

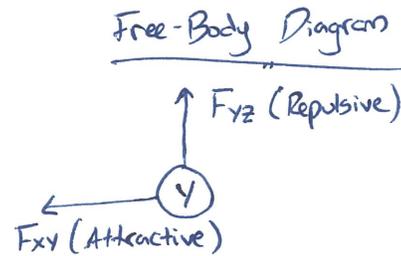
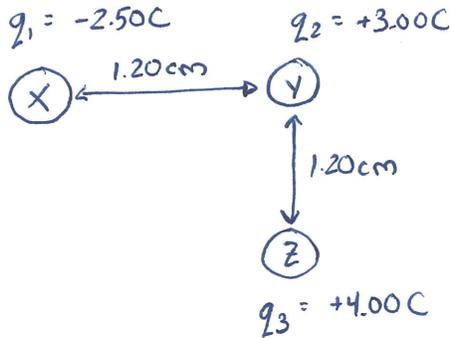
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103 - Worksheet - Coulomb's Law in 2-Dimensions

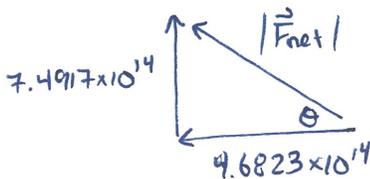
Textbook Questions

Pg 534 #1: A small metal sphere X with a negative charge of -2.50 C is 1.20 cm directly to the left of another similar sphere Y with a charge of +3.00 C. A third sphere Z with a charge of +4.00 C is 1.20 cm directly below sphere Y. The three spheres are at the vertices of a right triangle, with sphere Y at the right angle. Calculate the net electrostatic force on sphere Y, sketching diagrams as necessary.



$$F_{12} = \frac{kq_1q_2}{r^2} = \frac{(8.99 \times 10^9)(2.50)(3.00)}{(1.20 \times 10^{-2})^2} = 4.6823 \times 10^{14}\text{ N}$$

$$F_{23} = \frac{kq_2q_3}{r^2} = \frac{(8.99 \times 10^9)(3.00)(4.00)}{(1.20 \times 10^{-2})^2} = 7.4917 \times 10^{14}\text{ N}$$



$$a^2 + b^2 = c^2$$

$$|\vec{F}_{net}| = 8.8346 \times 10^{14}\text{ N}$$

$$\tan \theta = \frac{a}{b}$$

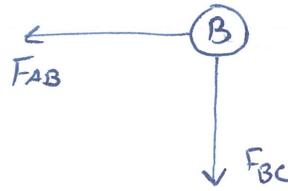
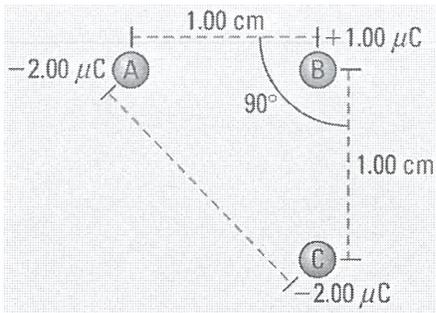
$$\theta = 58^\circ \text{ N of W}$$

or 122°

$$\vec{F}_{net} = 8.83 \times 10^{14}\text{ N } [122^\circ]$$

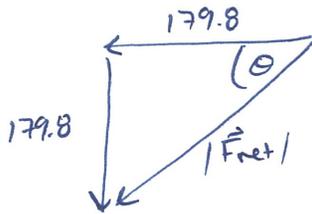
■ KEY ■

Pg 534 #2: Calculate the net electrostatic force on charge B in the figure below.



$$F_{AB} = \frac{kq_A q_B}{r^2} = \frac{(8.99 \times 10^9)(2.00 \times 10^{-6})(1.00 \times 10^{-6})}{(1.00 \times 10^{-2})^2} = 179.8 \text{ N}$$

$$F_{BC} = \frac{kq_B q_C}{r^2} = \frac{(8.99 \times 10^9)(1.00 \times 10^{-6})(2.00 \times 10^{-6})}{(1.00 \times 10^{-2})^2} = 179.8 \text{ N}$$



$$a^2 + b^2 = c^2$$

$$|F_{net}| = 254.28 \text{ N}$$

$$\tan \theta = \frac{a}{a}$$

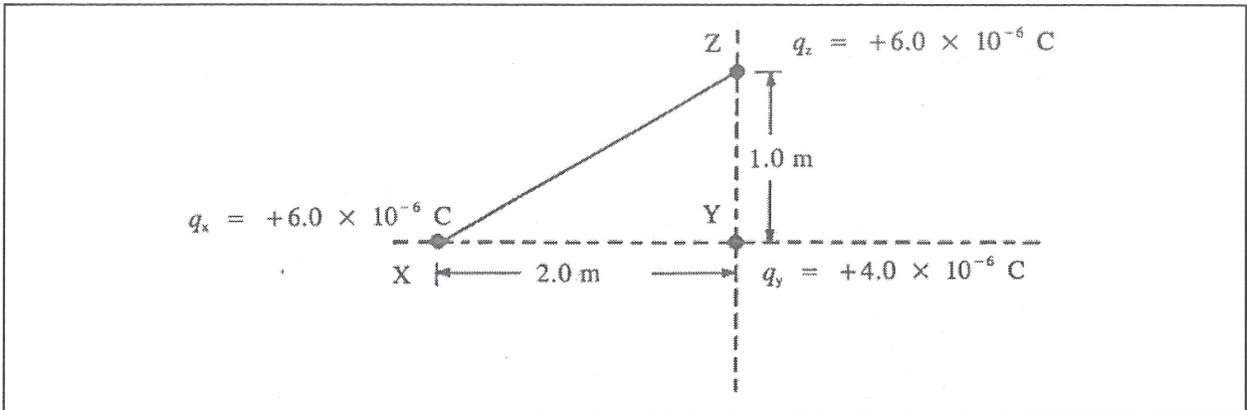
$$\theta = 45^\circ \text{ 3of W or } 225^\circ$$

↑
BEST

$$\vec{F}_{net} = 254.28 \text{ N } [225^\circ]$$

Diploma Worksheet Questions – Coulomb's Law (in 2-Dimensions)

Use the following information to answer Q118:

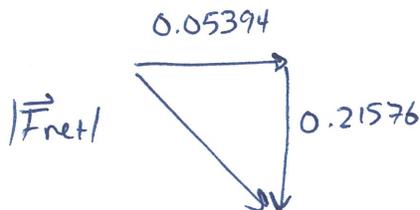


Q118: The magnitude of the force acting on Y due to X and Z is

- a. 0.76 N
- b. 0.22 N
- c. 0.032 N
- d. 0.027 N

$$F_{xy} = \frac{kq_x q_y}{r^2} = \frac{(8.99 \times 10^9)(6.0 \times 10^{-6})(4.0 \times 10^{-6})}{(2.0)^2} = 0.05394 \text{ N}$$

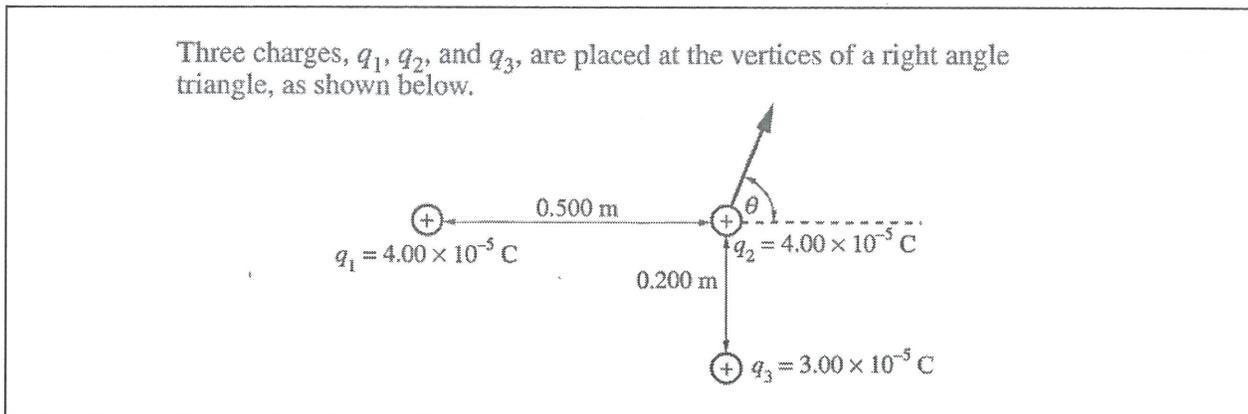
$$F_{yz} = \frac{kq_y q_z}{r^2} = \frac{(8.99 \times 10^9)(4.0 \times 10^{-6})(6.0 \times 10^{-6})}{(1.0)^2} = 0.21576 \text{ N}$$



$$a^2 + b^2 = c^2$$

$$|\vec{F}_{net}| = 0.2224 \text{ N} \approx 0.22 \text{ N}$$

Use the following information to answer Q119 and Q120:



Q119: The magnitude of the net electrostatic force acting on q_2 is

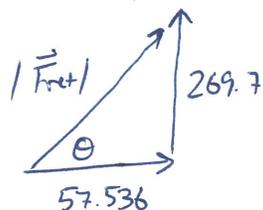
- a. 212 N
- b. 263 N
- c. 276 N
- d. 327 N

$$F_{12} = \frac{kq_1q_2}{r^2} = \frac{(8.99 \times 10^9)(4.00 \times 10^{-5})(4.00 \times 10^{-5})}{(0.5)^2}$$

$$= 57.536 \text{ N}$$

$$F_{23} = \frac{kq_2q_3}{r^2} = \frac{(8.99 \times 10^9)(4.00 \times 10^{-5})(3.00 \times 10^{-5})}{(0.2)^2}$$

$$= 269.7$$



$$a^2 + b^2 = c^2$$

$$|F_{net}| = 275.769 \text{ N}$$

$$\theta = \tan^{-1}\left(\frac{269.7}{57.536}\right)$$

$$\theta = 77.9574^\circ$$

$$\theta \approx 78.0^\circ$$



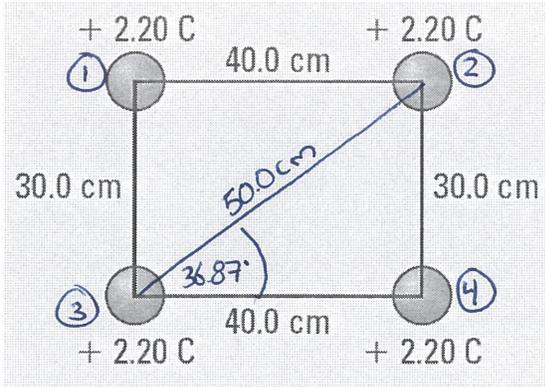
Q120: The angle labelled θ indicates the direction of the net electrostatic force on q_2 . The value of θ is _____°.

(Record your **three digit** answer in the Numerical Response boxes below)

7	8	.	0
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Challenge Questions

Pg 535 #2: Four charged spheres, with equal charges of +2.20 C, are situated in positions forming a rectangle, as shown in the figure below. Determine the net electrostatic force on the charge in the top right corner of the rectangle.

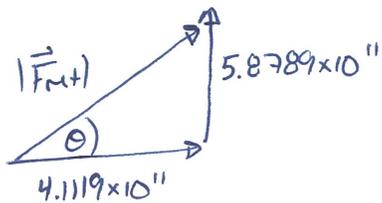


$$F_{12} = 2.7195 \times 10^{11} \text{ N } [0^\circ]$$

$$F_{23} = 1.7405 \times 10^{11} \text{ N } [36.87^\circ]$$

$$F_{24} = 4.8346 \times 10^{11} \text{ N } [90^\circ]$$

	x-comp	y-comp
F_{12} →	$+2.7195 \times 10^{11}$	$+0$
F_{23} ↗ 36.87° F_x → F_y ↑	$+1.3924 \times 10^{11}$	$+1.0443 \times 10^{11}$
F_{24} ↑	$+0$	$+4.8346 \times 10^{11}$
	$F_{netx} = 4.1119 \times 10^{11} \text{ N}$	$F_{nety} = 5.8789 \times 10^{11} \text{ N}$



$$a^2 + b^2 = c^2$$

$$|F_{net}| = 7.1742 \times 10^{11} \text{ N}$$

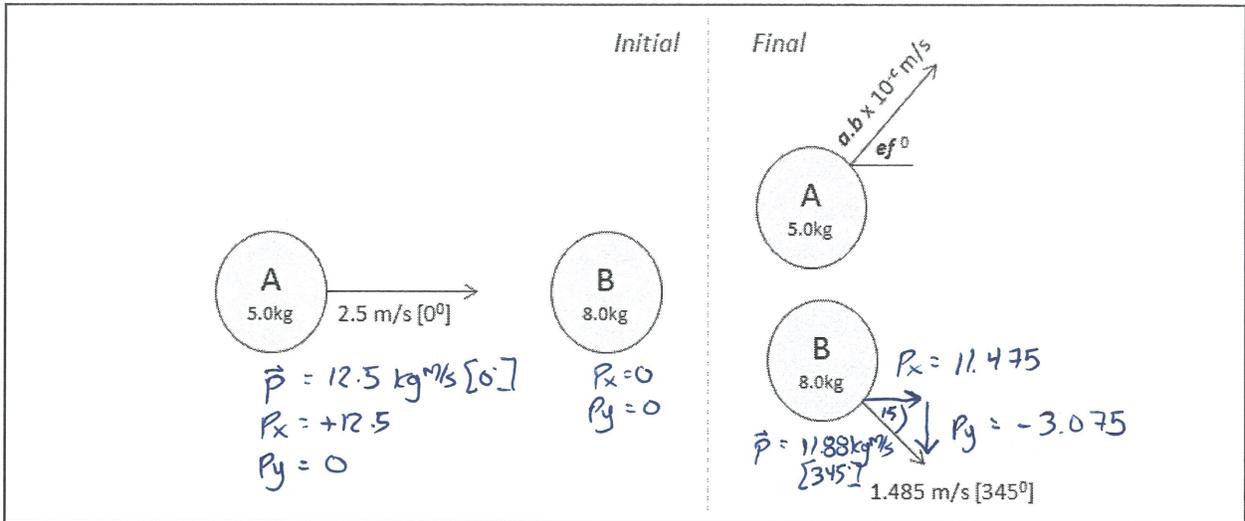
$$\tan \theta = \frac{b}{a}$$

$$\theta = 55.03^\circ$$

$$\vec{F}_{net} = 7.1742 \times 10^{11} \text{ N } [55.03^\circ]$$

Cumulative Review from Previous Units

Use the following information to answer Q1:



Q1: In an isolated system, Object A hits Object B inelastically. Object A then rebounds upward with a velocity of $a.b \times 10^{-1} \text{ m/s } [ef^\circ]$, where a , b , e , and f are __, __, __, and __.

Isolated system \rightarrow No external net forces. \rightarrow Momentum is conserved.
(Gravity may be balanced against Normal force).

Inelastic \rightarrow Kinetic energy is lost to other forms.

x-comp

$$p_i = p_f$$

$$(+12.5) + (0) = (+11.475) + p_{Af}$$

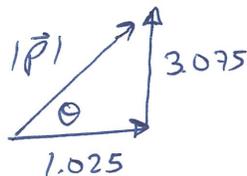
$$p_{Af} = +1.025 \text{ kg m/s}$$

y-comp

$$p_i = p_f$$

$$(0) + (0) = (-3.075) + p_{Bf}$$

$$p_{Bf} = +3.075 \text{ kg m/s}$$



$$a^2 + b^2 = c^2$$

$$|\vec{p}| = 3.24105 \text{ kg m/s}$$

$$\tan \theta = \frac{a}{b}$$

$$\theta = 71.565^\circ$$

$$\vec{p} = 3.24105 \text{ kg m/s } [71.565^\circ]$$

$$\vec{v} = 0.6482 \text{ m/s } [71.565^\circ]$$

$$\vec{v} \approx 6.5 \times 10^{-1} \text{ m/s } [72^\circ]$$

$$a.b \times 10^{-1} \text{ } [ef]$$



6 5 7 2