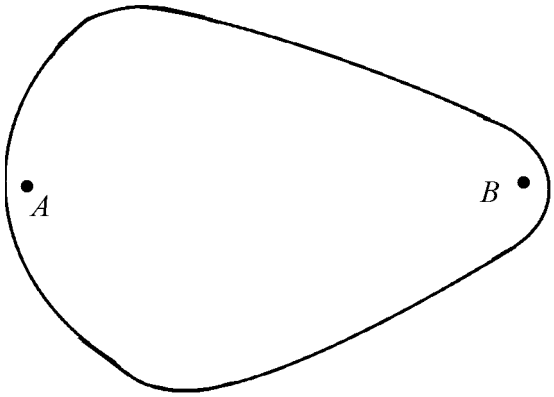
1.



A solid conducting object with the above shape is given a charge Q. How is the charge distributed on or in the object?

A) It is distributed itself uniformly through the object.

B) It is distributed itself uniformly on the surface of the object.

C) It is distributed itself thought the object with a greater density at point B than at point A.

D) It is distributed itself on the surface the object only with a greater density at point B than at point A.

E) It is all at point B.

2. What is the electric field created by a long, straight wire carrying a total charge of $+Q$, distributed uniformly along its entire length, L at a distance r from the wire?

A) $Q/2\pi L\varepsilon_0 r$

B) $-Q/2\pi L\varepsilon_0 r$

C) $Q/4\pi L\varepsilon_0 r$

D) $2\pi\varepsilon_0 rQ/L$

E) $2\pi\varepsilon_0 rQ/L$

3. The negative derivative of electric potential with respect to radius is equal to

A) charge

B) electric force

C) electric field

D) capacitance

E) potential energy

4. What is the potential due to a spherical shell of radius R for $r > R$?

A) kQ/r

B) kQ/r^2

C) kQ^2/r

D) kQ/R

E) kQ^2/R

5. What is the potential due to a spherical shell of radius R for $r < R$?

A) kQ/r

B) kQ/r^2

C) kQ^2/r

D) kQ/R

E) kQ^2/R

6. What is the ratio of potential due to a spherical shell of radius R and a solid conducting sphere of radius R, for $r < R$?

A) 1:1

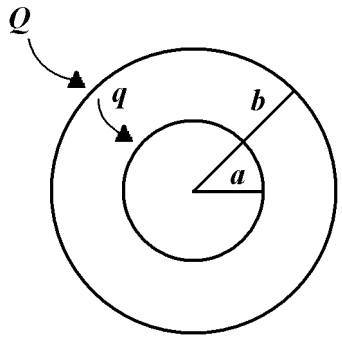
B) 1:2

C) 2:1

D) –1:1

E) –1:2

7.



The figure above shows two concentric, conducting, thin spherical shells of radii a and b, and charges q and Q. What is the work required to bring a test charge of q_0 from the outer shell to the inner shell?

A) $kQq(a\text{-}b)$

B) $kQq(b\text{-}a)$

C) $kQq(1/a\text{-}1/b)$

D) $kQq/(b\text{-}a)^2$

E) $kQq/(b\text{-}a)$

8. What is the electric potential of a very long conducting cylinder of radius R and a uniform linear charge density λ a distance r away from the center of the cylinder?

A) $k\lambda\ln(R/r)$

B) $2k\lambda\ln(R/r)$

C) $4k\lambda\ln(R/r)$

D) $2k/\lambda\ln(R/r)$

E) $k/\lambda\ln(R/r)$

9. The electric potential a distance r away from a cylinder can be calculated by dividing a charge q into

A) the work done on the magnetic field as a charge q moves from a point on the cylinder to a point outside the cylinder.

B) the work done on the magnetic field as a charge q moves from a point on the cylinder to a point inside the cylinder.

C) the work done on the electric field as a charge q moves from a point on the cylinder to a point outside the cylinder.

D) the work done on the electric field as a charge q moves from a point on the cylinder to a point inside the cylinder.

E) the force on a charge q as it moves from a point on the cylinder to a point inside the cylinder.

10. A conducting spherical shell of radius R carries a charge Q. What is the potential inside the sphere a distance r away from the center?

A) KQ/r

B) KQ/R

C) KQ/r^2

D) KQ/R^2

E) $KQ/2R$

11. All of the following about a sphere of charge that has spherical symmetry are true **EXCEPT**

A) The electric field and the potential outside of the distribution is the same as if all the charge was concentrated at the center of the sphere

B) A charged metal shell produces the field of an ordinary point charge

C) Inside a charged metal shell the electric field and the potential are equal to zero

D) All of the charge on a solid metal sphere resides on the surface

E) The electric field inside a solid metal sphere is zero and the potential is constant

12. All of the following are true about an infinitely long cylindrically symmetric distribution of charge **EXCEPT**

    A) The electric field is perpendicular to the axis of the cylinder

    B) For a positive charge, the electric field points away from the cylinder axis

    C) For a positive charge, the potential decreases as the distance to the cylinder axis increases

    D) The potential difference between two points outside the distribution is the derivitave of the electric field

    E) For a negative charge, the electric field points towards the cylinder axis

13. What is the potential due to a spherical shell with charge Q of radius R for $r = R$?

    A) 0

    B) kQ/R

    C) kQ^2/R

    D) $-kQ/R$

    E) $-kQ/R^2$

Base your answers to questions **14** through **16** on the information below.

A conducting cylindrical shell of inner radius a and outer radius b initially has a charge of $+Q$. A wire of the same length as the cylindrical shell with charge $-Q$ is then inserted along the axis of the cylindrical shell.

14. What is the charge on the cylindrical shell after the wire is put inside it?

    A) 0

    B) Q/a

    C) Q/b

    D) $Q/2$

    E) Q

15. What is the electric field at a distance of r < a?

    A) 0

    B) kQ/a^2

    C) kQ/r^2

    D) $-kQ/r^2$

    E) $-kQr/(a^2 + b^2)^{3/2}$

16. If the charge on the wire were changed to $+Q$, what is now the charge on the outer surface of the cylinder?

    A) 0

    B) $-Q$

    C) $-2Q$

    D) $+Q$

    E) $+2Q$

---

17. The potential at a point outside of a very long conducting cylinder of radius R and uniform charge density λ relative to the potential on the cylinder is given by the equation $V(r) = 2k\lambda\ln(R/r)$. What is the electric field at some distance r from the center of the cylinder?

    A) $-k\lambda/2r$

    B) $-k\lambda/r$

    C) $-2k\lambda/r$

    D) $-4k\lambda/r$

    E) $-\lambda/r$

18. The potential difference due to a finite rod along the x-axis is given by the equation $V(x) = C[\ln(x + L) - \ln(x)]$, where C and L are constants. What is the electric field due to this rod?

    A) $-C/x$

    B) $-C[1/(x + L) - 1/x]$

    C) $-C/(x + L)$

    D) $-C/L$

    E) $1/(x + L) - 1/x$

19. If the electric potential of a system is given by the equation $V(r) = 5ln(r^2)$, what is the equation for the electric field in this system?

A) $5ln(r^2)/r$

B) $-5rln(r^2)$

C) $5/r^2$

D) $-10/r$

E) $10/r^2$

20. The negative integral of electric field with respect to radius is which of the following?

A) electrostatic force

B) electric potential

C) electric potential energy

D) charge

E) capacitance

21. The potential of a non-uniform cloud of charge is given by $V(r) = Kr^2$, where r is the distance from the center of the cloud. What is the electric field as a function of r?

A) $-2Kr$

B) $2Kr$

C) $Kr^3/3$

D) $-Kr$

E) $-Kr^2$

22. What is the electric field created by a very large rectangular plate with a surface charge density of + σ, where σ is charge per unit area?

A) $\sigma/2\varepsilon_0$

B) σ/ε_0

C) $2\sigma/\varepsilon_0$

D) $\sigma/2\varepsilon_0$

E) σ/ε_0

23. Which shape Gaussian surface is most likely to be used to calculate the electric field for a long, straight wire?

A) sphere

B) circle

C) cylinder

D) rectangle

E) line

24. Which shape Gaussian surface is most likely to be used to calculate the electric field for a very large rectangular plate?

A) rectangle

B) sphere

C) circle

D) cylinder

E) line

25. What is the electric field inside a charged hollow metal sphere?

A) **Zero**

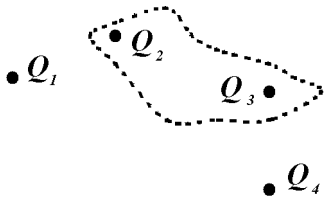
B) kq/r^2

C) kq/r

D) kq/r^2

E) kq/r

26.



The Gaussian surface above is the area enclosed by the dotted line. The net flux through the Gaussian surface depends on which of the following charges?

A) All four

B) Q_2 and Q_3

C) Q_1 and Q_4

D) Q_1 and Q_2

E) Q_3 and Q_4

27. What is the net flux due to a $+4Q$, $-2Q$ and $+Q$ charge in an enclosed area of 4 m^2?

A) Q/ε_0

B) $2Q/\varepsilon_0$

C) $3Q/\varepsilon_0$

D) $4Q/\varepsilon_0$

E) $12Q/\varepsilon_0$

28. What is the enclosed charge in an area if the net flux due to that charge contained in the area is 3 Nm^2/C?

A) Zero

B) $\varepsilon_0/9$

C) $\varepsilon_0/3$

D) $3\varepsilon_0$

E) $9\varepsilon_0$

29. What is the net flux of a Gaussian surface enclosing an electric dipole?

A) Zero

B) Q/ε_0

C) $2Q/\varepsilon_0$

D) $-Q/\varepsilon_0$

E) $-2Q/\varepsilon_0$

30. All of the following are true about Gauss' law **EXCEPT**

A) Gauss' law refers to the flux through a closed surface.

B) Gauss' law states that the flux through the closed surface is proportional to the total charge within the surface.

C) Gauss' law is useful when the electric field is perpendicular to the differential area.

D) Gauss' law is useful when the electric field is zero.

E) A rectangle is an example of a Gaussian surface.

31. What is the electric field created by a spherical capacitor of radius R with charge $+Q$ on the outer plate at a distance r from the center of the capacitor where $r > R$?

A) 0

B) $Q/2p\hat{u}_0 r^2$

C) $Q/4p\hat{u}_0 r^2$

D) $-Q/2p\hat{u}_0 r^2$

E) $-Q/4p\hat{u}_0 r^2$

32. All of the following are true about Gauss' Law **EXCEPT**

A) It is one of Maxwell's Equations.

B) It involves a line integral.

C) It is helpful in finding the electric field associated with a charge.

D) It says that the electric field is dependent on the enclosed charge of the Gaussian surface.

E) The permittivity of free space is included in the formal statement of Gauss' Law.

33. Based on Gauss' Law, which of the following affects the electric flux through a Gaussian surface?

A) a magnetic monopole enclosed by the surface

B) a magnetic dipole outside of the surface

C) a stationary electric charge enclosed by the surface

D) a stationary electric charge outside the surface

E) a charge moving with a constant velocity outside the surface

34. What is the electric flux through a cylinder of radius r and height h due to a charged plane parallel to the base of the cylinder with charge density σ that cuts through the cylinder?

A) σ/E_0

B) $\sigma/2E_0$

C) $r^2\sigma/4E_0$

D) $\pi r^2\sigma/E_0$

E) $\pi r^2\sigma/2E_0$

35. Which of the following pairs of charge distributions and Gaussian surfaces are correctly paired such that the Gaussian surface can be used to find the electric field associated with that charge distribution?

A) plane and sphere

B) plane and cylinder

C) plane and rectangle

D) infinite line and rectangle

E) infinite line and sphere

36. The electric field near each of the following charged objects can be determined easily using Gauss' Law **EXCEPT**

A) a spherical shell

B) a solid sphere

C) a long, solid cylinder

D) a long, hollow cylinder

E) an arc

37. Two conducting spheres of different radii each carry a charge $+Q$. Which of the following occurs when the two spheres are touched together?

A) No charge flows.

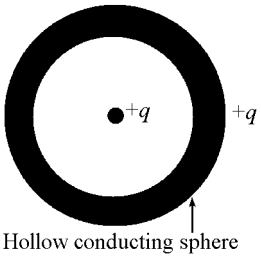
B) Positive charge flows from the larger sphere to the smaller sphere until the electric field at the surface of each sphere is the same.

C) Positive charge flows from the smaller sphere to the larger sphere until the electric field at the surface of each sphere is the same.

D) Positive charge flows from the larger sphere to the smaller sphere until the electric potential at the surface of each sphere is the same.

E) Positive charge flows from the smaller sphere to the larger sphere until the electric potential at the surface of each sphere is the same.

Base your answers to questions **38** and **39** on the figure below that shows a conducting sphere of radius R and a charge $+q$, that has a large inner cavity which has a small point charge $+q$.



38. The charge on the inside of the hollow sphere is

A) $-q$

B) $-2q$

C) $\frac{-q}{2}$

D) $+2q$

E) $+q$

39. The magnitude of the electric field a distance $r >> R$ away from the center of the hollow sphere is

A) $\frac{kq}{2r^2}$

B) $\frac{kq}{r^2}$

C) $\frac{2kq}{r^2}$

D) $\frac{3kq}{r^2}$

E) $\frac{4kq}{r^2}$

40. A conducting sphere of radius 0.10 meter has a charge of $+4.0 \times 10^{-6}$ coulomb. It is brought in contact with a second conducting sphere of radius 0.20 meter and no charge flows between them. What is the charge on the second sphere?

A) $+1.0 \times 10^{-6}$ C

B) $+2.0 \times 10^{-6}$ C

C) $+4.0 \times 10^{-6}$ C

D) $+8.0 \times 10^{-6}$ C

E) $+1.6 \times 10^{-5}$ C

41. Three identical metal spheres are mounted on insulating stands. Initially, sphere A has a net charge of q and spheres B and C are uncharged. Sphere A is touched to sphere B and removed. Then sphere A is touched to sphere C and removed. What is the final charge on sphere A?

A) $\frac{1}{6}q$

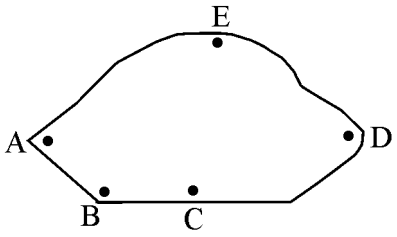
B) $\frac{1}{4}q$

C) $\frac{1}{3}q$

D) $\frac{1}{2}q$

E) q

42. Base your answer to the following question on the diagram below which shows a solid conductor with a charge of Q placed on it.



At what point is the charge density the least?

A) A

B) B

C) C

D) D

E) E

43. A solid sphere consists of a metal core, a non-conducting middle shell, and a metal outer shell. If a positive charge is placed on the core, where in the sphere will a net positive charge be found?

A) evenly distributed throughout the core

B) on the outer surface of the core

C) on the outer surface of the outer shell

D) evenly distributed throughout the two metal regions

E) on both the outer surface of the core and the outer surface of the outer shell

44. A hollow conducting sphere of radius R is positively charged. If the electric field strength at the surface of the sphere is E, what is the electric field strength at a point a distance $\frac{1}{2}R$ from the center of the sphere?

A) 0

B) $\frac{1}{2}E$

C) E

D) $2E$

E) $4E$

45. A charge Q is placed at the center of a hollow conducting sphere of radius $2R$. If the electric field strength at a distance R from the charge is E, what is the electric field strength at a point a distance $3R$ from the center of the sphere?

A) 0

B) $\frac{1}{9}E$

C) $\frac{1}{3}E$

D) E

E) $3E$

46. An uncharged metal sphere is placed within a uniform electric field. Which of the following is true about the net force and torque on the sphere?

A) The net force is in the direction of the field, and the net torque is in the direction of the field.

B) The net force is against the direction of the field, and the net torque is against the direction of the field.

C) The net force is zero and the net torque is in the direction of the field.

D) The net force is zero and the net torque is against the direction of the field.

E) The net force and net torque are both zero.

47. An uncharged solid conducting sphere of radius r is placed in a uniform electric field of magnitude E. The magnitude of the electric field at the center of the conductor is

A) $-E$

B) 0

C) E

D) $\frac{E}{r}$

E) $\frac{E}{r^2}$

48. Which of the following statements involving conductors is false?

A) All excess charge lies on the outside surface.

B) The electric field at the surface is perpendicular to it.

C) The electric potential inside is zero.

D) They can have non-zero resistance.

E) None of the above.

49. A negative charge of 10^{-5} coulombs is placed on a solid conducting sphere. Which of the following best describes the magnitudes of the electric field and electrostatic potential inside the sphere?

A) Both the magnitude of the electric field and the electrostatic potential are zero.

B) The magnitude of the electric field is zero and the electrostatic potential is constant and non-zero.

C) The magnitude of the electric field is constant and non-zero and the electrostatic potential is zero.

D) Both the magnitude of the electric field and the electrostatic potential are constant and non-zero.

E) The magnitude of the electric field is constant and non-zero and the electrostatic potential varies radially.

50. Two charged conducting spheres are touched together. Charge flows between them until which of the following is the same for both spheres?

A) electric field at the surface

B) electric field at the center

C) electric potential

D) total charge

E) total energy

51. A hollow conducting sphere of a radius of 0.60 m carries a charge of 4.0 μC. A 2.0 μC charge is placed at the center of the sphere. How much work does it take to move the charge to a distance of 0.30 m from the center?

A) 0 J

B) 0.12 J

C) 0.20 J

D) 0.24 J

E) 0.8 J

52. What is the electric potential at the center of a conducting sphere with a diameter of 0.6 meters that carries a total charge of 2.0×10^{-8} C?

A) 0 V

B) 300 V

C) 500 V

D) 600 V

E) 2000 V

53. Which of the following is true of the electric potential of a conducting solid sphere?

A) it varies within the sphere

B) it is uniform throughout the sphere

C) it is inversely proportional to the charge on the sphere

D) it has an inverse squared relationship with the radius from the center outside of the sphere

E) it has an inverse squared relationship with electric field

54. What is the electric potential inside a hollow sphere of radius R that holds a charge Q?

A) 0

B) $kQ/2R$

C) kQ/R

D) $2kQ/R$

E) $-kQ/R$

55. The potential of a point-charge is given by the equation $V(r) = kq/r$. Determine the electric field at some distance r from q.

A) $-kq/r^2$

B) kq/r^2

C) kqr

D) $-kqr$

E) $-kq/r$

Answer Key
Gauss's Law MC Questions [Mar 28, 2011]

1. D
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3. C
4. A
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6. A
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