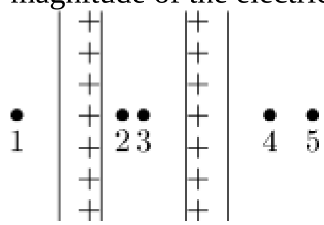
Name: ___________________________ Date: _____________

1. A point charged particle is placed at the center of a spherical Gaussian surface. The net electric flux Φ^{net} at the surface 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 particle is moved off center (but still inside the original sphere)
D) the particle is moved to just outside the sphere
E) a second point charged particle is placed just outside the sphere

2. Two large parallel plates carry positive charge of equal magnitude that is distributed uniformly over their inner surfaces. Rank the points 1 through 5 according to the magnitude of the electric field at the points, least to greatest.



A) 1, 2, 3, 4, 5
B) 5, 4, 3, 2, 1
C) 1, 4, and 5 tie, then 2 and 3 tie
D) 2 and 3 tie, then 1 and 4 tie, then 5
E) 2 and 3 tie, then 1, 4, and 5 tie

3. 10 C of charge are placed on a spherical conducting shell. A –3-C point charge is placed at the center of the cavity. The net charge in coulombs on the inner surface of the shell is:

A) –7
B) –3
C) 0
D) + 3
E) + 7

4. Charge Q is distributed uniformly throughout an insulating sphere of radius R. The magnitude of the electric field at a point $R/2$ from the center is:

A) $Q/4\pi \epsilon_0 R^2$
B) $Q/\pi \epsilon_0 R^2$
C) $3Q/4\pi \epsilon_0 R^2$
D) $Q/8\pi \epsilon_0 R^2$
E) none of these

5. A 5.0-μC point charge is placed at the corner of a cube. The total electric flux in $N \cdot m^2$ /C through all sides of the cube is:

A) 0
B) 7.1×10^4
C) 9.4×10^4
D) 1.4×10^5
E) 5.6×10^5

6. Charge Q is distributed uniformly throughout a spherical insulating shell. The net electric flux at the outer surface of the shell is:

A) 0
B) Q/ϵ_0
C) $2Q/\epsilon_0$
D) $Q/4\epsilon_0$
E) $Q/2\pi \epsilon_0$

7. A 3.5-cm radius hemisphere contains a total charge of 6.6×10^{-7} C. The net flux at the rounded portion of the surface is 9.8×10^4 $N \cdot m^2$ /C. The net flux at the flat base is:

A) 0
B) $+2.3 \times 10^4$ $N \cdot m^2$ /C
C) -2.3×10^4 $N \cdot m^2$ /C
D) -9.8×10^4 $N \cdot m^2$ /C
E) $+9.8 \times 10^4$ $N \cdot m^2$ /C

8. Charge is distributed uniformly along a long straight wire. The electric field 2 cm from the wire is 20 N/C. The electric field 4 cm from the wire is:

A) 120 N/C
B) 80 N/C
C) 40 N/C
D) 10 N/C
E) 5 N/C

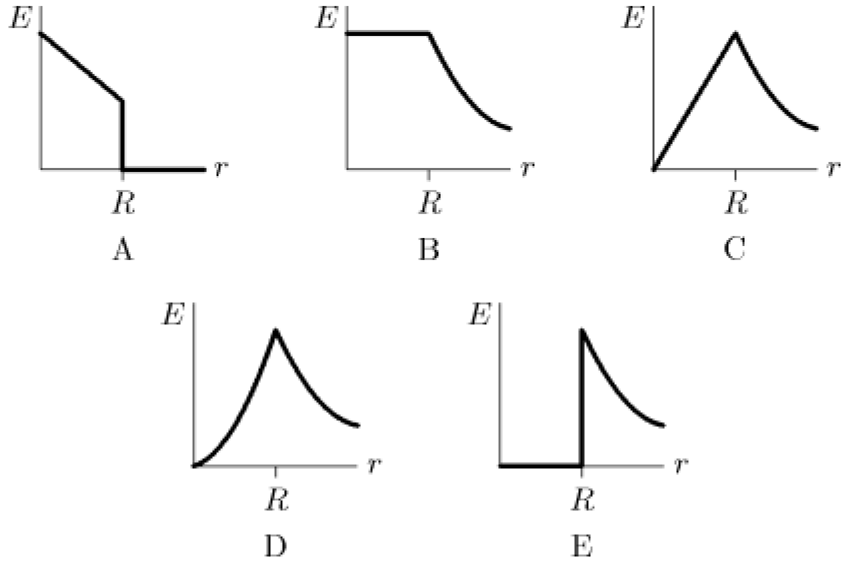
9. Positive charge *Q* is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A point charge *q* is placed at the center of the cavity. The magnitude of the electric field at a point in the cavity, a distance *r* from the center, is:

A) zero
B) $Q/4\pi \in_0 R_1^2$
C) $q/4\pi \in_0 r^2$
D) $(q+Q)/4\pi \in_0 r^2$
E) $(q+Q)/4\pi \in_0 (R_1^2 - r^2)$

10. The outer surface of the cardboard center of a paper towel roll:

A) is a possible Gaussian surface
B) cannot be a Gaussian surface because it encloses no charge
C) cannot be a Gaussian surface since it is an insulator
D) is not a closed surface
E) none of the above

11. 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

12. A total charge of 6.3×10^{-8} C is distributed uniformly throughout a 2.7-cm radius sphere. The volume charge density is:

A) 3.7×10^{-7} C/m^3
B) 6.9×10^{-6} C/m^3
C) 6.9×10^{-6} C/m^2
D) 2.5×10^{-4} C/m^3
E) 7.6×10^{-4} C/m^3

13. A point particle with charge *q* is placed inside the cube but not at its center. The electric flux through any one side of the cube:

A) is zero
B) is q/ϵ_0
C) is $q/4\epsilon_0$
D) is $q/6\epsilon_0$
E) cannot be computed using Gauss' law

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 25º 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 30-N/C uniform electric field points perpendicularly toward the left face of a large neutral conducting sheet. The surface charge density in C/m^2 on the left and right faces, respectively, are:

A) -2.7×10^{-9} C/m^2; $+2.7 \times 10^{-9}$ C/m^2
B) $+2.7 \times 10^{-9}$ C/m^2; -2.7×10^{-9} C/m^2
C) -5.3×10^{-9} C/m^2; $+5.3 \times 10^{-9}$ C/m^2
D) $+5.3 \times 10^{-9}$ C/m^2; -5.3×10^{-9} C/m^2
E) 0; 0

16. A long line of charge with λ_ℓ charge per unit length runs along the cylindrical axis of a cylindrical conducting shell which carries a charge per unit length of λ_c. The charge per unit length on the inner and outer surfaces of the shell, respectively are:

A) λ_ℓ and λ_c
B) $-\lambda_\ell$ and $\lambda_c + \lambda_\ell$
C) $-\lambda_\ell$ and $\lambda_c - \lambda_c$
D) $\lambda_\ell + \lambda_c$ and $\lambda_c - \lambda_\ell$
E) $\lambda_\ell - \lambda_c$ and $\lambda_c + \lambda_\ell$

17. A hollow conductor is positively charged. A small uncharged metal ball is lowered by a silk thread through a small opening in the top of the conductor and allowed to touch its inner surface. After the ball is removed, it will have:

A) a positive charge
B) a negative charge
C) no appreciable charge
D) a charge whose sign depends on what part of the inner surface it touched
E) a charge whose sign depends on where the small hole is located in the conductor

18. A cylinder has a radius of 2.1 cm and a length of 8.8 cm. Total charge 6.1×10^{-7} C is distributed uniformly throughout. The volume charge density is:

A) 5.3×10^{-5} C/m^3
B) 5.3×10^{-5} C/m^2
C) 8.5×10^{-4} C/m^3
D) 5.0×10^{-3} C/m^3
E) 6.3×10^{-2} C/m^3

19. A conducting sphere of radius 0.01 m has a charge of 1.0×10^{-9} C deposited on it. The magnitude of the electric field in N/C just outside the surface of the sphere is:

A) 0
B) 450
C) 900
D) 4500
E) 90,000

20. Choose the INCORRECT statement:

A) Gauss' law can be derived from Coulomb's law
B) Gauss' law states that the net number of lines crossing any closed surface in an outward direction is proportional to the net charge enclosed within the surface
C) Coulomb's law can be derived from Gauss' law and symmetry
D) Gauss' law applies to a closed surface of any shape
E) According to Gauss' law, if a closed surface encloses no charge, then the electric field must vanish everywhere on the surface

21. 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) $q/4\pi\epsilon_0$
C) $q/3\epsilon_0$
D) $q/6\epsilon_0$
E) $q/12\epsilon_0$

22. Positive charge Q is distributed uniformly throughout an insulating sphere of radius R, centered at the origin. A positive point charge Q is placed at $x = 2R$ on the x axis. The magnitude of the electric field at $x = R/2$ on the x axis is:

A) $Q/4\pi \epsilon_0 R^2$
B) $Q/8\pi \epsilon_0 R^2$
C) $7Q/18\pi \epsilon_0 R^2$
D) $11Q/18\pi \epsilon_0 R^2$
E) none of these

23. Consider Gauss' law: $\oint \vec{E} \cdot d\vec{A} = q^{\text{enc}}/\epsilon_0$. Which of the following is true?

A) $\vec{E}$ must be the electric field due to the enclosed charge
B) If $q^{\text{enc}} = 0$, then $\vec{E} = 0$ everywhere on the Gaussian surface
C) If three particles are inside and they have charges of $+q$, $+q$, and $-2q$, then the integral is zero
D) on the surface $\vec{E}$ is everywhere parallel to $d\vec{A}$
E) If a charged particle is placed outside the surface, then it cannot affect $\vec{E}$ at any point on the surface

24. The table below gives the electric flux in $\text{N} \cdot \text{m}^2/\text{C}$ through the ends and round surfaces of four Gaussian surfaces in the form of cylinders. Rank the cylinders according to the net charge inside, from the most negative to the most positive.

	left end	right end	rounded surface
cylinder 1:	$+2 \times 10^{-9}$	$+4 \times 10^{-9}$	-6×10^{-9}
cylinder 2:	$+3 \times 10^{-9}$	-2×10^{-9}	$+6 \times 10^{-9}$
cylinder 3:	-2×10^{-9}	-5×10^{-9}	$+3 \times 10^{-9}$
cylinder 4:	$+2 \times 10^{-9}$	-5×10^{-9}	-3×10^{-9}

A) 1, 2, 3, 4
B) 4, 3, 2, 1
C) 3, 4, 2, 1
D) 3, 1, 4, 2
E) 4, 3, 1, 2

25. A spherical conducting shell has charge Q. A point 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

Answer Key

1. D
2. E
3. D
4. D
5. E
6. B
7. C
8. D
9. C
10. D
11. E
12. E
13. E
14. D
15. A
16. B
17. C
18. D
19. C
20. E
21. D
22. C
23. C
24. E
25. D