Halliday/Resnick/Walker
Fundamentals of Physics 8th edition

Classroom Response System Questions

Chapter 24 Electric Potential

Reading Quiz Questions
24.2.1. Electric potential energy is defined in a similar manner to the gravitational potential energy. Complete the following statement: These two potential energies are analogous to each other because

a) both electric and gravitational forces are always attractive forces.

b) both the electric and gravitational forces are fundamental forces of nature.

c) both the electric and gravitational forces are conservative forces.

d) both the electric and gravitational forces can be either attractive or repulsive forces.

e) both the electric and gravitational forces are dependent on the mass of particles.
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d) both the electric and gravitational forces can be either attractive or repulsive forces.

e) both the electric and gravitational forces are dependent on the mass of particles.
24.2.2. A positively-charged particle is held at point A between two parallel metal plates. The plate on the left has a net positive charge $+q$ and the plate on the right has a net negative charge $-q$. The particle is then moved to point B. How does the electric potential energy at point A compare with that at point B?

a) $U_A > U_B$

b) $U_A = U_B$

c) $U_A < U_B$

d) $U_A > U_B$ or $U_A < U_B$ depending on the actual distances from the points to the plates.
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24.2.3. An electron, which has a charge of $1.60 \times 10^{-19}$ C, is released at rest in a uniform electric field of magnitude 120 N/C. What is the potential energy of the electron just before it is released from rest?

a) $1.93 \times 10^{-17}$ J
b) $1.33 \times 10^{-18}$ J
c) $2.13 \times 10^{-20}$ J
d) $3.11 \times 10^{-21}$ J
e) Too little information is given to determine an answer.
24.2.3. An electron, which has a charge of $1.60 \times 10^{-19}$ C, is released at rest in a uniform electric field of magnitude 120 N/C. What is the potential energy of the electron just before it is released from rest?

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e) Too little information is given to determine an answer.
24.3.1. Which of the following choices represents the quantity that is equal to the electric potential?

a) \( \frac{kq}{r} \)

b) \( U_A - U_B \)

c) \( q \times U \)

d) \( \frac{U}{q} \)

e) \( \frac{kq}{r^2} \)
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24.3.2. Which of the following units are the SI units for the electric potential?

a) ampere (A)

b) newton/coulomb (N/C)

c) joule (J)

d) gauss (G)

e) volt (V)
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e) volt (V)
24.3.3. Points A, B, and C lie along a line from left to right, respectively. Point B is at a lower electric potential than point A. Point C is at a lower electric potential than point B. Which one of the following statements best describes the subsequent motion, if any, of a positively-charged particle released from rest at point B?

a) The particle will move at constant velocity in the direction of point A.
b) The particle will move at constant velocity in the direction of point C.
c) The particle will remain at rest.
d) The particle will accelerate in the direction of point A.
e) The particle will accelerate in the direction of point C.
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c) The particle will remain at rest.

d) The particle will accelerate in the direction of point A.

e) The particle will accelerate in the direction of point C.
24.3.4. What is the name of unit of energy that is the amount by which the electric potential energy of an electron when it moves through a potential difference of one volt?

a) volt (V)

b) electron volt (eV)

c) joule (J)

d) watt (W)

e) becquerel (Bq)
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24.3.5. A conducting sphere is connected via a wire to the ground. For a very short time, electrons move from the ground to the sphere. Then, no more electrons move to the sphere. Complete the following sentence: Before the wire was connected, the sphere’s electric potential had a

a) positive value.

b) negative value.

c) value that could have been either positive or negative.

d) value equal to zero volts.
24.3.5. A conducting sphere is connected via a wire to the ground. For a very short time, electrons move from the ground to the sphere. Then, no more electrons move to the sphere. Complete the following sentence: Before the wire was connected, the sphere’s electric potential had a

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d) value equal to zero volts.
24.3.6. Which one of the following phrases best describes the electric potential of a charged particle?

a) the total force exerted on or by the charged particle

b) the force per unit charge

c) the potential energy of the particle relative to infinity

d) the potential energy per unit charge

e) the potential energy per unit force on the particle
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24.3.7. A force is exerted on a positively-charged particle that moves the particle in the direction opposite to that of an electric field. Which one of the following statements concerning the work performed in this movement is true?

a) The work done on the particle has a positive sign.

b) No work is done on such a charged particle, if it is moved in a direction that is parallel or anti-parallel to an electric field.

c) The work done on the particle has a negative sign.

d) One cannot answer this question without knowing the kind of particle involved.
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24.3.8. A uniform electric field is directed parallel to the +y axis. If a positive test charge begins at the origin and moves upward along the y axis, how does the electric potential vary, if at all?

a) The electric potential will decrease with increasing y.

b) The electric potential will increase with increasing y.

c) The electric potential will remain constant with increasing y.

d) Too little information is given to answer this question.
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c) The electric potential will remain constant with increasing y.

d) Too little information is given to answer this question.
24.4.1. Which one of the following statements concerning equipotential surfaces is true?

a) The electric field lines are directed parallel to the equipotential surface.

b) Equipotential surfaces are a three dimensional representation of electric field lines.

c) The electric potential at points on each equipotential surface is equal to that of all other equipotential surfaces.

d) The net work done by electric forces that move a charge from one equipotential surface to another is equal to zero joules.

e) The net work done by electric forces that move a charge along an equipotential surface is equal to zero joules.
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e) The net work done by electric forces that move a charge along an equipotential surface is equal to zero joules.
24.4.2. Which one of the following statements concerning equipotential surfaces is false?

a) All points on an equipotential surface have the same electric potential.

b) No work is done by the net electric force as a charge moves from one equipotential surface to another.

c) The electric field created by one or more charges is everywhere perpendicular to the associated equipotential surfaces.

d) The electric field created by one or more charges points in the direction of decreasing potential.

e) There is a quantitative relationship between the electric field and the associated equipotential surfaces that surround one or more charges.
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e) There is a quantitative relationship between the electric field and the associated equipotential surfaces that surround one or more charges.
24.4.3. Complete the following statement: Along an equipotential surface,

a) the magnitude of the electric field is constant.

b) the electric field lines are parallel to the surface.

c) the direction of the magnetic field is constant.

d) the electric field lines are perpendicular to the surface.

e) both the magnitude and direction of the electric field is constant.
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b) the electric field lines are parallel to the surface.

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d) the electric field lines are perpendicular to the surface.

e) both the magnitude and direction of the electric field is constant.
24.4.4. The potential difference between an initial point and a final point can be calculated using $V_f - V_i = -\int_i^f \vec{E} \cdot d\vec{s}$. Under what circumstances is the potential difference equal to zero volts?

a) The electric field is perpendicular to the path at all points between the initial and final points.

b) The electric field has the same magnitude at the initial and final points.

c) The electric field has the same magnitude and direction at the initial and final points.

d) The electric field strength is the same along the path between the initial and final points.

e) The path between the initial and final points is a straight line.
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e) The path between the initial and final points is a straight line.
24.5.1. A sphere has a radius $R$ and a total charge $Q$ uniformly distributed throughout its volume. Where is the electric potential of the sphere a minimum?

a) at infinity

b) at the surface of the sphere, $r = R$

c) $R/2 < r < R$

d) $0 < r < R/2$

e) at the center of the sphere, $r = 0$
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e) at the center of the sphere, \( r = 0 \)
24.5.2. Points P and Q are separated by a distance of 0.10 m in a uniform electric field. The potential difference between points P and Q is 55 V. What is the magnitude of the electric field?

a) 0.55 V/m
b) 5.5 V/m
c) 55 V/m
d) 550 V/m
e) 5500 V/m
24.5.2. Points P and Q are separated by a distance of 0.10 m in a uniform electric field. The potential difference between points P and Q is 55 V. What is the magnitude of the electric field?

a) 0.55 V/m
b) 5.5 V/m
c) 55 V/m
d) 550 V/m
e) 5500 V/m
24.6.1. Four point charges are individually brought from infinity and placed at the corners of a square as shown in the figure. Each charge has the identical value $+Q$. The length of the diagonal of the square is $2a$. What is the electric potential at the center of the square?

a) $kQ/a$

b) $4kQ/a$

c) $2kQ/a$

d) $kQ/4a$

e) zero volts
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a) $kQ/a$

b) $4kQ/a$

c) $2kQ/a$

d) $kQ/4a$

e) zero volts
24.7.1. Point charge A is located at point A and point charge B is at point B. Points A and B are separated by a distance $r$. To determine the electric potential at the mid-point along a line between points A and B, which of the following mathematical approaches is correct?

a) The electric potential due to each charge is determined at a distance $r/2$ from each of the charges and an average is taken of the two values.

b) The vector sum of the two electric potentials determines the total electric potential at a distance $r/2$ from each of the charges.

c) The algebraic sum of the two electric potentials is determined at a distance $r/2$ from each of the charges, making sure to include the signs of the charges.

d) The difference in the absolute value (the sign of the charges does not enter into the calculation) of the two electric potentials is determined at a distance $r/2$ from each of the charges.
24.7.1. Point charge A is located at point A and point charge B is at point B. Points A and B are separated by a distance \( r \). To determine the electric potential at the mid-point along a line between points A and B, which of the following mathematical approaches is correct?

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d) The difference in the absolute value (the sign of the charges does not enter into the calculation) of the two electric potentials is determined at a distance \( r/2 \) from each of the charges.
24.7.2. Consider the two charged particles. One charge located on the $y$ axis has a value $-2q$ and is located at a distance $r$ from the origin, point $O$. The other charge has a value $-q$ and is located at a distance $2r$ from the origin along the $x$ axis. Which one of the following statements concerning the electric potential at the origin is true?

a) The total electric potential at the origin is equal to $-5kq/2r$.

b) The total electric potential at the origin is equal to zero volts.

c) The total electric potential at the origin is equal to $-2kq/r$.

d) The total electric potential at the origin cannot be calculated since the charges are on different axes.

e) The total electric potential at the origin is equal to $-3kq/2r$. 
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d) The total electric potential at the origin cannot be calculated since the charges are on different axes.

e) The total electric potential at the origin is equal to $-3kq/2r$. 
24.8.1. An electric dipole is situated on the y axis as shown. The two charges of opposite sign are of equal magnitude \( Q = 2.0 \text{ C} \). Determine the magnitude of the electric potential at point P.

a) \( 1.1 \times 10^9 \text{ V} \)
b) \( 2.2 \times 10^9 \text{ V} \)
c) \( 4.5 \times 10^9 \text{ V} \)
d) \( 9.0 \times 10^9 \text{ V} \)
e) zero volts
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b) $2.2 \times 10^9$ V

c) $4.5 \times 10^9$ V

d) $9.0 \times 10^9$ V

e) zero volts
24.9.1. When you calculate the potential at some point P due to a continuous charge distribution, the sign for the potential can be troublesome. If the charge distribution is negative, should the quantities \( dq \) and \( \lambda \) represent negative quantities?

a) The sign on \( dq \) should be negative and the sign on \( \lambda \) should be positive.

b) The sign on \( dq \) should be positive and the sign on \( \lambda \) should be negative.

c) The signs can be ignored; and at the end of the calculation inserted. The potential is negative if the charge distribution is negative.

d) The signs can be ignored; and at the end of the calculation inserted. The potential is positive if the charge distribution is negative.

e) The signs can be ignored. The potential should have a positive sign, regardless of the sign of the charge distribution.
24.9.1. When you calculate the potential at some point $P$ due to a continuous charge distribution, the sign for the potential can be troublesome. If the charge distribution is negative, should the quantities $dq$ and $\lambda$ represent negative quantities?

a) The sign on $dq$ should be negative and the sign on $\lambda$ should be positive.

b) The sign on $dq$ should be positive and the sign on $\lambda$ should be negative.

c) The signs can be ignored; and at the end of the calculation inserted. The potential is negative if the charge distribution is negative.

d) The signs can be ignored; and at the end of the calculation inserted. The potential is positive if the charge distribution is negative.

e) The signs can be ignored. The potential should have a positive sign, regardless of the sign of the charge distribution.
24.11.1. The electric potential at the surface of a conducting, spherical shell of radius \( R \) is \( V \) relative to Earth ground. What is the electric potential at the center of the shell?

a) zero volts

b) \( V/R \)

c) \( V/(4\pi R)^2 \)

d) \( V/2 \)

e) \( V \)
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a) zero volts

b) $V/R$

c) $V/(4\pi R)^2$

d) $V/2$

e) $V$
24.12.1. Consider two isolated conductive metal spheres. Each carries the same amount of excess charge $Q$, but one has a radius that is five times greater than the other. How does the electrostatic potential of the two spheres compare?

a) The electrostatic potential of the larger sphere is at a higher potential than the smaller sphere.

b) The electrostatic potential of the larger sphere is at a lower potential than the smaller sphere.

c) The electrostatic potential of the larger sphere is at the same potential than the smaller sphere.
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