B3 · Extra practice

Worked solutions | Items 1-2

Extra practice for this lesson. Original questions, not released diploma items. Select one option for multiple choice; other tasks state the required response.

Use $k = 8.99 \times 10^9$ N·m²/C² and $g = 9.81$ m/s² where needed (Alberta Physics 30 data sheets, Constants). For numerical responses, use the stated unit or coefficient and precision. Work in degrees.

B3-D01 · Multiple choice

A positive source is left of a negative target and a negative source is right of it. Which pair of target-force arrows is correct, in left-source then right-source order?

A. Left; right.
B. Right; left.
C. Right; right.
D. Left; left.

1. The positive source attracts the negative target left. The negative source repels it away from the right, also left.

2. Both arrows act on the target and add. A and B reverse one force; C reverses both.

3. Answer: D.

B3-D02 · Multiple choice

A target feels two perpendicular forces of magnitudes 3 units and 4 units. Which net force magnitude is correct?

A. 1 unit
B. 5 units
C. 7 units
D. 12 units

1. Perpendicular vectors form a right triangle: $\sqrt{(3^2 + 4^2)} = \sqrt{25} = 5$ units.

2. 1 assumes opposite forces on one line; 7 assumes forces that point the same way; 12 multiplies magnitudes without a vector rule.

3. Answer: B.

B3 · Extra practice

Worked solutions | Items 3-4

B3-D03 · Multiple choice

A sphere is at rest under weight, tension and a horizontal electric force. String angle θ is measured from vertical. Which equation balances vertical forces?

A. $T \sin \theta = mg$

B. $T = mg$

C. $T \cos \theta = mg$

D. $Fe \cos \theta = mg$

1. The angle between the string tension and vertical is θ, so the adjacent vertical component is $T \cos \theta$. Weight is downward and the electric force has no vertical component.

2. A uses the horizontal component. B ignores the tilted string. D projects a horizontal force onto an unrelated angle.

3. Answer: C.

B3-D04 · Multiple choice

A problem gives a hanging sphere’s mass and string angle, but no source charges or distance. Which method directly finds the horizontal electric force?

A. Balance horizontal and vertical force components.

B. Substitute directly into Coulomb’s law.

C. Add mass to the string angle.

D. Assume the electric force is zero because the sphere is at rest.

1. At rest means zero net force, not zero individual forces. Use $T \cos \theta = mg$ and $Fe = T \sin \theta$; eliminate T to get $Fe = mg \tan \theta$.

2. B lacks required charge/distance data. C combines incompatible quantities. D mistakes balance for absence of force.

3. Answer: A.

B3 · Extra practice

Worked solutions | Items 5-6

B3-D05 · Numerical response

Forces on one target are 0.720 N right and 0.180 N left. What is net force magnitude in N? Record three significant figures.

1. Choose right positive. Fnet,x = +0.720 - 0.180 = +0.540 N.

2. The requested magnitude is 0.540 N. The full direction is right because the signed component is positive.

3. Response: 0.540.

B3-D06 · Numerical response

Forces on a target are 0.900 N east and 1.20 N south. What is the magnitude of the net force in N? Record three significant figures.

1. Perpendicular components require Pythagoras: $F = \sqrt{(0.900^2 + 1.20^2)} = \sqrt{2.25} = 1.50$ N.

2. The result points southeast. It exceeds either component but is below their sum of 2.10 N.

3. Response: 1.50.

B3 · Extra practice

Worked solutions | Items 7-8

B3-D07 · Numerical response

A sphere of mass 2.00×10^{-4} kg is at rest with its string 40.0° from vertical. The electric force is horizontal. Use g = 9.81 m/s². What is its electric-force magnitude, expressed as a $\times 10^{-3}$ N? Record a to three significant figures.

1. Givens: m and θ from the prompt; rest means a = 0. Vertical balance gives T cos θ = mg, horizontal balance gives Fe = T sin θ.

2. $Fe = mg \tan\theta = (2.00 \times 10^{-4})(9.81)\tan 40.0° = 1.6463 \times 10^{-3}$ N. Thus a = 1.65. The force is below mg because θ < 45°.

3. Response: 1.65.

B3-D08 · Numerical response

Point charges in air: target B = −1.00 µC at x = 0, A = +1.00 µC at x = −0.300 m, C = −3.00 µC at x = +0.300 m. Use $k = 8.99 \times 10^{9}$ N·m²/C². What is the net force magnitude in N? Record three significant figures.

1. A attracts B left; C repels B left. Both distances are 0.300 m, and the forces point the same way, so they add.

2. $F_A = k(1.00 \times 10^{-6})^2/0.300^2 = 0.099889$ N. $F_C = k(3.00 \times 10^{-6})(1.00 \times 10^{-6})/0.300^2 = 0.299667$ N.

3. Net = 0.399556 N left, rounded to 0.400 N. Do not subtract merely because the source charges have different signs.

4. Response: 0.400.

B3 · Extra practice

Worked solutions | Items 9-10

B3-D09 · Select all that apply

A suspended sphere is at rest under weight, tension and horizontal electric force. Choose every true statement: A. Net force is zero. B. Electric force must be zero. C. Tension acts along the string. D. Vertical tension balances weight.

1. At rest means a = 0, so the vector sum is zero. Tension follows the string; its vertical component balances weight.

2. B is false: an electric force can be balanced by tension’s horizontal component. Zero net force does not remove the individual forces.

3. Answer: A, C and D.

B3-D10 · Matching

Match each description to a method. 1 = add signed forces on one line; 2 = the Pythagorean theorem and an angle; 3 = balanced forces. Cases: (a) known forces east and north; (b) mass and steady string angle; (c) known forces left and right. Record a-b-c codes.

1. East and north are perpendicular, so (a) uses method 2. A steady tilted string involves balance, so (b) uses method 3.

2. Left and right share an axis; choose a positive direction and add signed components, so (c) uses method 1. Code 231.

3. Answer: 231.

B3 · Extra practice

Worked solutions | Items 11-12

B3-D11 · Ranking

Each pair acts on one target: A has 0.300 N east and 0.400 N north; B has 0.300 N east and 0.400 N east; C has 0.300 N east and 0.400 N west. Rank net force magnitudes largest to smallest.

1. A is perpendicular: $\sqrt{(0.300^2 + 0.400^2)} = 0.500$ N. B adds along one line: 0.700 N.

2. C opposes on one axis: magnitude $|0.300 - 0.400| = 0.100$ N. Thus B > A > C. Identical magnitudes do not guarantee identical net forces.

3. Answer: B > A > C.

B3-D12 · Ordering

For several charges around a target, order these actions: 1 add signed components; 2 identify the target and source-target distances; 3 draw each force direction from signs and positions; 4 calculate each force magnitude. Give a sensible four-digit order.

1. Identify one target and its distances (2). Determine arrows from attraction/repulsion (3). Calculate each contribution using Coulomb’s law (4).

2. Finally split the forces into parts and add the signed parts (1), then interpret the result. Adding raw charge signs would not replace this vector procedure.

3. Answer: 2341.