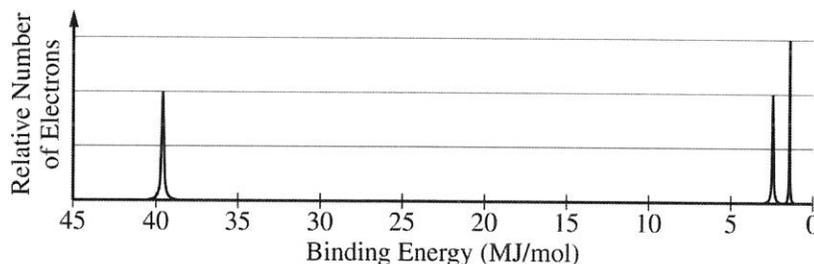


AP<sup>®</sup> CHEMISTRY  
2018 SCORING GUIDELINES

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.
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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.
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(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.

$64 \rightarrow 32 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$ <p style="text-align: center;">6 half-lives are required.  <math>6 \times 10. \text{ min} = 60. \text{ min}</math></p> <p style="text-align: center;"><b>OR</b></p> $\ln[A]_t - \ln[A]_0 = -kt$ $t = \frac{\ln(1) - \ln(64)}{-0.069 \text{ min}^{-1}} = 60. \text{ min}$	1 point is earned for the correct answer <u>and</u> a valid method.
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