1. When an element \( ^A_Z E \) absorbs a \( \beta^- \) particles it becomes:
   A. \( ^{A}_{Z+1} E \)
   B. \( ^{A}_{Z-1} E \)
   C. \( ^{A+1}_{Z+1} E \)
   D. \( ^{A-1}_{Z-1} E \)

2. The number of neutrons in a nucleus can be changed by:
   A. electron capture
   B. emission of \( \gamma \)-rays
   C. chemical reaction
   D. X-ray absorption

3. What is the mass number of an alpha particle?
   A. 3
   B. 2
   C. 4
   D. 0

4. Nuclei above the belt of stability can lower their neutron-to-proton ratio by:
   A. beta emission
   B. gamma emission
   C. positron emission
   D. electron capture

5. \(^{83}\)B will decay through:
   A. beta emission
   B. alpha emission
   C. \( \gamma \)-decay
   D. positron emission

6. How many neutrons are being generated by bombardment of \(^{238}\)U with a deuteron \(^2\)H with neptunium-237 as a product?
   A. 1
   B. 2
   C. 3
   D. 4

7. The beta decay of cesium-137 has a half-life of 30 years. How many years must pass to reduce 25 mg of cesium-137 to 8.7 mg?
   A. 32
   B. 46
   C. 50
   D. 3.2
8. The mass of a proton is 1.00728 amu and that of a neutron is 1.00867 amu. What is the binding energy (in MeV) of a $^{60}_{27}$Co nucleus? The mass of a cobalt-60 nucleus is 59.9338 amu (1 amu=931.5 MeV)
   A. 360  
   B. 514  
   C. 980  
   D. 129 

9. What type of reaction occurs by combining light nuclei to form heavier nuclei?
   A. fission  
   B. fusion  
   C. transmutation  
   D. neutron emission

10. What is the respective central-metal oxidation state, coordination number, and the overall charge of the complex ion in Na$_2$[Cr(NH$_3$)$_2$(NCS)$_4$]?  
   A. +3, 6, -1  
   B. +3, 6, +1  
   C. +2, 6, -2  
   D. +2, 4, -1

11. Which of the following species is paramagnetic?  
   A. Zn$^{2+}$  
   B. Cr$^{3+}$  
   C. Ca  
   D. Na$^+$

12. What is the oxidation state of iron in CaNa[Fe(CN)$_6$]?  
   A. 2  
   B. 8  
   C. 4  
   D. 3

13. What is the coordination number of chromium in [Cr(H$_2$O)$_4$Cl$_2$]$^+$?  
   A. 8  
   B. 6  
   C. 4  
   D. 12

14. The formula for sodium hexafluorocobaltate(III) is:  
   A. Na$_3$[CoF$_6$]  
   B. Na[CoF$_6$]  
   C. Na[CoF]  
   D. Na$_2$[CoF$_6$]

15. How many donor atoms does the ethylenediamine (en) molecule have?  
   A. 1  
   B. 4  
   C. 6  
   D. 2

16. Which of the following will display optical isomerism (H$_2$NC$_2$H$_4$NH$_2$=en)?  
   A. square-planar Rh(CO)$_2$Cl$_2^-$  
   B. octahedral Co(H$_2$NC$_2$H$_4$NH$_2$)$_3^{3+}$
17. How many isomers exist for the octahedral complex ion \([\text{Co(NH}_3\text{)}_4\text{F}_2]^{2+}\)?
   A. 3
   B. 2
   C. 1
   D. 4

18. On the sketch below three absorption spectra of octahedral Ti complex ions are shown: \([\text{TiX}_6]^{3-}\), \([\text{TiY}_6]^{3-}\), \([\text{TiZ}_6]^{3-}\). Place X, Y, and Z ligands in the order of increasing \(\Delta\).
   A. X < Y < Z
   B. Z < Y < X
   C. Y < Z < X
   D. Z < X < Y

19. Based on electronic configuration, which is most likely colorless?
   A. \([\text{Cu(NH}_3\text{)}_4]^{2+}\)
   B. \([\text{Cd(NH}_3\text{)}_4]^{2+}\)
   C. \([\text{Ni(NH}_3\text{)}_6]^{2+}\)
   D. \([\text{Co(NH}_3\text{)}_6]^{2+}\)

20. Which of the following complex ions will be paramagnetic? (low spin)
   A. \([\text{Fe(H}_2\text{O)}_6]^{2+}\)
   B. \([\text{Fe(H}_2\text{O)}_6]^{3+}\)
   C. \([\text{Co(H}_2\text{O)}_6]^{3+}\)
   D. \([\text{Zn(NH}_3\text{)}_4]^{2+}\)

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**Summer 2003**

**CHEMISTRY 115**

**EXAM 4(B)**

1. When an element \(^A\text{Z}_E\) absorbs a \(\beta^-\) particle it becomes:
   A. \(^A\text{Z}_1\text{E}\)
   E. \(^A\text{Z}_{1}\text{E}\)
   F. \(^{A-1}\text{Z}_1\text{E}\)
   G. \(^{A+1}\text{Z}_1\text{E}\)

2. The number of neutrons in a nucleus can be changed by
   E. emission of \(\gamma\)-rays
   F. electron capture
3. What is the mass number of an alpha particle?
   E. 0
   F. 4
   G. 2
   H. 3

4. Nuclei above the belt of stability can lower their neutron-to-proton ratio by:
   E. gamma emission
   F. beta emission
   G. electron capture
   H. positron emission

5. $^8_3\text{B}$ will decay through:
   E. positron emission
   F. alpha emission
   G. $\gamma$-decay
   H. beta emission

6. How many neutrons are being generated by bombardment of $^{238}\text{U}$ with a deuteron ($^2\text{H}$) with neptunium-237 as a product?
   E. 2
   F. 3
   G. 1
   H. 4

7. The beta decay of cesium-137 has a half-life of 30 years. How many years must pass to reduce 25 mg of cesium-137 to 8.7 mg?
   E. 46
   F. 32
   G. 3.2
   H. 50

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   A. 514
   B. 360
   C. 129
   D. 980

9. What type of reaction occurs by combining light nuclei to form heavier nuclei?
   E. fission
   F. transmutation
   G. fusion
   H. neutron emission

10. What is the respective central-metal oxidation state, coordination number, and the overall charge of the complex ion in $\text{Na}_2[\text{Cr}(\text{NH}_3)_2(\text{NCS})_4]$?
    E. +3, 6, +1
    F. +3, 6, -1
    G. +2, 6, -2
11. Which of the following species is paramagnetic?
   A. Ca
   E. Zn$^{2+}$
   F. Cr$^{3+}$
   G. Na$^+$

12. What is the oxidation state of iron in CaNa[Fe(CN)$_6$]?
   E. 3
   F. 8
   G. 4
   H. 2

13. What is the coordination number of chromium in [Cr(H$_2$O)$_4$Cl$_2$]$^+$?
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14. The formula for sodium hexafluorocobaltate(III) is:
   A. Na$_2$[CoF$_6$]
   E. Na[CoF]
   F. Na[CoF$_6$]
   G. Na$_3$[CoF$_6$]

15. How many donor atoms does the ethylenediamine (en) molecule have?
   E. 2
   F. 6
   G. 4
   H. 1

16. Which of the following will display optical isomerism (H$_2$NC$_2$H$_4$NH$_2$=en)?
   E. octahedral Co(H$_2$NC$_2$H$_4$NH$_2$)$_3^{3+}$
   F. square-planar Rh(CO)$_2$Cl$_2^-$
   G. octahedral Co(NH$_3$)$_6^{3+}$
   H. octahedral Co(NH$_3$)$_5$Cl$_2^{2+}$

17. How many isomers exist for the octahedral complex ion [Co(NH$_3$)$_4$F$_2$]$^+$?
   E. 1
   F. 4
   G. 3
   H. 2

   E. Z < Y < X
   F. X < Y < Z
   G. Z < X < Y
   H. Y < Z < X
19. Based on electronic configuration, which is most likely colorless?
   E. $[\text{Cd(NH}_3\text{)}_4]^{2+}$
   F. $[\text{Cu(NH}_3\text{)}_4]^{2+}$
   G. $[\text{Co(NH}_3\text{)}_6]^{2+}$
   H. $[\text{Ni(NH}_3\text{)}_6]^{2+}$

20. Which of the following complex ions will be **paramagnetic**?
   A. $[\text{Fe(H}_2\text{O)}_6]^{3+}$ (low spin)
   B. $[\text{Fe(H}_2\text{O)}_6]^{2+}$ (low spin)
   E. $[\text{Zn(NH}_3\text{)}_4]^{2+}$
   F. $[\text{Co(H}_2\text{O)}_6]^{3+}$ (low spin)