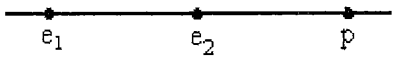
1121 Exam 1

Answers

1. Two electrons (e_1 and e_2) and and proton (p) lie on a straight line, as shown. The directions of the force of e_2 on e_1, the force of p on e_1, and the total force on e_1, respectively, are:



A) →, ←, →
B) ←, →, →
C) →, ←, ←
D) ←, →, ←
E) ←, ←, ←

2. An electrical insulator is a material:
A) containing no electrons
B) through which electrons do not flow easily
C) which has more electrons than protons on its surface
D) cannot be a pure chemical element
E) must be a crystal

3. A small object has charge Q. Charge q is removed from it and placed on a second small object. The two objects are placed 1 m apart. For the force that each object exerts on the other to be a maximum. q should be:
A) $2Q$
B) Q
C) $Q/2$
D) $Q/4$
E) 0

4. Two small charged objects repel each other with a force F when separated by a distance d. If the charge on each object is reduced to one-fourth of its original value and the distance between them is reduced to $d/2$ the force becomes:
A) $F/16$
B) $F/8$
C) $F/4$
D) $F/2$
E) F

5 Two identical charges, 2.0 m apart, exert forces of magnitude 4.0 N on each other. The value of either charge is:
A) 1.8×10^{-9} C
B) 2.1×10^{-5} C
C) 4.2×10^{-5} C
D) 1.9×10^{5} C
E) 3.8×10^{5} C

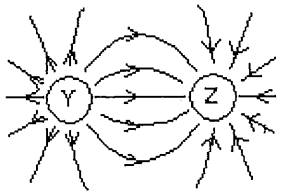
6. A particle with charge 2μC charge is placed at the origin, an identical particle, with the same charge, is placed 2 m from the origin on the x axis, and a third identical particle, with the same charge, is placed 2 m from the origin on the y axis. The magnitude of the force on the particle at the origin is:

A) 9.0×10^{-3} N
B) 6.4×10^{-3} N
C) 1.3×10^{-2} N
D) 1.8×10^{-2} N
E) 3.6×10^{-2} N

7. Electric field lines:

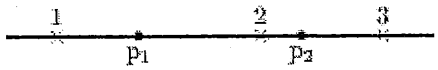
A) are trajectories of a test charge
B) are vectors in the direction of the electric field
C) form closed loops
D) cross each other in the region between two point charges
E) are none of the above

8. The diagram shows the electric field lines in a region of space containing two small charged spheres (Y and Z). Then:



A) Y is negative and Z is positive
B) the magnitude of the electric filed is the same everywhere
C) the electric field is strongest midway between Y and Z
D) Y is positive and Z is negative
E) Y and Z must have the same sign

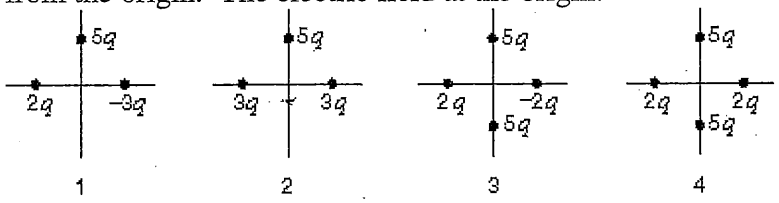
9. Two protons (p_1 and p_2) are on the x axis, as shown below. The directions of the electric field at points 1, 2, and 3 respectively, are:



A) $\rightarrow, \leftarrow, \rightarrow$
B) $\leftarrow, \rightarrow, \leftarrow$
C) $\leftarrow, \rightarrow, \rightarrow$
D) $\leftarrow, \leftarrow, \leftarrow$
E) $\leftarrow, \leftarrow, \rightarrow$

10. Two point particles,with charges of q_1 and q_2, are placed a distance r apart. The electric field is zero at a point P between the particles on the line segment connecting them. We conclude that:
A) q_1 and q_2 must have the same magnitude and sign
B) P must be midway between the particles
C) q_1 and q_2 must have the same sign but may have different magnitudes
D) q_1 and q_2 must have equal magnitudes and opposite signs
E) q_1 and q_2 must have opposite signs and may have different magnitudes

11. The diagrams below depict four different charge distributions. The charged particles are all the same distance from the origin. The electric field at the origin:



A) is greatest for situation 1
B) is greatest for situation 3
C) is zero for situation 4
D) is downward for situation 1
E) is downward for situation 3

12. Two point particles, one with charge $+8 \times 10^{-9}$ C and the other with charge -2×10^{-9} C, are separated by 4 m. The electric field in N/C midway between them is:
A) 9×10^{9}
B) 13,500
C) 135,000
D) 36×10^{-9}
E) 22.5

13. A 200-N/C electric field is in the positive x direction. The force on an electron in this field is:
A) 200 N in the positive x direction
B) 200 N in the negative x direction
C) 3.2×10^{-17} m/s^2, in the positive x direction
D) 3.2×10^{-17} m/s^2, in the negative x direction
E) 0

14. When a piece of paper is held with one face perpendicular to a uniform electric field the flux through it is 25 N · m^2/C. When the paper is turned 25° with respect to the field the flux through it is:
A) 0
B) 12 N · m^2/C
C) 21 N · m^2/C
D) 23 N · m^2/C
E) 25 N · m^2/C

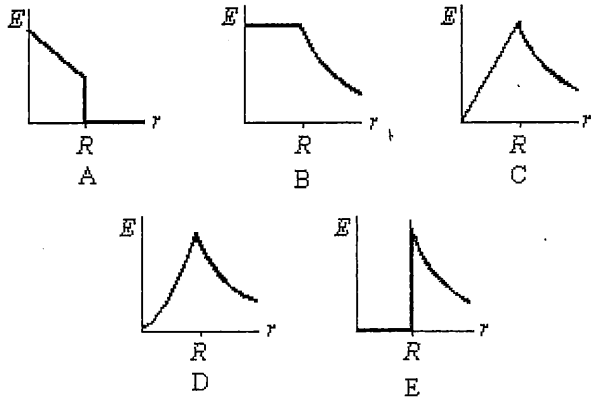
15. A point charge is placed at the center of a spherical Gaussian surface. The electric flux Φ_E is changed if:

A) the sphere is replaced by a cube of the same volume
B) the sphere is replaced by a cube of one-tenth the volume
C) the point charge is moved off center (but still inside the original sphere)
D) the point charge is moved to just outside the sphere
E) a second point charge is placed just outside the sphere

16. A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is:

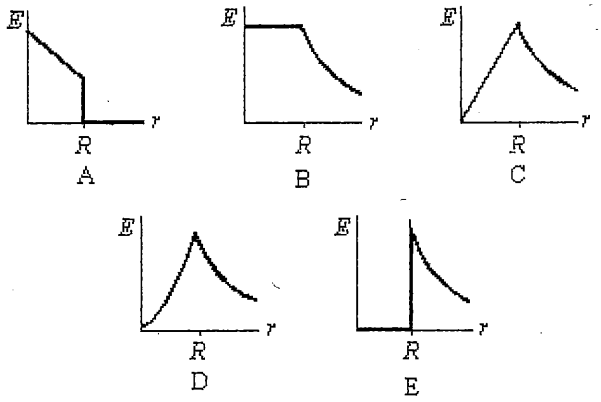
A) q/ε_0
B) $q/4\pi\varepsilon_0$
C) $q/4\varepsilon_0$
D) $q/6\varepsilon_0$
E) $q/16\varepsilon_0$

17. A solid insulating sphere of radius R contains a positive charge that is distributed with a volume charge density that does not depend on angle but does increase with distance from the sphere center. Which of the graphs below correctly gives the magnitude E of the electric field as a function of the distance r from the center of the sphere?



A) A
B) B
C) C
D) D
E) E

18. Which of the following graphs represents the magnitude of the electric field as a function of the distance from the center of a solid charged conducting sphere of radius R?



A) A
B) B
C) C
D) D
E) E

19. Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A point charge q is placed at the center of the cavity. The magnitude of the electric field at a point outside the shell, a distance r from the center, is:

A) $Q/4\pi\varepsilon_0 R_1^2$
B) $Q/4\pi\varepsilon_0(R_1^2 - r^2)$
C) $q/4\pi\varepsilon_0 r^2$
D) $(q + Q)/4\pi\varepsilon_0 r^2$
E) $(q+Q)/4\pi\varepsilon_0(R_1^2 - r^2)$

20. A spherical conducting shell has charge Q. A particle with charge q is placed at the center of the cavity. The charge on the inner surface of the shell and the charge on the outer surface of the shell, respectively, are:

A) $0, Q$
B) $q, Q - q$
C) $Q, 0$
D) $-q, Q + q$
E) $-q, 0$