AST1004 Summer 2018 Exam 1 Review Questions

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Abstract

This is a set of review questions for the upcoming midterm exam on **June 21, 2018**. These questions are on the material covered from chapters 1 – 5, 16, and some of 17. The questions that are in this review are very similar in style and difficulty to those that will be on the actual midterm. It will not be important to memorize "numbers" for the exam (the mass of the Earth, for example), but to know important definitions and to understand *why* things happen.

1. Quantum mechanics is the study of:

   (a) Things that are large
   (b) Things that are small
   (c) Things that are fast
   (d) Things with a large mass

2. General Relativity is the study of:

   (a) Things that are large
   (b) Things that are small
   (c) Things that are fast
   (d) Things with a large mass

3. Protons and neutrons are built from which elementary particles?

   (a) Leptons
   (b) Quarks
   (c) Photons
   (d) Bosons

4. A photon is:

   (a) The quantum mechanical description of light
   (b) The classical description of light
   (c) The quantum mechanical description of heat
   (d) The classical description of heat

5. The energy of a photon depends upon:
   (a) The speed of the photon
   (b) The mass of the photon
   (c) The frequency of the photon
   (d) None of the above

6. Uranium-238, ${}^{238}_{92}\text{U}$, decays via α emission. What would the daughter nucleus of this α decay be?
   (a) ${}^{238}_{93}\text{Np}$
   (b) ${}^{238}_{91}\text{Pa}$
   (c) ${}^{234}_{90}\text{Th}$
   (d) ${}^{242}_{94}\text{Pu}$

7. Consider four particles, A, B, C, and D, each with a respective mass of $m_A = 15$ GeV, $m_B = 14$ GeV, $m_C = 1$ GeV, and $m_D = 0.5$ GeV. Given these masses, which of the following particle processes would be energetically favorable? *Note: 1 GeV is 1 billion eV.*
   (a) $A \rightarrow B + C + D$
   (b) $A + C \rightarrow B + D$
   (c) $B + C \rightarrow A + D$
   (d) $C + D \rightarrow A + B$

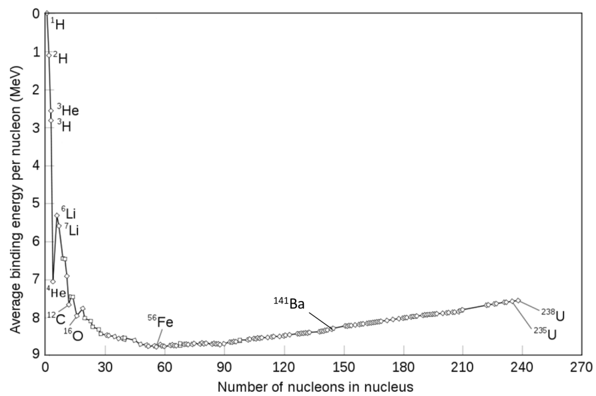
8. Which of the following particle processes *cannot* occur because it violates charge conservation?
   (a) $\pi^+ \rightarrow \mu^+ + \nu_\mu$
   (b) $\Sigma^+ \rightarrow \pi^0 + p^+$
   (c) $n + e^- \rightarrow p^+$
   (d) $p^+ + e^- \rightarrow n$

9. As the temperature of a blackbody rises,
   (a) It becomes bluer and dimmer
   (b) It becomes bluer and brighter
   (c) It becomes redder and dimmer
   (d) It becomes redder and brighter

10. The emission of blackbodies is:
    (a) Only in the visible part of the spectrum
    (b) Discrete, so that only light of specific frequencies are emitted
    (c) Continuous across the entire spectrum
    (d) It depends on the temperature of the blackbody

11. The combining of two light nuclei to form a heavy nucleus is called:

    (a) Alpha decay
    (b) Beta decay
    (c) Fission
    (d) Fusion



12. Referencing the figure above, Uranium-235 can undergo which of the following nuclear reactions?

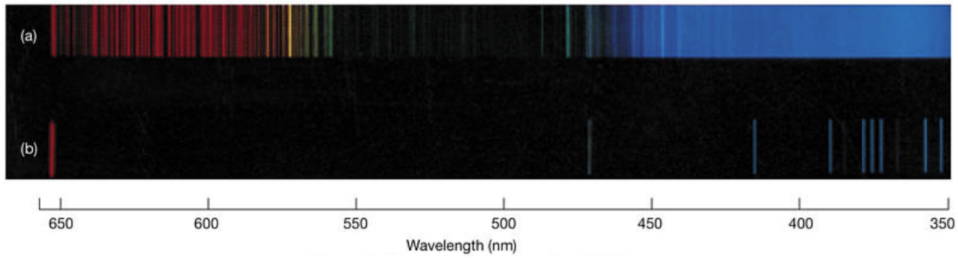
    (a) Fusion into Ba-141
    (b) Fission into Ba-141
    (c) Fusion into U-238
    (d) Fission into U-238

13. In a simple gas, like atomic hydrogen, the emission spectrum of the gas is produced by:

    (a) Electrons jumping from a low orbital to a high orbital
    (b) Electrons dropping from a high orbital to a low orbital
    (c) The atom reducing its vibrational energy
    (d) The atom reducing its rotational energy

14. An electron in hydrogen moves from an orbital with an energy of -13.6 eV to an orbital with an energy of -3.4 eV. Which of the following is true?

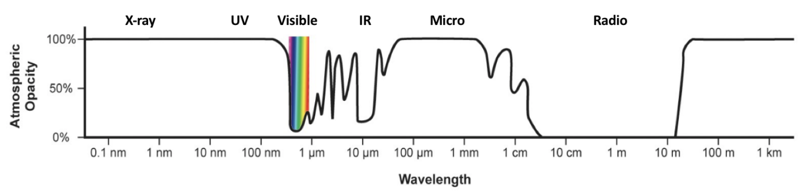
    (a) A photon must be absorbed with an energy of 10.2 eV
    (b) A photon must be absorbed with an energy of 13.6 eV
    (c) A photon must be emitted with an energy of 10.2 eV
    (d) A photon must be emitted with an energy of 13.6 eV



15. The above figure shows the emission spectra of two different chemical elements. If each emission spectrum is produced by only a *single* chemical element, which of the following is probably true?
    (a) Figure (a) is the emission of a molecule while figure (b) is the emission of an atom
    (b) Figure (a) is the emission of an atom while figure (b) is the emission of a molecule
    (c) They're both emissions from atoms
    (d) It's impossible to make any sort of educated guess
16. Spectroscopy is the study of:
    (a) The spectrum of light
    (b) The polarization of light
    (c) Un-altered light
    (d) Gravitational waves
17. A CCD chip in the camera of a telescope can determine the color of light on its own.
    (a) True
    (b) Flase
18. Which spectral lines are emitted by a gas depends upon:
    (a) Temperature
    (b) Line-of-sight speed
    (c) Rotational motion
    (d) Chemical composition
19. The brightness of light emitted by a gas depends upon:
    (a) Temperature
    (b) Line-of-sight speed
    (c) Rotational motion
    (d) Chemical composition

20. Broadening of the spectral lines emitted by a gas depends upon:
    (a) Temperature
    (b) Line-of-sight speed
    (c) Rotational motion
    (d) Chemical composition

21. The star Vega is significantly hotter than the Sun (about 1.5 times the temperature). What color should we expect Vega to be?
    (a) Red
    (b) Yellow
    (c) White
    (d) Blue



22. An Earth-bound telescope can make observations in which portions of the electromagnetic spectrum? Above I've included the absorption spectrum of the Earth's atmosphere.
    (a) X-ray, UV, and microwave
    (b) Visible and IR
    (c) Visible, IR, and radiowave
    (d) The entire electromagnetic spectrum

23. Which type of telescope must physically be the largest?
    (a) A γ-ray telescope
    (b) An X-ray telescope
    (c) An optical telescope
    (d) A radio telescope

24. The majority of telescopes I've used in research have had a mirror with a diameter of 1m. Last year, I was able to use a telescope that had a mirror with a diameter of 10m. How much more powerful is this telescope than my usual 1m telescopes?
    (a) It has the same resolving power
    (b) It has $\sqrt{10}$ times the resolving power
    (c) It has 10 times the resolving power
    (d) It has 100 times the resolving power

25. Rank the order of the zones of the Sun, from inner-most to outer-most.

    (a) Core, convection zone, radiation zone, atmosphere
    (b) Radiation zone, core, convection zone, atmosphere
    (c) Core, radiation zone, convection zone, atmosphere
    (d) Core, radiation zone, atmosphere, convection zone

26. The light we see from the Sun comes from which region?

    (a) The core
    (b) The radiation zone
    (c) The convection zone
    (d) The photosphere

27. As compared to the atmosphere, in the radiation zone:

    (a) The temperature is higher and the light is bluer
    (b) The temperature is lower and the light is bluer
    (c) The temperature is higher and the light is redder
    (d) The temperature is lower and the light is redder

28. The Sun is mainly composed of:

    (a) Hydrogen
    (b) Helium
    (c) Carbon/Oxygen
    (d) Iron

29. Every characteristic about a star is controlled by:

    (a) The star's temperature
    (b) The star's mass
    (c) The star's radius
    (d) The star's class

30. Large mass stars, as compared to low mass stars, will:

    (a) Live fast and die gently
    (b) Live fast and die violently
    (c) Live slowly and die gently
    (d) Live slowly and die violently

31. After a star's core has run out of hydrogen, what must happen in order for the star to be able to burn the helium ash left in the core? *Assume the star is close to the mass of the Sun.*

    (a) The star must expand to great size, but the core can remain unchanged
    (b) The star must expand to great size along with the core
    (c) The star must expand to great size while the core must compress to very small size
    (d) The star remains unchanged and is able to burn helium right away.

32. A main-sequence star reaches equilibrium when:

    (a) Inward thermal pressure balances outward gravitational pressure
    (b) Inward gravitational pressure balances outward thermal pressure
    (c) Inward gravitational pressure balances outward radiation pressure
    (d) Inward radiation pressure balances outward fusion pressure

33. To determine the motion of a star relative to us, we need to measure:

    (a) Translational speed with the Doppler effect and line-of-sight speed with parallax
    (b) Both translation and line-of-sight speed with the Doppler effect
    (c) Translational speed with parallax and line-of-sight speed with the Doppler effect
    (d) Both translational and line-of-sight speed with the Doppler effect

34. The best way to determine the temperature of a star is by:

    (a) Looking at the wavelength of the peak, which depends on temperature
    (b) Classifying the star by spectrum
    (c) Using the Doppler effect by looking for line-shifts in its emission spectrum
    (d) Using the Stefan-Boltzmann law to relate the overall brightness of the star to its temperature.

35. As the temperature of a star increases:

    (a) Its radius and luminosity both increase
    (b) Its radius increases but its luminosity decreases
    (c) Its radius decreases but its luminosity increases
    (d) Both its radius and luminosity decrease

36. A star will eventually become:

    (a) A white dwarf
    (b) A neutron star
    (c) A black hole
    (d) A star could become any of these

37. As a star runs out of hydrogen at its core and becomes a red giant, it should move from the main sequence:

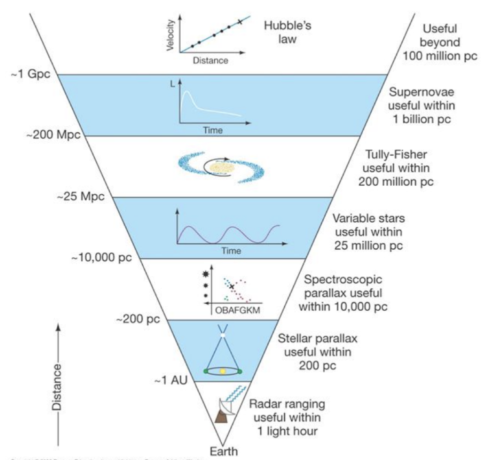
(a) Up and to the right on an HR diagram
(b) Up and to the left on an HR diagram
(c) Down and to the right on an HR diagram
(d) Down and to the left on and HR diagram

38. As compared to main-sequence stars, white dwarfs are typically:

(a) Hotter and brighter
(b) Hotter and dimmer
(c) Colder and brighter
(d) Colder and dimmer

39. Typically, with hotter stars, the spectra your are likely to see will have

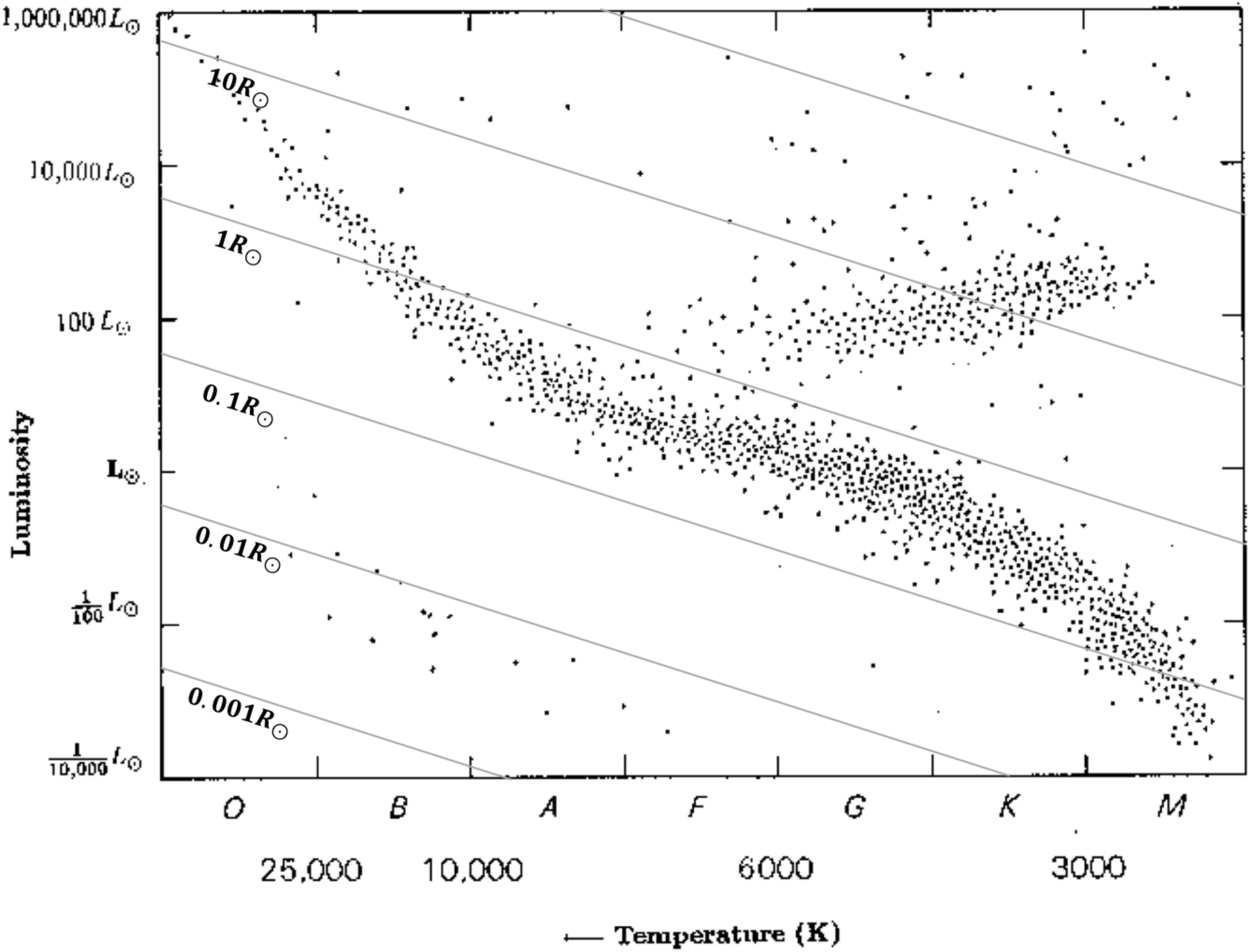
(a) More atomic lines than molecular lines
(b) More molecular lines than atomic lines
(c) Roughly equal molecular and atomic lines
(d) It depends on the star



40. You want to measure the distance to a nearby galaxy by measuring the distance to a star within that galaxy. Which method from the cosmic distance ladder above should you use? *Note: The distance to Andromeda, a nearby galaxy, is about 800,000 pc.*

(a) Spectroscopic parallax
(b) Variable stars
(c) Supernovae
(d) Hubble's law

Hertzsprung-Russell Diagram for Stars in the Solar Neighborhood



PERIODIC TABLE OF THE ELEMENTS

Proton Number → 1
Symbol → H
1.008 ← Atomic Mass
Hydrogen ← Name

1 H 1.008 Hydrogen																	2 He 4.002602 Helium
3 Li 6.94 Lithium	4 Be 9.0121831 Beryllium											5 B 10.81 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998403163 Fluorine	10 Ne 20.1797 Neon
11 Na 22.98976928 Sodium	12 Mg 24.305 Magnesium											13 Al 26.9815385 Aluminium	14 Si 28.085 Silicon	15 P 30.973761998 Phosphorus	16 S 32.06 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.948 Argon
19 K 39.0983 Potassium	20 Ca 40.078 Calcium	21 Sc 44.955908 Scandium	22 Ti 47.867 Titanium	23 V 50.9415 Vanadium	24 Cr 51.9961 Chromium	25 Mn 54.938044 Manganese	26 Fe 55.845 Iron	27 Co 58.933194 Cobalt	28 Ni 58.6934 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.630 Germanium	33 As 74.921595 Arsenic	34 Se 78.971 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
37 Rb 85.4678 Rubidium	38 Sr 87.62 Strontium	39 Y 88.90584 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.90637 Niobium	42 Mo 95.95 Molybdenum	43 Tc 98 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.90550 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.8682 Silver	48 Cd 112.414 Cadmium	49 In 114.818 Indium	50 Sn 118.710 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.90447 Iodine	54 Xe 131.293 Xenon
55 Cs 132.90545196 Caesium	56 Ba 137.327 Barium	57/71	72 Hf 178.49 Hafnium	73 Ta 180.94788 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.084 Platinum	79 Au 196.966569 Gold	80 Hg 200.592 Mercury	81 Tl 204.38 Thallium	82 Pb 207.2 Lead	83 Bi 208.98040 Bismuth	84 Po 209 Polonium	85 At 210 Astatine	86 Rn 222 Radon
87 Fr 223 Francium	88 Ra 226 Radium	89/103	104 Rf 267 Rutherfordium	105 Db 268 Dubnium	106 Sg 269 Seaborgium	107 Bh 270 Bohrium	108 Hs 269 Hassium	109 Mt 278 Meitnerium	110 Ds 281 Darmstadtium	111 Rg 281 Roentgenium	112 Cn 285 Copernicium	113 Uut 286 Ununtrium	114 Fl 289 Flerovium	115 Uup 289 Ununpentium	116 Lv 293 Livermorium	117 Uus 294 Ununseptium	118 Uuo 294 Ununoctium

Lanthanide Series	57 La 138.90547 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.90766 Praseodymium	60 Nd 144.242 Neodymium	61 Pm 145 Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.92535 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.93033 Holmium	68 Er 167.259 Erbium	69 Tm 168.93422 Thulium	70 Yb 173.054 Ytterbium	71 Lu 174.9668 Lutetium
Actinide Series	89 Ac 227 Actinium	90 Th 232.0377 Thorium	91 Pa 231.03588 Protactinium	92 U 238.02891 Uranium	93 Np 237 Neptunium	94 Pu 244 Plutonium	95 Am 243 Americium	96 Cm 247 Curium	97 Bk 247 Berkelium	98 Cf 251 Californium	99 Es 252 Einsteinium	100 Fm 257 Fermium	101 Md 258 Mendelevium	102 No 259 Nobelium	103 Lr 266 Lawrencium