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AP PHYSICS C: ELECTRICITY AND MAGNETISM

# AP物理C电磁 新样题

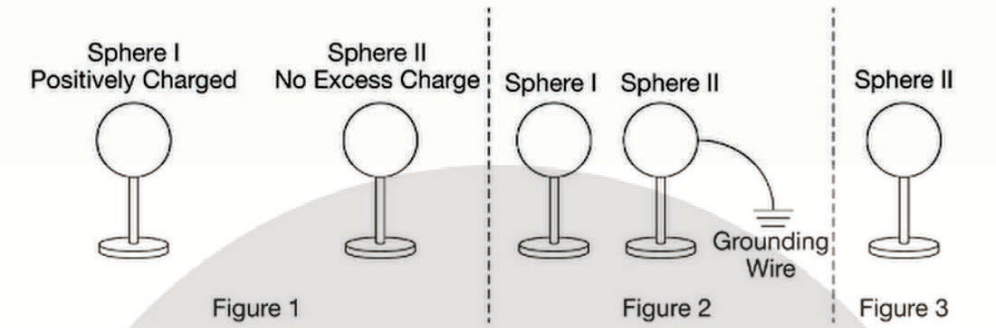
「2021 版本」

有干货 x 有陪伴 x 有进步

AP Physics C: Electricity and Magnetism

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## Section I: Multiple-Choice Question




1. Two identical conducting spheres are mounted on insulating handles, as shown. Sphere I has a positive charge, and sphere II has no excess charge, as shown in Figure 1. Sphere I is brought close to sphere II, which is grounded with a wire, as shown in Figure 2. The grounding wire is disconnected and then sphere I is removed, isolating sphere II as shown in Figure 3. Which of the following correctly predicts the charge on sphere II after this procedure is followed?

A. Sphere II will have a positive charge.

B. Sphere II will have a negative charge.

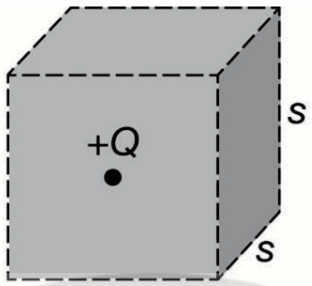
C. Sphere II will have no net charge.

D. Sphere II will be polarized, and its left side will have a positive charge.

E. Sphere II will be polarized, and its left side will have a negative charge.

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2. A Gaussian cube with sides of length s encloses a single point charge +Q. The electric flux through one face of the cube is

A. 0

B. $\frac{Q}{\varepsilon_0}$

C. $\frac{Q}{6\varepsilon_0}$

D. $\frac{Q}{s^2\varepsilon_0}$

E. $\frac{Q}{6s^2\varepsilon_0}$

3. In a region of space, the electric potential $V_x$ as a function of position $x$ along an $x$-axis is given by the equation $V_x = Rx - Sx^2$, where $R = 3.0\frac{v}{m}$ and $S = 8.0\frac{v}{m^2}$. At what point on the $x$-axis is the magnitude of the electric field equal to zero?

A. $x$=0. 19m

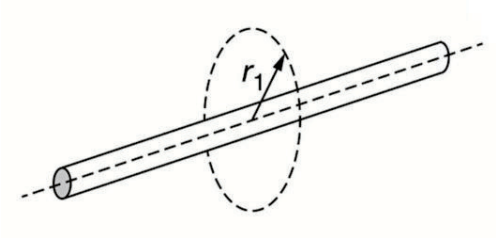
B. $x$=0. 38m

C. $x$=0. 56m

D. $x$=2. 7m

E. $x$=5. 3m


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4. The very long rod shown in the figure has a positive charge uniformly distributed along its length. The magnitude of the electric field at a point outside of the rod a distance $r_1$ from its axis is $E_1$. Which of the following is the magnitude of the electric field at a distance $5r_1$ from the axis of the rod?

A. $\frac{1}{25}E_1$

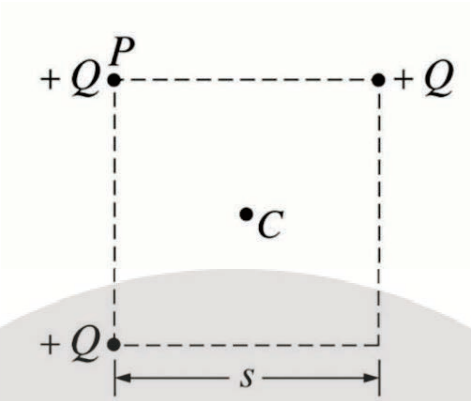
B. $\frac{1}{5}E_1$

C. $5E_1$

D. $25E_1$

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5. Three particles each with charge +Q are placed on three corners of a square, as shown. The sides of the square have length s. Point C is at the center of the square.

What is the direction of the electric field at point ***C***?

A. 

B. 

C. 

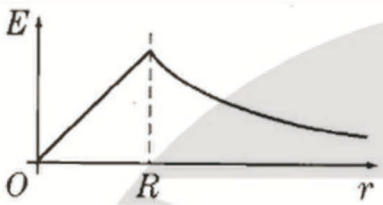
D. 

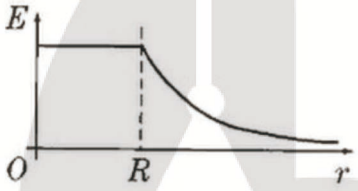
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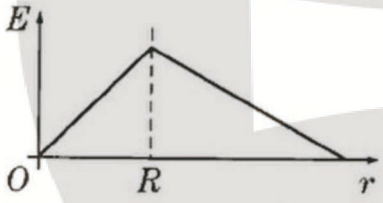

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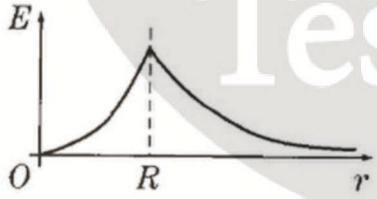
## Section II: Multiple-Choice Question

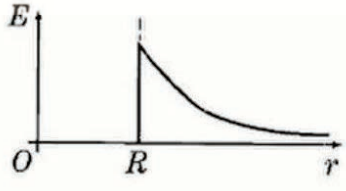
1. Charge is distributed uniformly throughout a long nonconducting cylinder of radius ***R***. Which of the following graphs best represents the magnitude of the resulting electric field ***E*** as a function of ***r***, the distance from the axis of the cylinder?

A.



B.



C.


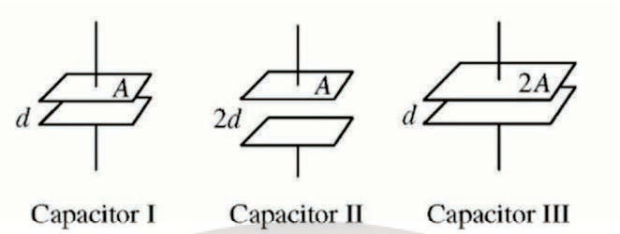

D.



E.




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Questions 2 through 3 refer to the following.




The plate areas and separations for three capacitors are shown in the diagram. The space between the plates in each capacitor is filled with air.

2. All three capacitors are connected in parallel with a 9V battery. Which of the following is true of the electric field between the plates?

A. It is greatest for capacitor I.

B. It is greatest for capacitor II.

C. It is greatest for capacitor III.

D. It is the same for capacitors I and III and the least for capacitor II.

E. It is the same for capacitors I and II and the least for capacitor III.

3. The three capacitors are charged such that each capacitor has a charge +Q on the top plate and -Q on the bottom plate. Which of the following is true of the potential difference across the plates of the three capacitors?

A. It is greatest for capacitor I.

B. It is greatest for capacitor II.

C. It is greatest for capacitor III.

D. It is the same for capacitors II and III and the least for capacitor I.

E. It is the same for all three capacitors.


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4. Two identical capacitors, X and Y, are connected in series across a battery. A dielectric material with $\kappa = 5$ is placed in capacitor X. Once equilibrium is reached, how do the potential differences across the two capacitors and their charges compare?

A.

| Potential Difference | Charge |
|---|---|
| $V_X > V_Y$ | $Q_X > Q_Y$ |

B.

| Potential Difference | Charge |
|---|---|
| $V_X > V_Y$ | $Q_X = Q_Y$ |

C.

| Potential Difference | Charge |
|---|---|
| $V_X = V_Y$ | $Q_X > Q_Y$ |

D.

| Potential Difference | Charge |
|---|---|
| $V_X < V_Y$ | $Q_X = Q_Y$ |

E.

| Potential Difference | Charge |
|---|---|
| $V_X < V_Y$ | $Q_X < Q_Y$ |

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2021 Digital Exam Practice

# AP Physics C: Electricity and Magnetism

## Scoring Materials for Digital Exam Practice

**Please note:** the digital exam practice resource was developed for students to complete technology checks, experience the digital platform, and practice answering exam questions, including each type of multiple-choice question they will encounter on exam day.

This digital exam practice is not a full-length exam, and it does not represent the complete scope of content and skills that students will see on the actual AP exam. This digital exam practice includes only content that would typically be taught in the first half of the school year, following the unit sequence in the AP Physics C: Electricity and Magnetism Course and Exam Description. For more information on the 2021 Exam format, please visit: apcentral.collegeboard.org/pdf/ap-2021-exam-formats.pdf

AP Exams are scored differently than traditional high school or college exams. When an AP Exam is administered, psychometric analysis determines the score ranges corresponding with each AP Exam score (5, 4, 3, 2, and 1) based on a composite score scale that combines and weights the different exam parts. Earning 40-50% of the available points can result in a score of 3 or better on many AP Exams. However, because the number of points corresponding with each AP Exam score can vary on different exams, students and teachers should not use the results of the digital exam practice to predict performance on the 2021 AP Exam.

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## Multiple-Choice Answer Key

| Multiple-Choice Question | Answer |
|---|---|
| 1 | B |
| 2 | C |
| 3 | A |
| 4 | B |
| 5 | E |
| 6 | A |
| 7 | D |
| 8 | B |
| 9 | D |

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## Section I: Multiple-Choice Question

1. 答案 B

**考点：**考察 Unit1 Electrostatics 中电荷极化和感应电荷。

**解释题目：**两个相同的金属球，球 1 带正电，球 2 不带电且接地，两球靠近以后先断开球 2 的导线，再移除球 1，问球 2 最终电荷。

**解题思路：**在球 1 靠近球 2 的时候会发生极化（polarization），负电荷会靠近球 1，正电荷会远离球 1，又因为球 2 接地，所以正电荷导入大地。断开导线以后球 2 上的剩余负电荷无法导走，所以最后会有负电荷，又因为球 1 已经移走，polarization 的条件失去了，所以最终没有 polarization，选 B。

2. 答案 C

**考点：**考察 Unit1 Electrostatics 中的高斯定律。

**解释题目：**一个正方体高斯面中央有一个+Q 的电荷，问其中一个面的电通量是多少。

**解题思路：**高斯定律：一个闭合面的电通量=内部电荷/ε，又因为对称性，6 个面的通量应该完全相同，所以一个面的通量=总通量/6，选 C。


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3. 答案 A

**考点：**考察 Unit1 Electrostatics 中电势和电场的关系。

**解释题目：**题目给出了 V(x)函数，问哪个点电场为 0。

**解题思路：**电场与电势的关系为，电场是电势关于位置的负导数，所以当电场为 0 时，电势变化率 dV/dx=0，所以只要选出导数为 0 的点，也就是 dV/dx=R-2Sx=0，x=R/2S=0.1875，选 A。

4. 答案 B

**考点：**考察 Unit1 Electrostatics 中高斯定律应用。

**解释题目：**求长直带电导线距离变化时电场的变化。

**解题思路：**应用高斯定律，作圆柱高斯面，通量$\phi = E \cdot 2\pi rl = \lambda l/\epsilon_0$，可以得到电场和 r 成反比，所以距离翻 5 倍，电场变成 1/5。


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5. 答案 E

**考点：**考察 Unit1 Electrostatics 中电场叠加。

**解释题目：**求 3 个点电荷在 C 点电场叠加。

**解题思路：**左下角和右上角在中央产生的电场等大反向，所以实际上 C 点电场只等于左上角电荷产生的电场，也就是向右下，选 E。

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**Section II: Multiple-Choice Question**

1. 答案 A

**考点：**考察 Unit1 Electrostatics 中高斯定律应用。

**解释题目：**求长直带电圆柱形导线电场。

**解题思路：**应用高斯定律，作圆柱高斯面，在圆柱外通量$\phi = E \cdot 2\pi rl = \lambda l/\epsilon_0$，可以得到电场和 r 成反比；在圆柱内通量$\phi = E \cdot 2\pi rl = \rho V/\epsilon_0 = \rho\pi r^2 l/\epsilon_0$，得到 E 与 r 成正比，所以根据这点只能选择 A 选项。

2. 答案 D

**考点：**考察 Unit2 Conductors, Capacitors, Dielectrics 中平行板电容。

**解释题目：**给定电压，问电场最强的电容。

**解题思路：**根据$V = Ed$,在电压一定的情况下，间距 d 越小，电场越强。在选项中 I 和 III 间距都最小为 d，所以 I 和 III 电场一样都比 II 大，选 D。


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3. 答案 B

**考点：**考察 Unit2 Conductors, Capacitors, Dielectrics 中平行板电容。

**解释题目：**给定电电荷，问电压最大的电容。

**解题思路：**根据$Q = CV$,Q 一致的情况下，C 越小 V 越大，再根据平行板电容公式，面积 A 越小，间距 d 越大，电容 C 越小，所以选 II，也就是 B 选项。

4. 答案 D

**考点：**考察 Unit3 Electric Circuits 中电容的串并联和 Unit2 Conductors, Capacitors, Dielectrics 平行板电容的结合。

**解释题目：**XY 两电容串联在一个电池上，问 X 插入一个电介质以后两电容的电压电荷关系。

**解题思路：**根据$Q = CV$,再根据串联电容电荷 Q 一致，在电介质插入 X 以后，X 的电容变大，所以 X 的电压比 Y 小，选 D。


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