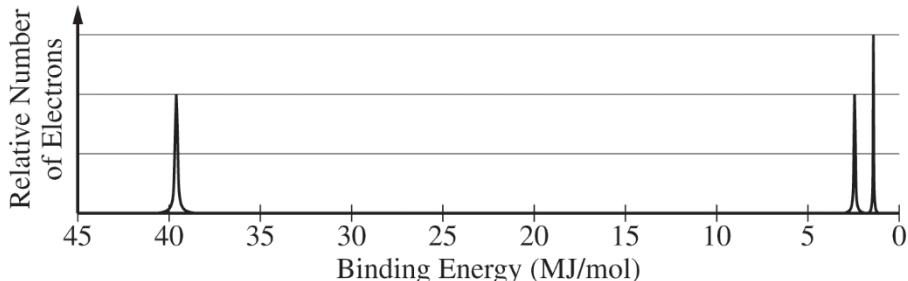


## 2018 AP<sup>®</sup> CHEMISTRY FREE-RESPONSE QUESTIONS



7. The complete photoelectron spectrum of an element is represented above.

- (a) Identify the element.

A radioactive isotope of the element decays with a half-life of 10. minutes.

- (b) Calculate the value of the rate constant,  $k$ , for the radioactive decay. Include units with your answer.

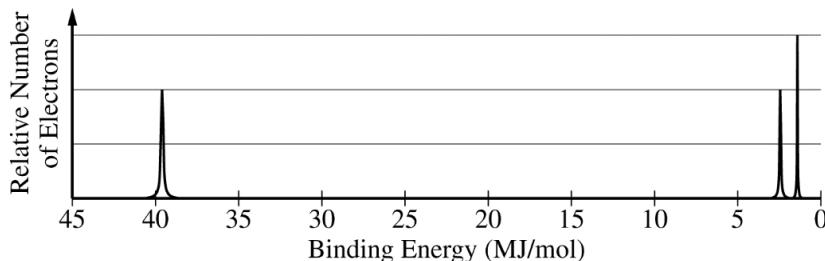
- (c) If 64 atoms of the radioactive isotope are originally present in a sample, what is the expected amount of time that will pass until only one atom of the isotope remains? Show how you arrived at your answer.

**STOP**

**END OF EXAM**

**AP<sup>®</sup> CHEMISTRY  
2018 SCORING GUIDELINES**

**Question 7**



The complete photoelectron spectrum of an element is represented above.

- (a) Identify the element.

The element is nitrogen, N.

1 point is earned for correctly identifying the element.

A radioactive isotope of the element decays with a half-life of 10. minutes.

- (b) Calculate the value of the rate constant,  $k$ , for the radioactive decay. Include units with your answer.

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{10. \text{ min}} = 0.069 \text{ min}^{-1}$$

1 point is earned for the correct numerical answer.

1 point is earned for the correct unit.

- (c) If 64 atoms of the radioactive isotope are originally present in a sample, what is the expected amount of time that will pass until only one atom of the isotope remains? Show how you arrived at your answer.

$$64 \rightarrow 32 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$$

6 half-lives are required.

$$6 \times 10. \text{ min} = 60. \text{ min}$$

**OR**

$$\ln[A]_t - \ln[A]_0 = -kt$$

$$t = \frac{\ln(1) - \ln(64)}{-0.069 \text{ min}^{-1}} = 60. \text{ min}$$

1 point is earned for the correct answer and a valid method.