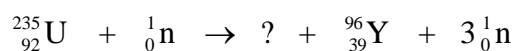


1. What is the decay product resulting from the emission of an alpha particle from  ${}^{210}_{85}\text{At}$  ?

- a)  ${}^{207}_{82}\text{Pb}$       b)  ${}^{210}_{86}\text{Rn}$       c)  ${}^{206}_{83}\text{Bi}$       d)  ${}^{206}_{81}\text{Tl}$       e)  ${}^{206}_{85}\text{At}$

2. Which nuclide is needed to balance the following nuclear reaction?



- a)  ${}^{139}_{53}\text{I}$       b)  ${}^{138}_{53}\text{I}$       c)  ${}^{137}_{53}\text{I}$       d)  ${}^{136}_{53}\text{I}$       e)  ${}^{135}_{53}\text{I}$

3. Only one of the following isotopes of strontium undergoes radioactive decay by  $\beta^-$  emission. Which one is it?

- a)  ${}^{83}_{38}\text{Sr}$       b)  ${}^{86}_{38}\text{Sr}$       c)  ${}^{87}_{38}\text{Sr}$       d)  ${}^{88}_{38}\text{Sr}$       e)  ${}^{90}_{38}\text{Sr}$

4. For which one of the following atoms or ions would the  $2s$  and  $2p$  orbitals have the same energy?

- a)  $\text{O}^{2-}$       b)  $\text{H}$       c)  $\text{He}$       d)  $\text{Li}^+$       e)  $\text{F}^{6+}$

5. Pure blue light has a wavelength of 470 nm. What frequency does this correspond to?

- a)  $6.4 \times 10^{14} \text{ s}^{-1}$   
b)  $2.2 \times 10^6 \text{ s}^{-1}$   
c)  $1.4 \times 10^2 \text{ s}^{-1}$   
d)  $4.2 \times 10^{-19} \text{ s}^{-1}$   
e)  $1.6 \times 10^{-15} \text{ s}^{-1}$

6. Which one of the following electron configurations is **not** valid?

- a)  $1s^2 2s^2 2p^2$
- b)  $1s^2 2s^2 2p^6 3s^2 3p^6$
- c)  $1s^2 2s^2 2p^6 3s^2 3p^2$
- d)  $1s^2 2s^2 2p^6 3s^2 3p^3$
- e)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^8$

7. What is the specific activity (in  $\text{Bq g}^{-1}$ ) of the nuclide  $^{90}_{35}\text{Br}$ , whose half-life is 1.6 seconds?

- a)  $2.9 \times 10^{21}$
- b)  $3.3 \times 10^{21}$
- c)  $3.6 \times 10^{21}$
- d)  $1.0 \times 10^{21}$
- e)  $2.6 \times 10^{23}$

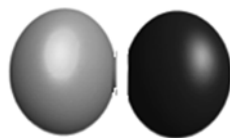
8. Which one of the following sets of quantum numbers is valid?

	$n$	$l$	$m_l$	$m_s$
a)	3	1	0	0
b)	1	1	0	$-\frac{1}{2}$
c)	3	3	-2	$+\frac{1}{2}$
d)	1	1	1	0
e)	5	4	3	$+\frac{1}{2}$

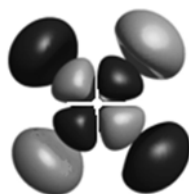
9. Which of the following lobe depictions of atomic orbitals is the best representation of a  $2s$  orbital?



a)



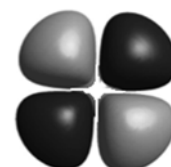
b)



c)



d)



e)

10. How many nodes does a  $5s$  atomic orbital have?

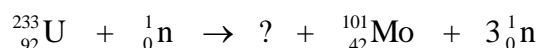
- a) 0 planar nodes and 0 spherical nodes
- b) 3 planar nodes and 2 spherical nodes
- c) 1 planar node and 1 spherical node
- d) 0 planar nodes and 4 spherical nodes
- e) 2 planar nodes and 3 spherical nodes

Correct answers: 1C, 2C, 3E, 4B, 5A, 6E, 7A, 8E, 9D, 10D

1. What is the decay product resulting from electron capture by the  $^{144}_{61}\text{Pm}$  nuclide?

- a)  $^{144}_{60}\text{Pm}$       b)  $^{144}_{62}\text{Pm}$       c)  $^{145}_{60}\text{Nd}$       d)  $^{144}_{60}\text{Nd}$       e)  $^{144}_{62}\text{Sm}$

2. Which nuclide is needed to balance the following nuclear reaction?



- a)  $^{132}_{50}\text{Sn}$       b)  $^{131}_{50}\text{Sn}$       c)  $^{130}_{50}\text{Sn}$       d)  $^{129}_{50}\text{Sn}$       e)  $^{128}_{50}\text{Sn}$

3. Only one of the following isotopes of gallium does not undergo radioactive decay via electron capture. Which one is it?

- a)  $^{69}_{31}\text{Ga}$       b)  $^{68}_{31}\text{Ga}$       c)  $^{67}_{31}\text{Ga}$       d)  $^{66}_{31}\text{Ga}$       e)  $^{65}_{31}\text{Ga}$

4. For which one of the following atoms or ions would the  $2s$  and  $2p$  orbitals have the same energy?

- a)  $\text{O}^{2-}$       b)  $\text{H}^-$       c)  $\text{He}$       d)  $\text{Be}^{2+}$       e)  $\text{N}^{6+}$

5. Pure green light has a frequency of  $5.66 \times 10^{14} \text{ s}^{-1}$ . What wavelength does this correspond to?

- a) 177 nm  
b) 530. nm  
c) 170 nm  
d) 0.375 nm  
e) 189 nm

6. Which one of the following electron configurations is **not** valid?

- a)  $1s^2 2s^2 2p^1 3s^1$
- b)  $1s^2 2s^2 2p^6 3s^2 3p^3$
- c)  $1s^2 2s^2 2p^6 3s^2 3p^8$
- d)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
- e)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

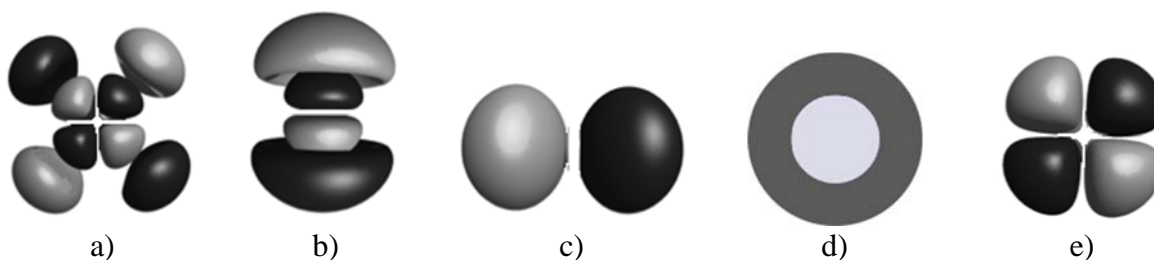
7. What is the specific activity (in  $\text{Bq g}^{-1}$ ) of the nuclide  $^{73}_{31}\text{Ga}$ , whose half-life is 4.8 hours?

- a)  $2.4 \times 10^{16}$
- b)  $2.5 \times 10^{16}$
- c)  $3.3 \times 10^{17}$
- d)  $5.9 \times 10^{16}$
- e)  $8.7 \times 10^{16}$

8. Which one of the following sets of quantum numbers is valid?

	$n$	$l$	$m_l$	$m_s$
a)	4	4	3	$+\frac{1}{2}$
b)	2	1	0	$-\frac{1}{2}$
c)	3	2	-2	+1
d)	1	1	1	0
e)	3	1	0	0

9. Which of the following lobe depictions of atomic orbitals is the best representation of a  $4d$  orbital?



10. How many nodes does a  $2p$  atomic orbital have?

- a) 0 planar nodes and 0 spherical nodes
- b) 0 planar nodes and 1 spherical nodes
- c) 1 planar nodes and 0 spherical nodes
- d) 1 planar node and 1 spherical node
- e) 2 planar nodes and 2 spherical nodes

Correct answers: 1D, 2C, 3A, 4E, 5B, 6C, 7C, 8B, 9A, 10C