B1 · 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.

B1-D01 · Multiple choice

A neutral solid metal sphere becomes positively charged by ordinary contact charging. Which change explains this?

A. It gains protons.
B. It loses electrons.
C. Its electrons become positive.
D. Its total positive and negative charges both disappear.

1. Protons stay in the nuclei of the metal. Electrons can transfer between objects. Losing negative charge leaves an electron deficit and a positive total charge.

2. A moves protons; C changes an electron's charge; D does not describe charging. None explains ordinary contact charging.

3. Answer: B.

B1-D02 · Multiple choice

A negative rod is held near the left side of a neutral metal sphere on an insulating stand without contact. Which pair describes the sphere while the rod remains near?

A. Near side negative; net negative.
B. Near side positive; net positive.
C. Near side positive; net zero.
D. Near side negative; net zero.

1. The negative rod repels electrons toward the far side, leaving the near side electron-deficient and positive.

2. No electrons enter or leave the sphere, so the total charge stays zero. Options A and B confuse charge separation with a transfer; D reverses electron motion.

3. Answer: C.

B1 · Extra practice

Worked solutions | Items 3-4

B1-D03 · Multiple choice

A positive rod is used to charge a neutral metal sphere by induction. The sphere is grounded, the ground is disconnected, then the rod is removed. Which result is correct?

A. Electrons enter from Earth; final sphere negative.
B. Electrons leave for Earth; final sphere positive.
C. Protons enter from Earth; final sphere positive.
D. No charge transfers; final sphere neutral.

1. The positive rod attracts electrons. Ground lets electrons enter the sphere from Earth. Disconnecting ground traps the extra; removing the rod leaves a negative sphere.

2. B reverses electron transfer; C treats protons as free to move; D ignores the open ground path.

3. Answer: A.

B1-D04 · Multiple choice

A neutral insulator is attracted to a charged object without contact. Which explanation is best?

A. Its particles must become net positive.
B. Electrons flow freely through its full length.
C. The charged object must lose its charge.
D. Charges inside its atoms shift slightly, producing unequal near-side and far-side forces.

1. An insulator resists charge flow through the object, but the charges inside its atoms can shift slightly. The nearer opposite charge is attracted more strongly.

2. Net charging is unnecessary, so A and C are not required. B describes conductor-like motion through the whole object rather than the small shift of charges inside an insulator.

3. Answer: D.

B1 · Extra practice

Worked solutions | Items 5-6

B1-D05 · Numerical response

Two identical metal spheres on insulating stands start at +7.0 µC and −1.0 µC. They touch, then separate far apart. What is each final charge in µC? Record the positive value to one decimal place.

1. Givens: +7.0 µC and −1.0 µC; identical spheres with no charge loss. Total = +6.0 µC by conservation.

2. Equal sharing between identical spheres gives +6.0/2 = +3.0 µC each. The sum checks the initial total.

3. Response: 3.0.

B1-D06 · Numerical response

For an induction procedure, actions are labelled: 1 remove rod; 2 disconnect ground; 3 connect ground; 4 bring negative rod near. Starting from a neutral conductor, what four-digit sequence leaves it positively charged without contact?

1. Bring the negative rod near first (4), then ground the conductor while the rod stays near (3). Electrons leave for Earth.

2. Disconnect ground before removing the rod (2, then 1). This retains the electron deficit. Removing the rod first would allow electrons to return.

3. Response: 4321.

B1 · Extra practice

Worked solutions | Items 7-8

B1-D07 · Numerical response

A neutral object has 14 protons and 14 electrons with charges of the same size. Four electrons leave. What is the size of its final total charge in units of e? Record a whole number.

1. The object keeps +14e but now has 10 electrons, or −10e. Total charge = +14e - 10e = +4e.

2. The requested size is 4 in units of e. The positive sign means electron deficit, not added protons.

3. Response: 4.

B1-D08 · Numerical response

Classify these processes: (i) electrons shift inside a sphere on an insulating stand; (ii) electrons move from Earth to a sphere; (iii) electrons move between touching spheres. Use 1 = separation only and 2 = transfer on or off an object. What three-digit code classifies (i), (ii), (iii), in that order?

1. In (i), no electron enters or leaves the sphere, so this is separation only: 1.

2. In (ii), electrons cross between Earth and the sphere: 2. In (iii), they cross between spheres: 2. The complete code is 122.

3. Response: 122.

B1 · Extra practice

Worked solutions | Items 9-10

B1-D09 · Select all that apply

Choose every true statement: A. A neutral sphere on an insulating stand can have its charges separated. B. An insulator cannot be charged. C. Ground can supply electrons. D. Attraction proves an object has the opposite total charge.

1. A is true: electrons can redistribute without changing the total. C is true: Earth can supply or accept electrons through a conducting path.

2. B is false because insulators can gain or lose charge locally. D is false because neutral objects with separated charges can also be attracted.

3. Answer: A and C.

B1-D10 · Matching

Match each situation to its final sign. 1 = positive, 2 = negative, 3 = neutral. Situations: (a) a neutral object gains electrons; (b) one loses electrons; (c) a sphere on an insulating stand only has its charges separated. Record the three digits in a-b-c order.

1. (a) Gaining negative electrons gives an extra: negative, code 2. (b) Losing electrons leaves a deficit: positive, code 1.

2. (c) Polarization changes distribution without net transfer: neutral, code 3. Thus 213.

3. Answer: 213.

B1 · Extra practice

Worked solutions | Items 11-12

B1-D11 · Ranking

Identical spheres have total charges A = +6 μC, B = −9 μC, C = +2 μC and D = 0. Rank the sizes of their total charges from largest to smallest. State any ties.

1. Magnitude means size without sign: 9, 6, 2 and 0 μC. The negative sphere B has the largest magnitude.

2. Rank the absolute values, not the signed numbers. This gives B > A > C > D.

3. Answer: B > A > C > D; no ties.

B1-D12 · Source-based reasoning

A record of charging by induction shows a neutral sphere with a negative rod nearby. Frame 1: electrons move within the sphere. Frame 2: a ground wire connects and electrons leave. Frame 3: the wire disconnects. Frame 4: the rod is removed. Which frame first changes the sphere’s total charge, and what is its final sign?

1. Frame 1 is charge separation inside the sphere, so total charge stays zero. In frame 2 electrons leave the sphere for the Earth; this is the first net-charge change.

2. Frames 3 and 4 retain the electron deficit and let it redistribute. The final sign is positive. The record is simulated, not measured in a physical lab.

3. Answer: Frame 2; positive.