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

2) 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) Henri Becquerel.
   B) Wilhelm Roentgen
   C) Hans Geiger
   D) Pierre Curie.
   E) none of the preceding.

3) Which of the following can alter the decay rate of a radioisotope?
   A) temperatures > 10,000 K
   B) pressures > 10^6 atmospheres
   C) high intensity electromagnetic radiation
   D) chemical reactions
   E) none of the preceding

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

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

6) 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) ${}^{1}_{1}\mathrm{H}$
   B) ${}^{0}_{1}\mathrm{e}$
   C) ${}^{0}_{-1}\mathrm{e}$
   D) ${}^{1}_{0}\mathrm{n}$
   E) none of the preceding

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

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

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

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

11) Sodium–22 ($^{22}_{11}Na$) decays to neon–22 ($^{22}_{10}Ne$) emitting a gamma photon and what two particles?

A) beta and neutrino
B) beta and positron
C) positron and neutrino
D) positron and antineutrino
E) alpha and beta

12) The force moderating radioactive decay is

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

13) Which of the following represents the non–radioactive end product of the decay of uranium–238?

A) lead–206
B) bismuth–210
C) lead–210
D) bismuth–214
E) thallium–206

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

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

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

16) The strong force that acts on hadrons is only significant at distances of about

A) 10^{-9} m.
B) 10^{-12} m.
C) 10^{-15} m.
D) 10^{-6} m.
E) none of thepreceding.

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

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

18) 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) an up quark changes to a down quark
E) a top quark changes to a bottom quark

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

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

21) $^{234}_{90}\mathrm{Th} \rightarrow {}^{234}_{91}\mathrm{Pa} + \ ?$
In the above equation the particle being emitted is the
A) proton B) positron C) beta D) alpha E) neutron

22) Which of the following is the most penetrating?
A) neutrino
B) alpha particle
C) beta particle
D) gamma radiation
E) positron.

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

24) Carbon–14 is used in radiometric dating of
A) things that had been alive millions of years ago (fossils)
B) ancient metal artifacts
C) things that had been alive up to about 50,000 years ago
D) rocks
E) all of the preceding

25) 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) 0.100 μCi
B) 0.004 μCi
C) 0.025 μCi
D) 0.010 μCi
E) none will remain