetic field lines

10. How can you calculate the horizontal distance of a projectile?

A. $d = V_{hor} \times t$

B. $d = V_{vert} \times t$

C. $d = a \times t^2$

D. $d = 0.5 \times a \times t^2$

Answers

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

Explanations

1. Torque is influenced by which of the following aspects?

A. The speed of an object

B. The angle at which force is applied

C. The mass of the object

D. The rotation frequency

Torque, which is a measure of the rotational force acting on an object, is significantly influenced by the angle at which the force is applied. When a force is applied at different angles relative to the lever arm (the distance from the pivot point to the point where the force is applied), the effectiveness of that force to produce torque changes. At a right angle (90 degrees) to the lever arm, the force will create the maximum torque because it acts perpendicularly to the arm. If the angle is reduced, the torque produced by the same force decreases, as the effective component of the force acting to cause rotation becomes smaller. This relationship is mathematically expressed in the equation for torque: $\tau = r \cdot F \cdot \sin(\theta)$, where r is the length of the lever arm, F is the force applied, and θ is the angle between the force and the lever arm. The other options do not directly relate to the calculation of torque. While the speed of an object and the rotations it makes can influence the overall dynamics of motion in a system, they do not affect the torque generated at a given moment. Similarly, the mass of

2. Which unit represents electric current?

A. I

B. V

C. R

D. P

The unit that represents electric current is the ampere, symbolized by the letter "I." Current is defined as the flow of electric charge through a conductor, and it measures how much charge passes a point in the circuit over a specific time. The symbol "I" is derived from the French term "intensité de courant," which translates to "intensity of current." Understanding this concept is crucial in physics as it allows for the analysis of electrical circuits and the flow of electricity in various components. The other symbols represent different electrical quantities: "V" stands for voltage, which is the potential difference, "R" represents resistance, which quantifies how much a material opposes the flow of current, and "P" signifies power, which is the rate at which electrical energy is transferred. Each of these plays a critical role in electrical systems but does not represent electric current itself.

3. What describes a projectile's vertical motion?

A. Constant velocity

B. Uniform acceleration

C. Constant acceleration due to gravity

D. Zero acceleration

A projectile's vertical motion is characterized by constant acceleration due to gravity. This acceleration is approximately 9.81 m/s² downward near the Earth's surface. When an object is projected into the air, it experiences the force of gravity pulling it downwards throughout its flight. This means that as the projectile rises, it slows down until it reaches its maximum height, and then it accelerates downward as it falls back to the ground. Constant acceleration due to gravity is significant because it leads to well-defined equations of motion, which can be used to predict various characteristics of the projectile's path, such as the time it takes to reach maximum height or how far it will travel horizontally before hitting the ground. While it may seem intuitive to think of vertical motion as exhibiting constant velocity, this is not the case when gravity is acting on the projectile. Instead, the projectile's vertical velocity changes continuously as it rises and falls. An idea of zero acceleration applies in scenarios where no forces act on an object, but in the case of a projectile, gravity is an ever-present force influencing its motion. Thus, the description of vertical motion as having uniform acceleration due to the constant force of gravity is indeed the most accurate representation of what occurs in projectile motion.

4. When does thermionic emission occur in an electron gun?

A. When the filament is exposed to magnetic fields

B. When the filament is heated by a DC supply

C. When the filament is cooled rapidly

D. When the filament is vibrating at low temperature

Thermionic emission occurs when a filament is heated to a temperature that provides enough energy for electrons to escape from the material. In the context of an electron gun, the filament is typically made of a material that releases electrons when sufficiently heated. When a direct current (DC) supply is applied to the filament, it generates heat through resistance, raising the temperature of the filament. As the temperature increases, electrons within the filament gain kinetic energy. Once this kinetic energy exceeds the work function of the material—which is the minimum energy needed for an electron to escape from the surface of the filament—electrons can be emitted into the vacuum. This process is fundamental in electron guns, where a focused stream of electrons is needed for various applications such as in cathode-ray tubes or electron microscopy. In contrast to the correct reasoning, other scenarios such as exposure to magnetic fields, rapid cooling, or low-temperature vibrations do not facilitate the thermionic emission process. In fact, cooling would lower the kinetic energy of electrons, making it less likely for them to overcome the work function and be emitted. Low-temperature vibrations of the filament do not provide the necessary thermal energy required for electron emission, either.

5. What does impulse define in terms of momentum?

A. Change in velocity

B. Change in energy

C. Change in acceleration

D. Change in momentum

Impulse is defined as the change in momentum of an object when a force is applied over a specific time interval. Mathematically, impulse can be expressed as the product of the average force applied to an object and the time duration during which the force acts. According to the impulse-momentum theorem, the impulse experienced by an object is equal to the change in its momentum. Momentum itself is the product of an object's mass and its velocity. Therefore, when a force is applied to an object, causing it to change speed or direction, its momentum changes. Impulse quantifies this effect, showing how much momentum is transferred or altered. In summary, when discussing impulse in the context of momentum, it is the measure of the change in an object's momentum due to the application of a force over time.

6. Which statement about projectile motion is true?

A. Horizontal and vertical motions are independent

B. Vertical motion is not affected by gravity

C. Horizontal motion varies with time

D. All projectiles have the same maximum height

In projectile motion, the horizontal and vertical motions are indeed independent of each other. This independence is a fundamental principle of kinematics. When an object is projected, the horizontal motion occurs at a constant velocity (assuming air resistance is negligible) while the vertical motion is influenced by gravity, resulting in a uniform acceleration downwards. At any given time during the projectile's flight, the horizontal displacement can be calculated using the horizontal speed multiplied by time, while the vertical displacement is influenced by the initial vertical velocity and the acceleration due to gravity. This separation of motions allows one to analyze them individually using different equations of motion, which is crucial for solving problems related to projectile trajectories. The other statements do not hold true in the context of projectile motion. The vertical motion is indeed affected by gravity, which causes an acceleration downwards. The horizontal motion does not vary with time; it remains constant in ideal conditions. Lastly, the maximum height of projectiles varies based on their initial velocity and launch angle; not all projectiles will reach the same height. Only when launched under identical conditions will they have the same maximum height.

7. What unit is force measured in?

A. Kilogram

B. Pound

C. Newton

D. Joule

Force is measured in Newtons, which is the standard unit of force in the International System of Units (SI). The Newton is defined as the amount of force required to accelerate a one-kilogram mass by one meter per second squared (1 N = 1 kg·m/s²). This relationship emphasizes the connection between force, mass, and acceleration, which is famously described by Newton's second law of motion. The other units listed have distinct meanings and purposes. Kilograms are a unit of mass, not force, while pounds can measure force in certain contexts, particularly in the Imperial system, but they are not widely used in scientific contexts. Joules measure energy, which is the work done when a force is applied over a distance, but they do not directly measure force itself. Thus, Newton is the appropriate unit for force in physics.

8. How is electric potential defined?

A. Force per charge

B. Work done per Coulomb

C. Power per unit of time

D. Energy per mass

Electric potential is defined as the amount of work done per unit charge in bringing a charge from a reference point (usually at infinity) to a specific point in an electric field without any acceleration. This definition fundamentally describes how much energy is required to move an electric charge within an electric field. When we consider work done to move a charge against an electric field, we divide this work by the amount of charge being moved, which gives us the electric potential. It is measured in volts, where one volt is equivalent to one joule of work done per coulomb of charge. This concept is crucial in understanding how electric fields influence the movement and potential energy of charged particles. The other choices don't accurately define electric potential. For instance, force per charge would refer to the electric field strength, while power per unit of time describes a different physical quantity that relates to the rate at which energy is transferred or converted. Energy per mass is a concept that relates to specific energy in mechanics or gravitational fields, not electric potential. Hence, the definition as work done per coulomb is the most accurate representation of electric potential.

9. What type of magnetic field lines are produced by a current going down a straight wire?

A. Straight magnetic field lines

B. Spiral magnetic field lines

C. Circular magnetic field lines

D. Conical magnetic field lines

When a current flows through a straight wire, it generates a magnetic field that circles around the wire. This phenomenon is a consequence of Ampère's circuital law, which states that a magnetic field is produced by electric currents. The magnetic field lines created by the current in the wire are circular in shape. Specifically, if you visualize the wire in three dimensions, the circular magnetic field lines extend outward from the wire in concentric circles. The direction of these circular lines can be determined using the right-hand grip rule; if you hold the wire with your right hand, with your thumb pointing in the direction of the current, your fingers will curl in the direction of the magnetic field lines. This specific arrangement of circular lines around the wire indicates that the magnetic field strength diminishes with distance from the wire; it is strongest right next to the wire and weakens further away. This understanding of magnetic fields is crucial in various applications, such as in electromagnets and the design of electrical circuits.

10. How can you calculate the horizontal distance of a projectile?

A. $d = V_{hor} \times t$

B. $d = V_{vert} \times t$

C. $d = a \times t^2$

D. $d = 0.5 \times a \times t^2$

To calculate the horizontal distance traveled by a projectile, you utilize the horizontal component of its initial velocity and the total time the projectile spends in the air. The formula $d = V_{hor} \times t$ indicates that the horizontal distance (d) is equal to the horizontal velocity (V_{hor}) multiplied by the time (t) of flight. In projectile motion, the horizontal motion occurs independently of the vertical motion. The horizontal velocity remains constant throughout the flight, assuming there is no air resistance. By knowing the horizontal velocity and the duration of the projectile's flight, you can directly compute the distance covered in the horizontal direction. In contrast, the other options involve vertical motion or include acceleration factors which do not apply to horizontal distance in projectile motion. The vertical velocity is relevant to vertical distance but not for calculating how far the projectile goes horizontally. Thus, the formula for horizontal distance must focus on the constant horizontal velocity and the time of flight.