King Saud University
College of Science
Department of Physics and Astronomy

PHYS. 104
first Term (1434-35)

Monday 1-1 1435	4 Nov 2013	3 - 4:30 p.m

Name:	
ID number:	
Section:	

حلول مفصلة لأحد الاختبارات الفصلية السابقة
الاختبار الفصلي الأول يغطي ثلاثة أبواب فقط

ناصر بن صالح الزايد

1-Two uncharged conducting spheres, A and B, are suspended from insulating threads so that they touch each other. While a negatively charged rod is held near, but not touching sphere A, someone moves ball B away from A. How will the spheres be charged, if at all?

	Sphere A	Sphere B
a)	0	+
b)	–	+
c)	0	0
d)	–	0
e)	+	–

بما أن الكرتين موصلتين وفي حالة اتصال فيمكن اعتبارهما جسما واحد

1- عند اقتراب العمود السالب من الكرة A يؤدي ذلك إلى تجمع الشحنات الموجبة على الكرة A

2- تتنافر الشحنات السالبة إلى الجهة الأخرى أي تصبح على الكرة B

3- بعد فصل الكرتين تحافظ كل كرة على شحنتها

2- There are two charges 1 µc and 6 µc, the ratio of forces acting on them will be .

a) 1:25 b) 1:6
c) 1:1 d) 6:1

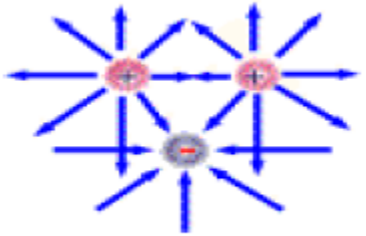
السبب في ذلك قانون نيوتن الثالث: لكل فعل رد فعل مساو له في المقدار مضاد له في الاتجاه.

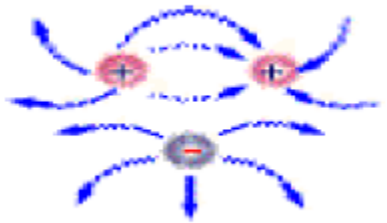
فتؤثر كل شحنة على الشحنة الأخرى بنفس القوة التي تتأثر هي بها.

توضيح: إذا كان وزنك 1000 نيوتن فمعنى ذلك أن الأرض تجذبك بقوة مقدارها 1000 نيوتن، وأنت تجذب الأرض أيضا بقوة 1000 نيوتن

3- What are electric field lines for two protons and one electron?


a)


b)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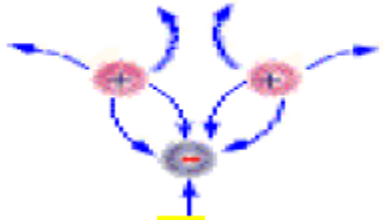

d)

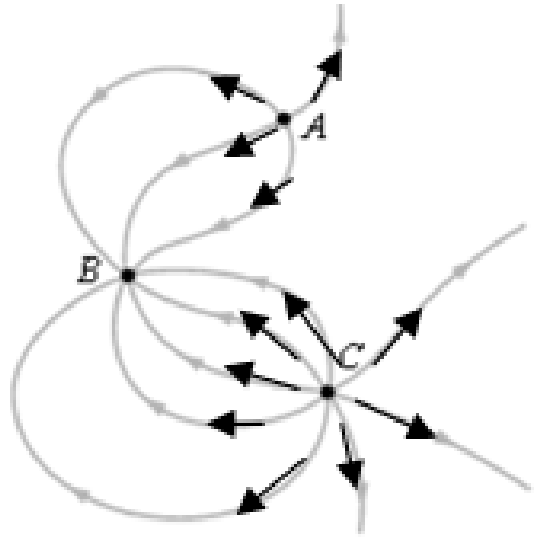
فقرة (a) وفقرة (c) خطأ واضح لأن الخطوط لابد وأن تدخل للشحنة السالبة

فقرة (b) صحيحة من حيث اتجاه الخطوط ولكن مشكلتها أن الخطوط الخارجة من الشحنتين الموجبتين لابد أن تنحني بسبب قوى التنافر

إذن فقرة d هي الصحيحة

4- The net charge shown in the Fig. is +Q. Identify each of the charges A,B,C shown.

a) $Q_c=2Q$, $Q_B=-2Q$, $Q_A=Q$
b) $Q_c=-2Q$, $Q_B=2Q$, $Q_A=-Q$
c) $Q_c=Q$, $Q_B=-2Q$, $Q_A=2Q$
d) $Q_c=2Q$, $Q_B=-2Q$, $Q_A=-Q$
e) None of the above



بحسب الرسم وعدد الخطوط واتجاه الخطوط:

شحنة A + (إذن فقرة b و d خطأ واضح)

شحنة B –

شحنة C +

شحنة B = شحنة C (إذن فقرة C خطأ)

وشحنة A = نصف شحنة B

فقرة (a) تحقق كل الشروط: شحنتي B و C متساويتين ومتعاكستين، وشحنة A على النصف وموجبة

5- the + 1.5 x 10^{-6} test charge experiences forces from two near by charges: a 12 N force due east and an 8 N force due west. What are the magnitude and direction of the electric field at the location of the test charge?

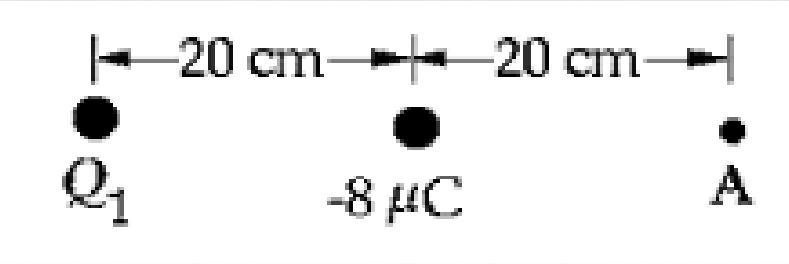
a) 2.67×10^{6} N/C due to west.
b) 2.67×10^{6} N/C due to east.
c) 2.67×10^{6} N/C due to south.
d) 2.67×10^{6} N/C due to north.

حل السؤال سهل بسبب عدم تغيير الأرقام فقط الاتجاه تم تغييره

إذن كل ما علينا أن نحدد اتجاه القوة المحصلة وهو 8-12 أي 4 N باتجاه East

إذن الأجابة الصحيحة هي فقط (b) بحسب الاتجاه وبغض النظر عن الرقم

6-The electric field at point A is zero. What is charge Q_1?



a)+32μC

b)–32μC

c)The field cannot be zero at A for any value ofQ1.

d)+16μC

e)–16μC

We need E at A:

$\therefore E = k\frac{q}{r^2}$

$\Rightarrow \therefore E = E_1 + E_2$

$\therefore E_A = k\frac{Q_1}{(0.4)^2} - k\frac{8\times10^{-6}}{0.2^2} = 0$ (20+20 cm → 0.4)

$\rightarrow k\frac{Q_1}{0.4^2} = k\frac{8\times10^{-6}}{0.2^2}$

$\rightarrow Q_1 = 8\times10^{-6} \times \frac{0.4^2}{0.2^2}$

$= 3.2\times10^{-5}\ C$ ✗ $= 32\ \mu C$ ✗

7- A -3nC point charge is located at the center of a thin spherical shell of total charge 3nC.The shell has a radius of 5 cm. The *electric flux* through a Gaussian surface of radius 2 cm is.

a) 3 nC/ε_0.
b) 6 nC/ε_0.
c) -3 nC/ε_0.
d)0.

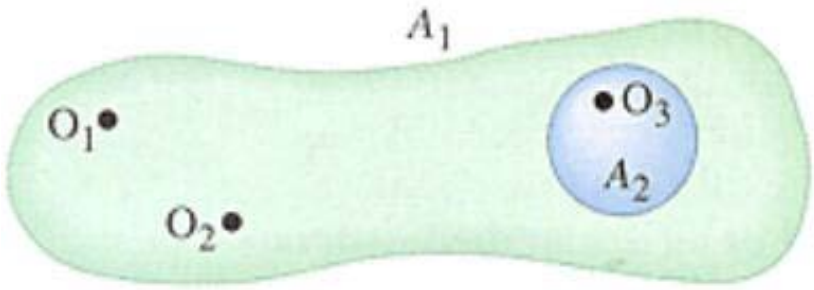
$\therefore \Phi_{net} = \int_S \vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\epsilon_0}$

only $-3\,nC$ is inside $3\,nC$ has no effect

$\therefore \Phi_{net} = \frac{-3\,nC}{\epsilon_0}$ #

8- In the Figure two objects, O_1 and O_2 have charges +1.5µC and -1.2µC, respectively, and a third object, O_3 , is electrically neutral. What is the *electric flux* through the surface A_1 that encloses all three objects?

a) zero
b) 34×10^3 Nm^2/ C
c) 43 Nm^2/C
d) 0.3×10^3 Nm^2/ C
e)need more information



using Gauss law: $\Phi_{net} = \frac{Q_{in}}{\epsilon_0}$

net charge inside A_1 is $1.5\mu C - 1.2\mu C = 0.3\mu C$

$\therefore \Phi_{net} = \frac{0.3 \times 10^{-6}}{8.85 \times 10^{-12}} = 34 \times 10^3$ N m^2/C ✳

9- A conducting sphere carries a net charge of –6 μC. The sphere is located at the center of a conducting spherical shell that carries a net charge of +2 μC. Determine the excess charge on the outer surface of the spherical shell.

a) –4 μC
b) +4 μC
c) –8 μC
d) +8 μC
e) +6 μC

For this question: simply: Q = -6μC + 2 μC = -4 μC

10- What is the charge per unit area, in coulombs per square meter, of an infinite sheet of charge if the electric field produced by the sheet of charge has a magnitude of 4.50 N/C ?

a) $7.97\ C/m^2$
b) $3.98 \times 10^{-11}\ C/m^2$
c) $7.97 \times 10^{-11}\ C/m^2$
d) need more information

$\therefore E = \frac{\sigma}{2\epsilon_0} = 4.5\ N/C$

we need $\sigma = ?$

$\sigma = 4.5 \times 2\epsilon_0 = 4.5 \times 8.85 \times 10^{-12} \times 2$

$\therefore \sigma = 7.96 \times 10^{-11}\ C/m^2$ ✳

11- The electric potential at a point of distance 1 m from 2 μc charge is

a) 1.8×10^6 V b) 1.8×10^6 N/C

c) 1.8×10^4 V d) 1.8×10^5 V

$$\because V = K\frac{Q}{r}$$

$$\therefore V = 9\times10^9 \frac{2\times10^{-6}}{1} = 1.8\times10^4 V$$

12- An object with positive charge is placed in a region of space where the electric field is directed vertically up ward. In which direction should the charge be moved in order to increase the electric potential energy of the system?

a) Vertically upward

b) Vertically downward

c)to the right

d) There is not enough information to tell.

$U \alpha r$ (+ charge)

➔ Decreasing r ➔ increasing U

يتم تحريك الشحنة الموجبة باتجاه (عكس اتجاه المجال) حتى نقلل من المسافة (المسافة في المقام) مما يؤدي إلى ارتفاع طاقة الوضع بالمنطق حتى ترتفع طاقة الوضع نقرب الشحنة الموجبة من السطح الموجب لمصدر المجال حتى يزداد التنافر

13- The potential energy of a 3.0×10^{-6} C charge changes from 0.02 J to 0.08 J when it is moved from point 1 to point 2. The change in the electric potential between these two points is.

a) 2×10^{4} V b) 6×10^{4} V c) 5×10^{4} V d) 6×10^{-6} N

$\therefore U = qV$ $\therefore$ at point ① : $U_1 = 3\times10^{-6} V_1 = 0.02$ J ①

at point ② $\therefore U_2 = 3\times10^{-6} V_2 = 0.08$ J ②

① $\rightarrow V_1 = \frac{0.02}{3\times10^{-6}}$ --③ ② $\rightarrow V_2 = \frac{0.08}{3\times10^{-6}}$ ④

$\therefore$ change in electrical potential: $V_2 - V_1 = \frac{0.08-0.02}{3\times10^{-6}}$

$\therefore V_2 - V_1 = 2\times10^{4}$ V #

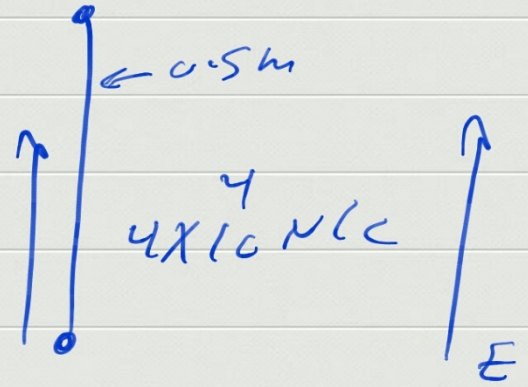
14- A positive charge of 3.0×10^{-8} coulomb is placed in an upward directed uniform electric field of 4.0×10^{4} N/C. When the charge is moved 0.5 meter upward, the work done by the electric force on the charge is

a) 6×10^{-4} J b) 12×10^{-4} J c) 2×10^{4} J d) 8×10^{4} J e) 12×10^{4} J

$Q = 3 \times 10^{-8}$ C

$\therefore F = qE = 3 \times 10^{-8} \times 4 \times 10^{4}$

$= 1.2 \times 10^{-3}$ N.



$\therefore W = F \Delta s = 1.2 \times 10^{-3} \times 0.5$

$= 6 \times 10^{-4}$ J ##

15- Select True Or false for the following statements

a)The net electric flux through a closed surface depends on the total charge located outside the surface (F). located inside

b) If a spherical shell has a positive net flux passing through its surface, then there are no negative charges enclosed within the surface (F). if net charge is + even if some - charge is there

c) The electric potential is equal to the electric potential energy (F). U = Vq

d)The electric field of a point charge always points away from the charge (F). + only

e) All macroscopic charges Q can be written as Q= ±Ne, where N is an integer and e is the charge of the electron (T). No fraction of e is allowed

f) Every point on an equipotential surface is at the same potential (T)