1. 8×10^{10} electrons pass through a wire in 2 μs. The amount of current due to these electrons is:

(a) 1.6 mA (b) 1.6 A (c) 6.4 A (d) 6.4 mA (e) 2 A

---

2. An electron and a proton are separated by a distance of 5 cm. If the net force on a particle located at the midway is zero, the charge of the particle is:

(a) -1 μC (b) zero (c) 1 μC (d) 2 μC (e) -2 μC

---

3. An unknown charge is located 4 cm away from another charge Q, produces a force four times greater than that produced if it is located 5 cm from an 8-μC charge. The charge Q is:

(a) 4 μC (b) 15.4 μC (c) 5.1 μC (d) 20.5 μC (e) 3.56 μC

---

4. As shown in **Fig. 1**, the resultant force on Q_3 will have a direction, with +x-axis, of:

(a) 150.6° (b) 90° (c) 119.4° (d) 57.4° (e) 35.1°

---

5. Two 1-g spheres are charged equally and placed 2 cm apart. When release, they begin to accelerate at 144 m/s^2. The magnitude of the charge on each sphere is:

(a) 1 μC (b) 2 μC (c) 93.3 nC (d) 100 nC (e) 80 nC

---

6. The magnitude of an electric field in which the electric force on electron equals in magnitude to its weight is:

(a) 100 N/C (b) 5.6×10^{-11} N/C (c) 3.92 kN/C (d) 1.02×10^{-7} N/C (e) zero

---

7. Two particles Q_1= 0.70 nC and Q_2= 12 nC are separated by a distance of 2 m. The net electric field due to these charges equals to zero at:

(a) 1.61 m from Q_2 (b) 2.63 from Q_1 (c) 0.39 from Q_2 (d) 1.61 from Q_1 (e) zero

---

8. A closed surface encloses a net charge of 4.425 pC. The net electric flux through the surface (in **SI** units) is:

(a) 2 (b) 4 (c) 0.5 (d) 2000 (e) 1

---

9. Each square centimeter of the surface of an infinite plane sheet of paper has 6×10^6 electrons. The magnitude of the electric field at a point 6 cm from the surface of the sheet is:

(a) 3.62 N/C (b) 362 N/C (c) 723 N/C (d) 542 N/C (e) zero

---

10. A metal sphere of radius 0.75 m carries a net charge of 4.68 nC. The magnitude of the electric field at a point 0.15 m above the surface of the sphere is:

(a) 52 N/C (b) 1.83 N/C (c) 3.25 N/C (d) 1.44 N/C (e) zero

---

11. In **Fig. 2**, the electric dipole will move**:**

(a) clockwise (b) anticlockwise (c) straight backward (d) straight forward (e) none

---

12. At the surface of a conductor, the electric field lines are:

(a) parallel to the surface (b) tangential on the surface (c) normal to the surface

(d) both (a) and (b) (e) both (b) and (c)

13. A charge is uniformly distributed with uniform volume charge density ρ throughout the volume of a sphere of radius 5 cm. If the magnitude of the electric field at 3 cm from its center is 40 kN/C, the value of ρ is:

(a) 35.4 μC/m³ (b) 8.85 μC/m³ (c) 53.1 μC/m³ (d) 17.7 μC/m³ (e) zero

---

14. Three charges Q_1=15 nC, Q_2=-5 nC, and Q_3 are randomly placed inside a cube of side length 2 cm. If the electric flux through one face of the cube is 1000 N.m²/C, the value of Q_3 is:

(a) 53.1 nC (b) 48.1 nC (c) 8.85 nC (d) 20.5 nC (e) 43.1 nC

---

15. The electric potential in a region of space is given by $\mathbf{V(x,y)=4xy+x^2}$ (volt). The strength of the electric field at the point (**x**=2 m, **y**=3 m) is:

(a) 33 V/m (b) 18.4 V/m (c) 10.8 V/m (d) 17.9 V/m (e) 5 V/m

---

16. A parallel-plate capacitor, of plate area 4 cm² and separation of 0.6 mm, is entirely filled with a dielectric material. If the capacitance is 8.85 pF, the dielectric constant is:

(a) 1.0 (b) 1.5 (c) 2.0 (d) 2.5 (e) 3.0

---

17. As shown in **Fig. 3**, the total charge is 17.7 nC. The voltage between the points **a** and **b** is:

(a) 3.54 V (b) 1.5 V (c) 10 V (d) 17.7 V (e) 1.77 V

---

18. The decrease of the capacitance of a capacitor will:

(a) increase the voltage across the capacitor (b) increase the charge (c) do nothing

(d) decrease the voltage across the capacitor (e) both (b) and (d)

---

19. A parallel-plate capacitor, of plate separation 4 cm, has an electric field of magnitude 300 N/C. The amount of energy needed to move a 6-mC charge from one plate of the capacitor to the other is:

(a) 72 mJ (b) 36 μJ (c) 7.2 eV (d) 72 μJ (e) 12 mJ

---

20. The capacitance of an isolated sphere does not depend on its:

(a) volume (b) material (c) surface (d) circumference (e) radius

---

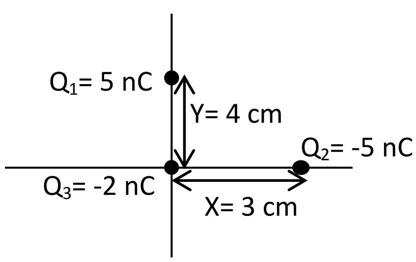


Fig. 1

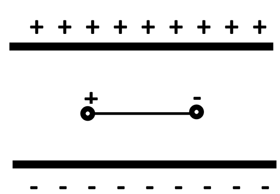


Fig. 2

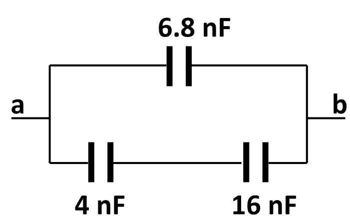


Fig. 3

نموذج B للاختبار الفصلي (مشابه لبقية النماذج).

① $i = \frac{q}{t} = \frac{ne}{t} = \frac{8\times10^{10}\times1.6\times10^{-19}}{2\times10^{-6}} = 6.4\ mA$

② بما أن الالكترون والبروتون لهما شحنتان مختلفتان، فمن المستحيل أن تكون محصلة القوى على اي جسيم يوضع بينهما تساوي صفر إلا لو كان الجسيم متعادل، بمعنى أن شحنته صفراً.

③ $F_1 = 4F_2 \Rightarrow \frac{kqQ}{r_1^2} = 4\frac{kq(8\times10^{-6})}{r_2^2}$

$\Rightarrow Q = 4\left(\frac{r_1}{r_2}\right)^2 \times 8\times10^{-6} = 4\left(\frac{4}{5}\right)^2\times8\times10^{-6} = 20.5\,\mu C$

④ $F_x = F_{23} = \frac{5\times10^{-9}\times9\times10^{+9}\times2\times10^{-9}}{(0.03)^2} = 0.0001\ N$ في الاتجاه السالب

$F_y = F_{13} = \frac{5\times10^{-9}\times9\times10^{+9}\times2\times10^{-9}}{(0.04)^2} = 0.000056\,N$ في الاتجاه الموجب

$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \left(\frac{0.000056}{-0.0001}\right) = -29.4$

وبالتالي ستكون الزاوية مع محور x الموجب

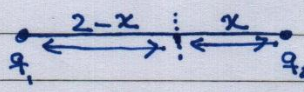
$\theta = 180 - 29.4 = 150.6^\circ$

⑤ $ma = \frac{kq^2}{r^2} \Rightarrow q = \sqrt{\frac{mar^2}{k}} = \sqrt{\frac{0.001\times144\times(0.02)^2}{9\times10^9}}$

$q = 80\ nC$

⑥ $qE = mg \Rightarrow E = \frac{mg}{q} = \frac{9.11\times10^{-31}\times9.8}{1.6\times10^{-19}} = 5.6\times10^{-11}\ N/C$

⑦



بما أن الشحنات متماثلة فلابد أن يكون المجال صفري بينهما

$\frac{kq_1}{(2-x)^2} = \frac{kq_2}{x^2} \Rightarrow \frac{\sqrt{q_1}}{(2-x)} = \frac{\sqrt{q_2}}{x}$

$$x\sqrt{q_1} = (2-x)\sqrt{q_2} \Rightarrow x\sqrt{q_1} + x\sqrt{q_2} = 2\sqrt{q_2}$$

$$x = \frac{2\sqrt{q_2}}{\sqrt{q_1}+\sqrt{q_2}} = \frac{2\sqrt{12\times10^{-9}}}{\sqrt{0.7\times10^{-9}}+\sqrt{12\times10^{-9}}} = 1.61 \text{ m}$$

النقطه التي تكون عندها المجال صفري تقع على بعد 1.61 عن Q_2

(8) $$\Phi = \frac{q}{\epsilon_0} = \frac{4.425\times10^{-12}}{8.85\times10^{-12}} = 0.5$$

(9) بما أن الصفيحة عازلة نستخدم العلاقة

$$E = \frac{\sigma}{2\epsilon_0} = \frac{q/A}{2\epsilon_0} = \frac{ne}{2\epsilon_0 A}$$

$$= \frac{6\times10^{6}\times1.6\times10^{-19}}{2\times8.85\times10^{-12}\times(0.01)^2} = 542 \text{ N/C}$$

(10) $$E = \frac{kq}{r^2} = \frac{9\times10^{9}\times4.68\times10^{-9}}{(0.9)^2} = 52 \text{ N/C}$$

(11) سيتحرك الثنائي عكس عقارب الساعة تحت تأثير الشحنات القائمة

(12) دائما خطوط المجال عمودية على اي سطح

(13) $$E = \frac{\rho r}{3\epsilon_0} \Rightarrow \rho = \frac{E(3\epsilon_0)}{r} = \frac{40\times10^{3}\times3\times8.85\times10^{-12}}{0.03}$$

$$= 35.4 \ \mu C/m^3$$

(14) الفيض الكلي خلال جميع الاوجه يساوي

$$\Phi = 6\times1000 = 6000 \ \text{N.m}^2/\text{C}$$

$$\Phi = \frac{q_{enc}}{\epsilon_0} = \frac{Q_1+Q_2+Q_3}{\epsilon_0}$$

$$Q_3 = \epsilon_0 \Phi - (Q_1 + Q_2) = 8.85\times10^{-12} \times 6000 - (15\times10^{-9} - 5\times10^{-9})$$

$$= 43.1 \text{ nC}$$

(15) $E_x = -\frac{\partial V}{\partial x} = -(4y + 2x) \Rightarrow E_x(2,3) = (4\times3 + 2\times2) = -16 \text{ V/m}$

$E_y = -\frac{\partial V}{\partial y} = -(4x) \Rightarrow E_y(2,3) = -(4\times2) = -8 \text{ V/m}$

$$E = \sqrt{E_x^2 + E_y^2} = \sqrt{(-16)^2 + (-8)^2} = 17.9 \text{ V/m}$$

(16) $C = \frac{kA\epsilon_0}{d} \Rightarrow k = \frac{Cd}{A\epsilon_0} = \frac{8.85\times10^{-12}\times0.6\times10^{-3}}{4\times10^{-4}\times8.85\times10^{-12}} = 1.5$

(17) $V = \frac{Q}{C}$ where $C = \left(\frac{4\times16}{4+16}\right) + 6.8 = 10 \text{ nF}$

$$V = \frac{17.7\times10^{-9}}{10\times10^{-9}} = 1.77 \text{ V}$$

(18) $V = \frac{Q}{C}$

فعندما تقل السعة يزداد الجهد .

(19) $W = qV = q(Ed) = 6\times10^{-3} \times 300 \times 0.04 = 72 \text{ mJ}$

(20) معروف أن سعة الكرة المعزولة تساوي

$$C = 4\pi\epsilon_0 R$$

يعني أنها تعتمد على نصف القطر (اللي هو أصغر خط ، ومساحة ، وحجم) ولكن
لا تعتمد على نوع مادتها .