Jerusalem Science Contest 2008-2009 -חידון המדע הירושלמי תשס"ח
Electromagnetic and Ionizing radiation
Exam 10 — Chapter 33 -The Atomic Nucleus and Radioactivity

Name:_____ **Date:**_____

Raw Score:_____ **Percentage Score:**_____%

Proctor for this Examinaton:_____ **Form:**_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Beyond the atomic number of what element are there no longer any stable isotopes?
A) lead B) bismuth C) thallium D) gold E) mercury

2) Which of the following represents the non–radioactive end product of the decay of uranium–238?
A) thallium–206
B) bismuth–210
C) lead–206
D) bismuth–214
E) lead–210

3) When a beta particle is emitted from a radionuclide
A) a strange quark changes to a charm quark
B) a bottom quark changes to a top quark
C) a down quark changes to an up quark
D) a top quark changes to a bottom quark
E) an up quark changes to a down quark

4) The number of neutrons in $^{235}_{92}\mathrm{U}$ is
A) 235.
B) 327.
C) 143.
D) 92.
E) none of the preceding.

5) What amount of radiation would be lethal to half of a population (LD_{50}) that received it as an acute (short–term) exposure?
A) 500rem B) 50 rems C) 25 rems D) 250 rems E) 100 rems

6) $^{234}_{90}\mathrm{Th} \rightarrow {}^{234}_{91}\mathrm{Pa} + \ ?$
In the above equation the particle being emitted is the
A) neutron B) positron C) alpha D) beta E) proton

7) The conversion of one element to another by radioactive decay is referred to as
   A) transmutation.
   B) nuclear fission.
   C) spallation.
   D) atomic emission.
   E) none of the preceding.

8) The force moderating radioactive decay is
   A) the electromagnetic force.
   B) the strong force.
   C) the gravitational force.
   D) the weak force.
   E) all of the preceding affect radioactive decay

9) Which of the following is <u>not</u> a form of nuclear radiation?
   A) gamma
   B) positron
   C) beta
   D) alpha
   E) none of the preceding (i.e. all are forms of nuclear radiation).

10) Over an entire lifetime, the average person will receive a cumulative radiation exposure of less than 20 rems. Most of this comes from.
   A) natural background (e.g. cosmic radiation).
   B) fallout from nuclear weapons testing.
   C) nuclear power plants.
   D) consumer products (e.g. smoke detectors containing americium –241).
   E) medicine and diagnostic procedures (e.g. X–rays).

11) The strong force that acts on hadrons is only significant at distances of about
   A) 10^{-9} m.
   B) 10^{-15} m.
   C) 10^{-12} m.
   D) 10^{-6} m.
   E) none of thepreceding.

12) The only person to have ever been awarded a Nobel prize in both chemistry and physics was
   A) Henri Becquerel.
   B) Lise Meitner.
   C) Marie Curie.
   D) Hans Geiger.
   E) Wilhelm Roentgen.

13) The individual who, while searching for materials that emitted X–rays, found that a fluorescent uranium compound produced rays that could cloud a photographic plate was
   A) Wilhelm Roentgen
   B) Henri Becquerel.
   C) Hans Geiger
   D) Pierre Curie.
   E) none of the preceding.

14) The earliest type of radiation detector was the
A) bubble chamber.
B) electroscope.
C) Geiger counter.
D) scintillation counter.
E) cloud chamber.

15) X–rays arise when
A) a beta particle and a positron collide.
B) an inner shell electron is ejected by a more energetic electron and an outer shell electron falls into its orbit.
C) an outer shell electron is excited by a gamma photon.
D) certain radioisotopes decay.
E) none of the preceding

16) In isotopic notation , ${}^{A}_{Z}\mathrm{X}$, the letter 'Z' represents
A) the number of neutrons in the atom.
B) the number of protons, neutrons and electrons in an atom.
C) the number of protons and electrons in the atom.
D) the number of protons in the atom.
E) none of the preceding.

17) Sodium–22 ($^{22}_{11}\mathrm{Na}$) decays to neon–22 ($^{22}_{10}\mathrm{Ne}$) emitting a gamma photon and what two particles?
A) beta and positron
B) positron and neutrino
C) positron and antineutrino
D) alpha and beta
E) beta and neutrino

18) In 1919 Ernest Rutherford succeeded in converting nitrogen–14 to oxygen–17, by bombarding the former with alpha particles, according to the following equation:

$$^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{17}_{8}\mathrm{O} + \ ?$$

What is the missing quantity?

A) $^{1}_{0}\mathrm{n}$
B) $^{0}_{-1}\mathrm{e}$
C) $^{1}_{1}\mathrm{H}$
D) $^{0}_{1}\mathrm{e}$
E) none of the preceding

19) U–234, U–235 and U–238 are _____ of the element uranium

A) diastereomers
B) isomers
C) none of the preceding
D) allotropes
E) nuclides

20) Which of the following is the most penetrating?

A) beta particle
B) neutrino
C) positron.
D) gamma radiation
E) alpha particle

21) Which of the following has the highest specific ionization?

A) beta B) gamma C) alpha D) neutron E) proton

22) Which of the following can alter the decay rate of a radioisotope?

A) pressures > 10^6 atmospheres
B) high intensity electromagnetic radiation
C) temperatures > 10,000 K
D) chemical reactions
E) none of the preceding

23) A tritium traser was demonstrated during the lecture. Tritium has a half–life of about 12.25 years. If there was initially 1.0 microcuries (1.0 μCi) sealed in the traser, about how much will remain a century from now?

A) 0.004 μCi
B) 0.010 μCi
C) none will remain
D) 0.100 μCi
E) 0.025 μCi

24) Carbon–14 is used in radiometric dating of

A) things that had been alive up to about 50,000 years ago
B) things that had been alive millions of years ago (fossils)
C) ancient metal artifacts
D) rocks
E) all of the preceding

25) Radium was once used to illuminate ZnS–painted watch dials ,but was replaced by another element in the 1960s. This element is the only rare earth (lanthanide) metal that has no stable isotopes. What is it?

A) thulium
B) praseodymium
C) cerium
D) promethium
E) europium