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Physics II
Bonus Assignment

Q1.

Given

$q_1 = 2.0\,\mu C = 2.0 \times 10^{-6}\,C$
$q_2 = -3.0\,\mu C = -3.0 \times 10^{-6}\,C$
$r = 0.05m$
constant $= K_e = 8.99 \times 10^9 N$

$$F = K_e \cdot \frac{|q_1 q_2|}{r^2} = 8.99 \times 10^9 \cdot \frac{|(2.0 \times 10^{-6})(-3.0 \times 10^{-6})|}{(0.05)^2}$$

$$F = 8.99 \times 10^9 \cdot \frac{6 \times 10^{-12}}{2.5 \times 10^{-3}} = \boxed{21.576N}$$

Reasoning

- Using absolute value because we are finding the magnitutde of the source
- Charges attract when they are opposite, so they both feel the same charge
- 1 negative + 1 positive = attractive
- Direction for each charge force is toward eachother.

Q2.

Given

$Q = 4.0\mu C = 4.0 \times 10^{-6} C$
$r = 0.1 m$

$$E = k_e \cdot \frac{|Q|}{r^2} = 8.99 \times 10^9 \cdot \frac{4.0 \times 10^{-6}}{(0.1)^2} =$$

$$8.99 \times 10^9 \cdot \frac{4.0 \times 10^{-6}}{0.01} =$$

$$\boxed{3.596 \times 10^6 N/C}$$

Reasoning: The magnitude is always positive while the direction depends on the sign of the charge.

For positive Q, field points away from the charge. Negative Q field would point towards it, so since Q>0 the Fields radiates outward.

Q3 (A)

Given

$q1 = +5.0\mu C$

$q2 = -2.0\mu C$

$D = 0.2m$

$r = 0.1m$

$q_{test} = 1.0\mu C = 1.0\times10^{-6} C$

$$E_1 = ke \cdot \frac{q_1}{(0.1)^2} = 8.99\times10^9 \cdot \frac{5.0\times10^{-6}}{0.01}$$

$$= 4.495\times10^6 N/C$$

$$E_2 = ke \cdot \frac{q_2}{(0.1)^2} = 8.99\times10^9 \cdot \frac{-2.0\times10^{-6}}{0.01}$$

$$= -1.798\times10^6 N/C$$

$$E_{net} = E_1 + E_2 = 4.495\times10^6 - 1.798\times10^6$$

$$\boxed{= 2.697\times10^6 N/C}$$

(To the right)

Reasoning: Within this question, direction plays a pivatol role. The field from q1 points right which is away. Then the field from q2 points towards the right as well, making it negative. This makes both electric fields add in the same direction. This makes the result a stronger right forward field at the midpoint.

Q3 (B)

$$F = q_{test} \cdot E = (1.0 \times 10^{-6}) \cdot (2.697 \times 10^{6})$$

$$\boxed{= 2.697 N}$$

(to the right)

Reasoning: With the test charge being positive, the force is within the same direction as the field that is right. Meaning, force on a test charge equals its charge times the electric field.

Q4

Given

$Q = 30\mu C = 3.0 \times 10^{-6} C$
$r = 0.15 m$

$$V = K_e \cdot \frac{Q}{r} = 8.99 \times 10^{9} \cdot \frac{3.0 \times 10^{-6}}{0.15}$$

$$\boxed{= 179800 V}$$

Reasoning: The electric potential is scalar, meaning there is no need for an vector addition or direction. Also, the the positive potential indicates that a positive test charge would gain potential energy at a specific location. This results in zero at infinity.

Q5.(A)

Given

$V_A = 12V$, $V_B = 5V$
$q = -1.6 \times 10^{-19} C$

$$\Delta V = V_B - V_A = 5 - 12 = \boxed{-7V}$$

Reasoning: Negative ΔV moves to a lower potential which favors positive charges. Though for an electron, the direction is unfavorable because it moves to a higher electrical potential energy

Q6(B)

$$W = q \cdot \Delta V = (-1.6 \times 10^{-19}) \cdot (-7)$$
$$= \boxed{1.12 \times 10^{-18} J}$$

Reasoning: - electron & - difference = positive work by field