

PHYS 223 University Physics III

Exam 1
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Name _____

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1. A charged particle produces an electric field with a magnitude of 3.0 N/C at a point that is 50 cm away from the particle. What is the magnitude of the particle's charge?

$$E = \frac{q}{4\pi\epsilon_0 r^2}$$

$$q = 4\pi\epsilon_0 r^2 E$$

$$= 4\pi (8.854 \times 10^{-12}) \times (0.5)^2 \times 3$$

$$= 8.3 \times 10^{-11} \text{ C}$$

$$q = 8.3 \times 10^{-11} \text{ C}$$

PHYS 223 University Physics III

Exam 1

2. What is the electric field at the point **P** ($x = 2, y = 0$), produced by the charge **Q** at $x = 0$ and $y = 2$ and the charge **-Q** at $x = 0$ and $y = -2$?

a. Magnitude $\sqrt{2} 16 \pi \epsilon_0$

b. Direction $-\hat{y}$, down

$$E_1 = \frac{Q}{4\pi\epsilon_0 R^2}$$

$$R^2 = 2^2 + 2^2 = 8$$

$$E_1 = \frac{Q}{4\pi\epsilon_0 8}$$

$$E = \frac{2 Q \cos\theta}{2 \cdot 4\pi\epsilon_0 8}$$

$$E = \frac{Q/\sqrt{2}}{16\pi\epsilon_0}$$

$$\cos\theta = \frac{1}{\sqrt{2}}$$

$$16 =$$

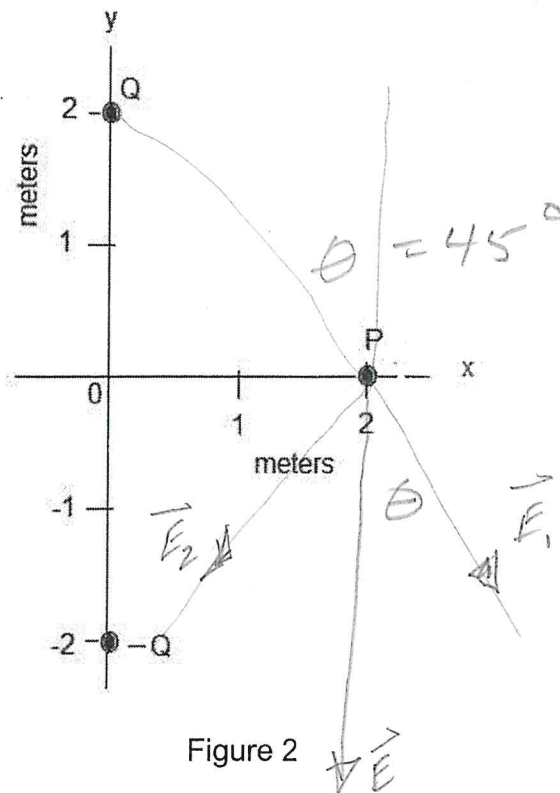


Figure 2

PHYS 223 University Physics III

Exam 1

3. Three identical spheres are shown in Figure 3. Spheres A and B are uncharged and are fixed in place, with a center to center separation of d , which is much larger than the spheres. Sphere C has a charge Q and is touched first to sphere A and then to sphere B and is then removed. What then is the magnitude of the electrostatic force between spheres A and B?

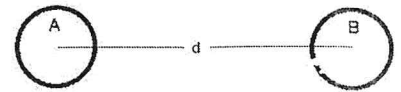


Figure 3

$$\frac{Q_A + Q_C}{2} = \frac{Q}{2} = \text{charge on A}$$

$$\frac{\frac{Q}{2} + Q_B}{2} = \frac{Q}{4} \quad \text{charge on B}$$

$$F = \frac{\left(\frac{Q}{2}\right)\left(\frac{Q}{4}\right)}{4\pi\epsilon_0 d^2} = \frac{Q^2}{32\pi\epsilon_0 d^2}$$

$$F = \frac{Q^2}{32\pi\epsilon_0 d^2}$$

$$F = K \frac{Q^2}{8d^2}$$

Physical Constants

Constant	Symbol	Magnitude
Avogadro's Number	N _A	6.022 x 10 ²³ molecules/mole
Boltzmann's constant	k	1.38 x 10 ⁻²³ J/K = 8.62 x 10 ⁻⁵ eV/K
Stefan-Boltzmann constant	s	5.67x10 ⁻⁸ J/(s*m ² *K ⁴)
Electronic charge	q	1.6 x 10 ⁻¹⁹ C
Electronvolt	eV	1.6 x 10 ⁻¹⁹ J
Planks constant	h	6.625 x 10 ⁻³⁴ J-s
Thermal voltage, kT, at 300 °K	V _t	25.8 mV
Velocity of light	c	3 x 10 ⁸ m/s
Permeability of free space	u _o	1.257 x 10 ⁻⁶ H/m
Permittivity of free space	e _o	8.854 x 10 ⁻¹² F/m
Electron mass	m _e	9.1 x 10 ⁻³¹ kg
Proton mass	m _p	1.673 x 10 ⁻²⁷ kg

Atomic Masses

Element	Symbol	Atomic Mass	Atomic Number
Hydrogen	H	1.00794 u	1
Helium	He	4.00260 u	2
Lithium	Li	6.941 u	3
Beryllium	Be	9.0122 u	4
Boron	B	10.811 u	5
Carbon	C	12.0107 u	6
Nitrogen	N	14.0067 u	7
Oxygen	O	15.9994 u	8
Fluorine	F	18.9984 u	9
Neon	N	20.1797 u	10
Sodium	Na	22.9897 u	11
Magnesium	Mg	24.305 u	12
Aluminum	Al	26.9815 u	13
Silicon	Si	28.0855 u	14
Phosphorus	P	30.9738 u	15