**Metallic Alloys and Material Properties**

New Regents original practice • Name: _____ Date: _____
Show your work for written answers.

A substitutional alloy model has some atoms of a second element in places that would otherwise contain atoms of the main metal.

**1** What change produces a substitutional alloy in the model?

(1) Some main-metal atoms are replaced by atoms of a second element.

(2) Every atom loses its nucleus.

(3) The metal atoms separate into individual molecules of water.

(4) All atoms of the second element stay outside the solid.

**2** Explain how atoms of different sizes can make an alloy harder to deform than the pure metal in this model. [1]

Answer and work

**3** Which measurement most directly compares resistance to a permanent indentation?

(1) Electrical current at fixed voltage

(2) Indentation size under a specified test load

(3) Water volume in a container

(4) The total number of samples

**4** Explain why the composition alone does not establish whether an alloy meets a conductivity requirement. [1]

Answer and work

**Choosing a Contact Material**

Use the information below to answer the questions.

A model compares pure copper and two copper alloys. A contact needs a hardness score of at least 60 and a relative conductivity of at least 75. Higher values are preferred within each property.

| Material | Zinc (% by mass) | Hardness score | Relative conductivity |
|---|---|---|---|
| P | 0 | 45 | 100 |
| Q | 5 | 68 | 85 |
| R | 15 | 82 | 67 |

**5** Which material meets both requirements?

(1) P only

(2) Q only

(3) R only

(4) Q and R

**6** Use the data to explain the tradeoff when changing from Q to R. [1]

Answer and work

**7** How many more conductivity units would R need to meet the stated minimum? [1]

Answer and work

**8** If the minimum hardness is reduced to 40 while conductivity must still be at least 75, which materials meet both limits?

(1) P and Q

(2) P and R

(3) Q and R

(4) All three