Dickie - Electricity - Forces & Fields

Physics 30 Worksheet # 6: *Coulomb's Law (1)*

1. An object with a charge of 2.00 C is separated from a second object with the same charge by a distance of 1.50 m. What is the electric force acting between the charges? Is the force an attractive or repulsive force?

2. An object with a charge of 1.50×10^{-2} C is separated from a second object with a charge of -2.50×10^{-2} C by a distance of 0.500 m. Calculate the force acting between the charges. Is the force attractive or repulsive?

3. An electric force of 7.19×10^{-8} N acts between two charges, both of magnitude 2.00×10^{-10} N. Calculate the distance between the two charges.

4. Two identical charges are separated by a distance of 1.00 m. An repulsive force of 3.60 N acts between the charges. What is the magnitude of each of the charges?

5. An electron and a proton are 5.29×10^{-29} m apart. Calculate the force that acts between them. Calculate the initial acceleration if the electron is free to move.

6. Calculate the initial acceleration of an alpha particle ($q=3.20 \times 10^{-19}$ C) if the alpha particle is 2.00×10^{-25} m away from an electron and the alpha particle is free to move. Calculate the acceleration of the electron if it is free to move.

7. A charge of 2.00 C is touched with a second charge of 6.00 C, then with a neutral object. The first charge is then separated from the second charge by a distance of 5.00×10^{-2} m. What is the electric force that acts between the first charge and the second charge.

8. Object 1 has an initial charge of 1.00×10^{-5} C. Object 2 has an initial charge of -2.00×10^{-5} C. Object 3 has a charge of -3.50×10^{-5} C. If object 1 touches object 2, then object 2 touches object 3, then object 1 is brought 2.00×10^{-3} m away from object 3, what is the electric force that acts between charge 1 and 3?

Physics 30 Worksheet # 7: *Coulomb's Law (2)*

1. Three charges are in a straight row. The first charge has a value of 5.00×10^{-5} C. The second charge also has a value of 5.00×10^{-5} C and is 2.50 cm to the right of the first charge. The third charge has a value of -2.50×10^{-5} C and is 2.00 cm to the right of the second charge.

   a. Find the net force on the first charge.

   b. Find the net force on the second charge.

   c. Find the net force on the third charge.

   d. If the first charge has a mass of 7.50×10^{-2} kg, find its initial acceleration.

2. Three charges are in a straight row. The first charge has a value of 2.50×10^{-2} C. The second charge has a value of -4.00×10^{-2} C and is 60.0 mm to the right of the first charge. The third charge has value of 3.00×10^{-2} C and is 5.00 cm to the right of the second charge.

   a. Find the net force on the first charge.

   b. Find the net force on the second charge.

   c. Find the net force on the third charge.

   d. If the first charge has a mass of 25.0 g, find its initial acceleration.

3. Repeat question 1 (b) above, but with the third charge **below** the second charge.

4. Repeat question 2 (b) above, but with the first charge **above** the second charge.

Physics 30 Worksheet # 8: *Electric Fields*

1. Calculate the strength and direction of the electric field 0.250 m to the right of a 1.00 C electric charge.

2. Calculate the strength and direction of the electric field 300 mm to the right of a -2.00 C electric charge.

3. Calculate the strength and direction of the electric field 8.50 cm to the left of a 300 μC electric charge.

4. Calculate the distance from a 3.00 C electric charge where the electric field strength is 1.09×10^{11} N/C.

5. Calculate the electric field experienced by an electron if the net force experienced is 6.50×10^{-16} N.

6. Calculate the electric field experienced by an alpha particle if the net force experienced is 2.00×10^{-16} N. Calculate the initial acceleration of the alpha particle.

7. Calculate the net force experienced by an electron if the electric field experienced is 1.00×10^{3} N/C.

8. Two charges are in a straight row. The first charge has a value of 5.00×10^{-5} C. The second charge has a value of -2.50×10^{-5} C and is 4.50 cm to the right of the first charge. Calculate the strength and direction of the net electric field midway between the two charges.

9. Three charges are in a straight row. The first charge has a value of 2.50×10^{-2} C. The second charge has a value of -4.00×10^{-2} C and is 60.0 mm to the right of the first charge. The third charge has value of 3.00×10^{-2} C and is 5.00 cm to the right of the second charge. Calculate the strength and direction of the net electric field 2.00 cm to the right of the third charge.

10. The potential difference between two charged, parallel plates is 200 V and the distance between the plates is 360 cm. Calculate the electric field strength between the plates.

11. Calculate the potential difference between two plates 1.50 m apart that is required to produce an electric field of 4.00×10^3 N/C.

12. An electron sits between two charged, parallel pates 10.0 cm apart. The electric field strength between the plates is 2.50×10^3 N/C.

    a. What is the potential difference across the plates?

    b. What is the magnitude of the electric force experienced by the electron?

    c. What is the acceleration experienced by the electron?

Physics 30 Worksheet # 9: *Charged Particles in Electric Fields*

1. An electron is accelerated from rest across a potential difference of 85.0 V. What is the final speed of the electron?

2. An electron is accelerated from rest to a speed of 6.00×10^6 m/s. What potential difference is required to do this?

3. An electron is accelerated through a potential difference of 9.00 V. If the electron begins at a speed of 6.00×10^4 m/s, what is the final speed of the electron?

4. A proton is accelerated from a speed of 5.00×10^4 m/s to 5.00×10^6 m/s. What potential difference is required to accomplish this?

5. A potential difference of 100 V exists across two parallel plates that are 16.0 cm apart. An electron begins at rest at one of the plates and accelerates toward the second plate. How fast is the electron moving when it has traveled 4.00 cm? How fast is it moving when it has traveled 8.00 cm? How fast is it moving when it has traveled 16.0 cm?

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6. An electron begins at a speed of 5.00×10^6 m/s and is slowed down by a potential difference of 15.0 V. What is the final speed of the electron?

7. An electron enters the gap between parallel plates (potential difference of 20.0 V, 10.0 cm apart) at 6.00×10^6 m/s. How fast is the electron moving when it reaches the second plate if it is moving from the negative plate to the positive plate? How fast is the electron moving when it reaches the second plate if it is moving from the positive plate to the negative plate?

Diploma Exam Review Questions

Basic Electricity

Use the following information to answer the next question.

> Two conducting spheres have identical surface areas. Sphere ***A*** has a charge of 4.50 μC. Sphere ***B*** has a charge of −2.40 μC. Spheres ***A*** and ***B*** are brought into momentary contact and separated to a distance of 2.50 cm.

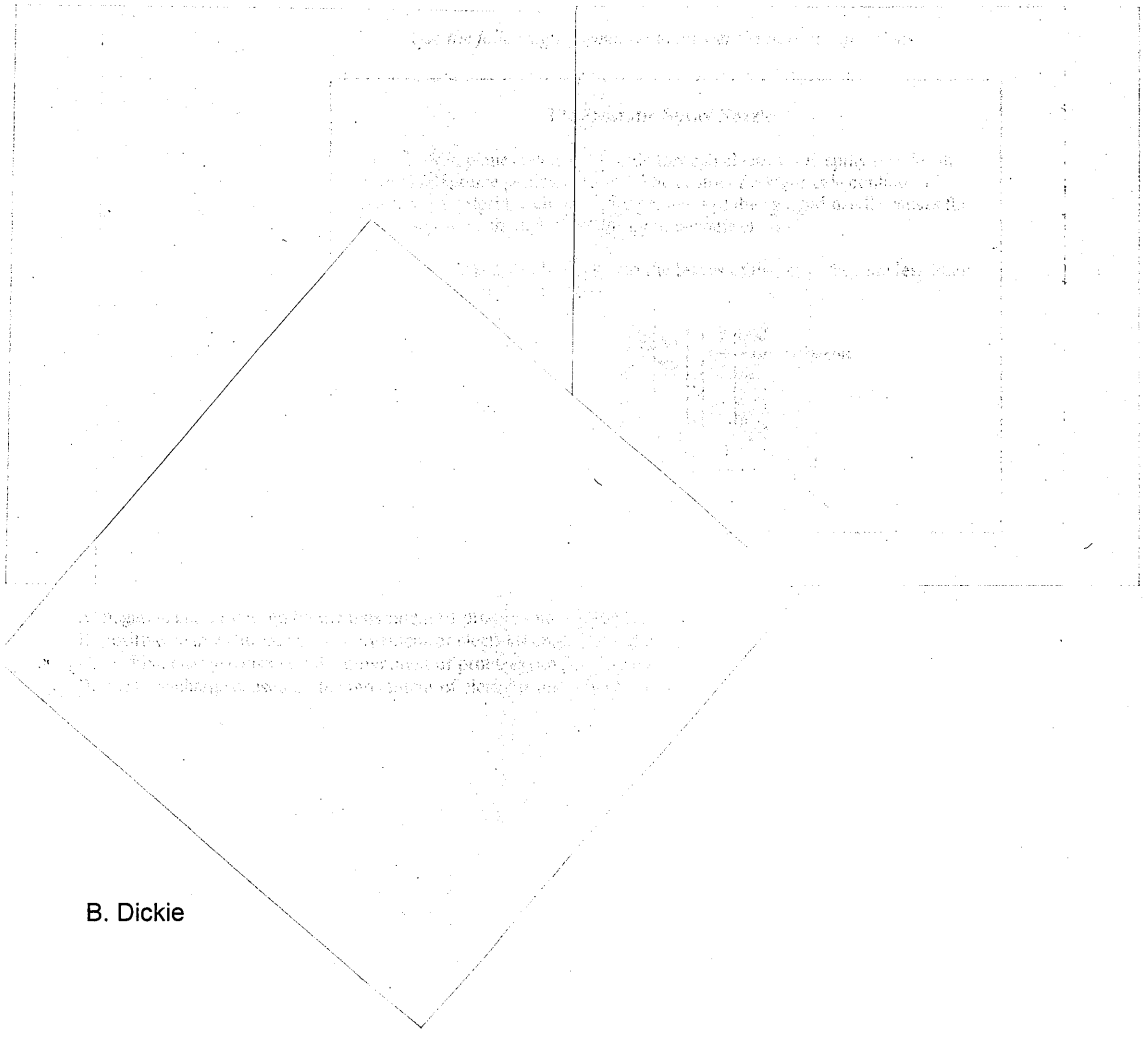
32. After contact, the charge on sphere ***A*** is

A. 1.05 μC
B. 2.10 μC
C. 3.45 μC
D. 6.90 μC

33. The number of excess electrons on a ball that has a charge of -3.60×10^{-17} C, expressed in scientific notation, is $a.bc \times 10^{d}$. The values of ***a***, ***b***, ***c***, and ***d*** are _____, _____, _____, and _____.

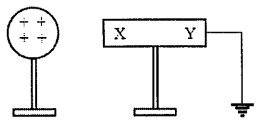
(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Charging Objects



Use the following information to answer the next question.

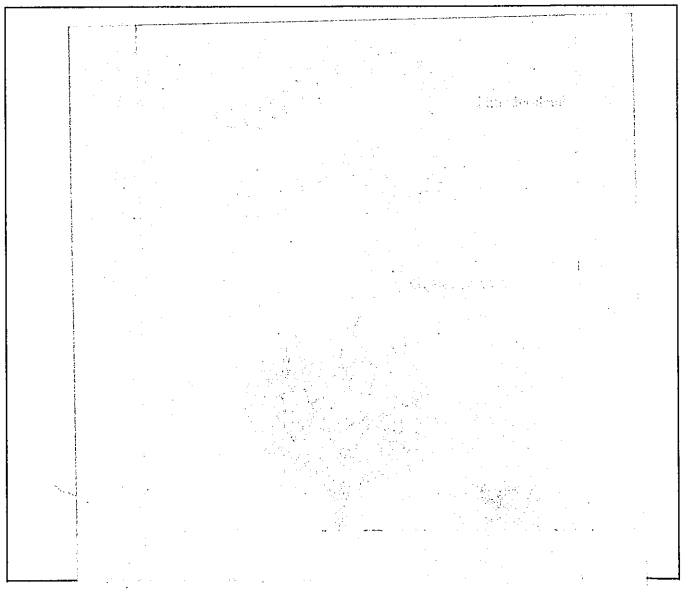
A student places a positively charged sphere near a metal rod. Both are on insulated stands and the rod is grounded.



36. The distribution of charge on the rod is

A. positive at end X and electrons move off the rod into the ground
B. negative at end X and electrons move off the rod into the ground
C. positive at end X and electrons move onto the rod from the ground
D. negative at end X and electrons move onto the rod from the ground

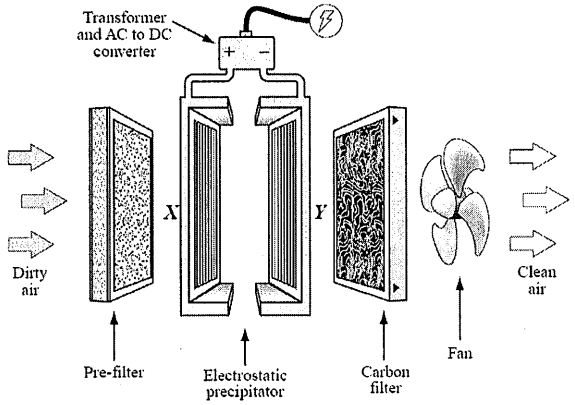
Use the following information to answer the next two questions.



the

Use the following information to answer the next question.

Air Cleaner



One type of air cleaner uses a single-stage electrostatic precipitator to remove very fine particles, such as cigarette smoke and pollen, from the air in a room. The first grid, marked as ***X*** in the diagram, removes electrons from the particles through a combination of friction and electrostatic action. The particles pass through grid ***X*** and leave with a positive charge. The positively charged particles are then removed from the air stream by a negatively charged grid, marked as ***Y*** in the diagram. This cleaner also contains a pre-filter and a carbon filter to help remove dust and odours.

39. When particles are between grids ***X*** and Y, they are repelled by

A. grid ***X*** and each other, but are attracted to grid ***Y***
B. grid ***Y*** and each other, but are attracted to grid ***X***
C. grid ***X*** but are attracted to each other and grid ***Y***
D. grid ***Y*** but are attracted to each other and grid ***X***

Coulomb's Torsion Balance Experiment

Use the following information to answer the next question.

> Charles Augustin de Coulomb performed a series of investigations on the quantitative nature of electrical forces. He was able to determine the effect of both distance and magnitude of charge on the electrostatic force between two charged metal spheres.

40. In order to determine the relationship between force and distance, Coulomb needed to

A. keep the magnitude of one charge constant
B. keep the magnitude of both charges constant
C. keep the distance between the charges constant
D. vary the magnitude of one charge while varying distance between the charges

41. Newton's Law of Universal Gravitation has a mathematical relationship similar to the one developed by

A. Coulomb
B. Einstein
C. Lenz
D. Ohm

Coulomb's Law (2 Charges)

Use the following information to answer the next question.

> Two conducting spheres have identical surface areas. Sphere ***A*** has a charge of 4.50 μC. Sphere ***B*** has a charge of −2.40 μC. Spheres ***A*** and ***B*** are brought into momentary contact and separated to a distance of 2.50 cm.

42. The magnitude of the electric force exerted by sphere ***A*** on sphere ***B*** after contact and separation is _____ N.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

43. A small object carrying a charge of 3.47 μC experiences an electric force of 7.22×10^{-2} N when placed at a distance, *d*, from a second, identically charged object. The value of *d* is _____ m.

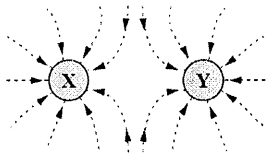
(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Coulomb's Law (3 Charges)

Electric Fields (Qualitative)

Use the following information to answer the next question.

Electric Field Lines Near Two Charged Spheres



44. The types of charge present on X and Y are, respectively,

A. negative and negative
B. negative and positive
C. positive and negative
D. positive and positive

45. A scalar field differs from a vector field in that

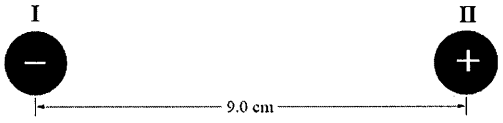
A. a scalar field acts in only one direction
B. a vector field acts in only one direction
C. direction is irrelevant for a scalar field
D. direction is irrelevant for a vector field

Electric Field Problems

Use the following information to answer the next question.

Electrostatics

Two particles, I and II, of equal mass have opposite charges. The negative charge on particle I is three times greater than is the positive charge on particle II. The particles are placed 9.0 cm apart.



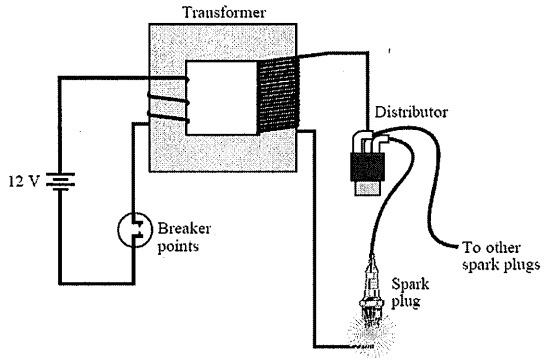
46. The electric field at a point halfway between the particles is

A. zero
B. toward the left of the page
C. toward the top of the page
D. toward the right of the page

Use the following information to answer the next two questions.

Automotive Wiring

In an automobile, a transformer is used to produce the high voltage that causes sparks in the spark plugs. A simplified automobile electrical system is shown below.



The 12 V direct current battery is connected to a switch called "breaker points" that turns the current in the primary coil on and off. The required voltage of 20 000 V is induced in the secondary coil. The secondary coil is connected to the distributor, which distributes the electrical voltage to each of the spark plugs. This voltage is high enough to cause a spark to jump across the 2.0 mm gap of a spark plug. This spark ignites the gasoline–air mixture in the automobile's cylinder.

47. The strength of the electrical field induced in the gap of the spark plug is

A. 6.0 N/C
B. 6.0×10^3 N/C
C. 1.0×10^4 N/C
D. 1.0×10^7 N/C

48. The acceleration of the electrons across the gap of the spark plug, expressed in scientific notation, is $a.b \times 10^{cd}$ m/s^2. The values of ***a***, ***b***, ***c***, and ***d*** are ____, ____, ____, and ____.

(Record your **four-digit answer** in the numerical response section on the answer sheet.)

49. A point charge of magnitude 6.9×10^{-5} C produces an electric field of 1.0×10^3 N/C at point P. The distance from P to the charge is

A. 4.3×10^{-2} m
B. 2.1×10^{-1} m
C. 2.5×10^{1} m
D. 6.2×10^{2} m

50. The intensity and direction of the electric field produced by an alpha particle at a distance of 5.0×10^{-11} m from the particle is

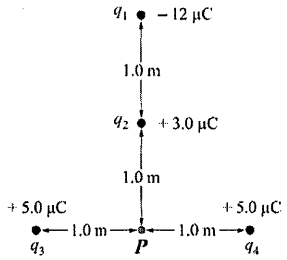
A. 5.8×10^{11} N/C, toward the alpha particle
B. 5.8×10^{11} N/C, away from the alpha particle
C. 1.2×10^{12} N/C, toward the alpha particle
D. 1.2×10^{12} N/C, away from the alpha particle

51. The magnitude of an electric field at a distance x from a point charge Q is 8.3×10^{-4} N/C. If the distance is increased to $3x$ and the charge is reduced to $Q/4$, then the magnitude of the electric field will be

A. 1.9×10^{-3} N/C
B. 3.7×10^{-4} N/C
C. 6.9×10^{-5} N/C
D. 2.3×10^{-5} N/C

Use the following information to answer the next question.

Four point charges are arranged as shown.

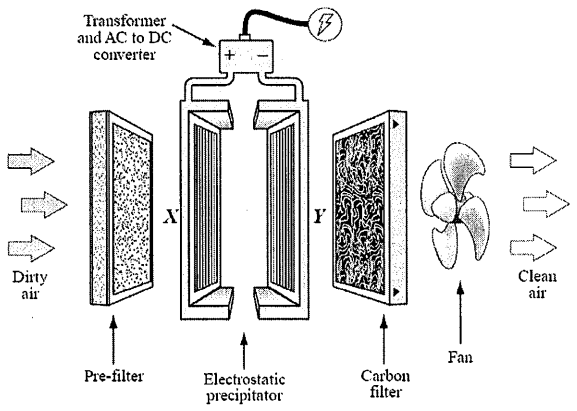


52. The magnitude of the net electric field at point ***P*** due to these four point charges is

A. 5.4×10^{4} N/C
B. 4.5×10^{4} N/C
C. 2.7×10^{4} N/C
D. 0.0 N/C

Use the following information to answer the next question.

Air Cleaner



One type of air cleaner uses a single-stage electrostatic precipitator to remove very fine particles, such as cigarette smoke and pollen, from the air in a room. The first grid, marked as X in the diagram, removes electrons from the particles through a combination of friction and electrostatic action. The particles pass through grid X and leave with a positive charge. The positively charged particles are then removed from the air stream by a negatively charged grid, marked as Y in the diagram. This cleaner also contains a pre-filter and a carbon filter to help remove dust and odours.

53. An electric field of magnitude 7.17×10^4 N/C is maintained between the grids of the electrostatic precipitator. The distance between grids ***X*** and ***Y*** is 5.60 cm. The potential difference across grids ***X*** and ***Y*** is

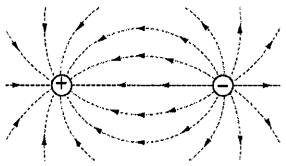
A. 1.28×10^6 V
B. 4.02×10^5 V
C. 1.28×10^4 V
D. 4.02×10^3 V

Charged Particles in External Magnetic Fields

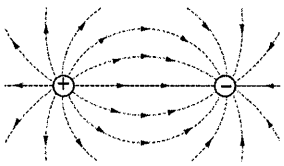
Unit 2 Review Questions

54. The electric field between a positive point charge and a negative point charge represented by

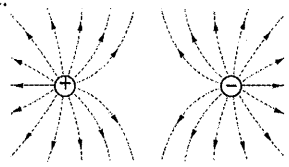
A.



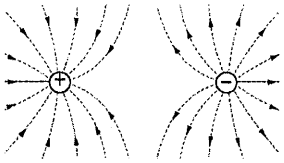
B.



C.



D.



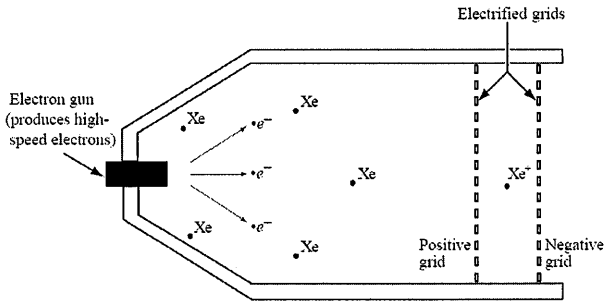
55. Two charged objects experience a force of 18.0 N when they are placed 5.00×10^{-2} m apart. If the charge on one object is 1.30×10^{-5} C, then the charge on the other object is $a.bc \times 10^{-d}$ C. The values of ***a***, ***b***, ***c***, and ***d*** are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next four questions.

The Deep Space 1 mission (DS1) uses a ion propulsion system (IPS) on the DS1 capsule. The IPS involves ionizing atoms of xenon, accelerating them through an electric field produced by electrified grids, and ejecting the ions into space behind the capsule.

IPS Chamber of the DS1 Capsule



In the IPS chamber, high-speed electrons collide with xenon atoms. These collisions can ionize xenon atoms. The electric field then accelerates the ions and ejects them from the IPS chamber, which propels the DS1 capsule forward.

IPS Operating Specifications for DS1

propellant ions	Xe^+
total mass of propellant	81.5 kg
mass of DS1 capsule (without propellant)	489.5 kg
energy required to ionize a xenon atom	12.1 eV
mass of a single xenon atom	2.18×10^{-25} kg
exit speed of xenon ions	43.0 km/s

56. The minimum electron speed necessary to ionize xenon atoms is

A. 2.66 × 10 31 m/s
B. 5.15 × 10 15 m/s
C. 4.25 × 10 12 m/s
D. 2.06 × 10 6 m/s

57. The electric potential difference across the electrified grids that is required to accelerate a xenon ion from rest to its exit speed is

A. 2.93×10^{-5} V
B. 1.26×10^{-3} V
C. 1.26×10^{3} V
D. 4.71×10^{29} V

58. If all of the xenon propellant could be expelled in a single short burst, the change in the speed of the DS1 capsule after all the fuel has been exhausted would be

A. 6.14 m/s
B. 7.16 m/s
C. 6.14×10^{3} m/s
D. 7.16×10^{3} m/s

59. The physics principle that **best** describes the propulsion of the DS1 capsule is the Law of Conservation of

A. Charge
B. Energy
C. Momentum
D. Nucleon Number

60. The energy gained by a proton that moves through a potential difference of 1.0 V is

A. 1.0 J
B. 1.0 eV
C. 6.3×10^{18} J
D. 1.6×10^{-19} eV

64. The magnitude of the force between two charged particles that are a fixed distance apart is 3.80×10^{-4} N. If the distance between their centres is exactly doubled, then the magnitude of the force between the particles, expressed in scientific notation, is $a.bc \times 10^{-d}$ N. The values of a, b, c, and d are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

65. The electric field strength 2.0×10^{-10} m from an alpha particle is

A. 7.2 N/C
B. 14 N/C
C. 3.4×10^{10} N/C
D. 7.2×10^{10} N/C

Electricity MC Answers

32	A										
33	2252										
34	B										
35	C										
36	D	41	A	46	B	51	D	56	D	61	A
37	A	42	15.9	47	D	52	D	57	C	62	B
38	B	43	1.22	48	1818	53	D	58	D	63	C
39	A	44	A	49	C	54	B	59	C	64	9505
40	B	45	C	50	D	55	3857	60	B	65	D