WKS - Honors
Sources, Measurement & Effects of Radiation

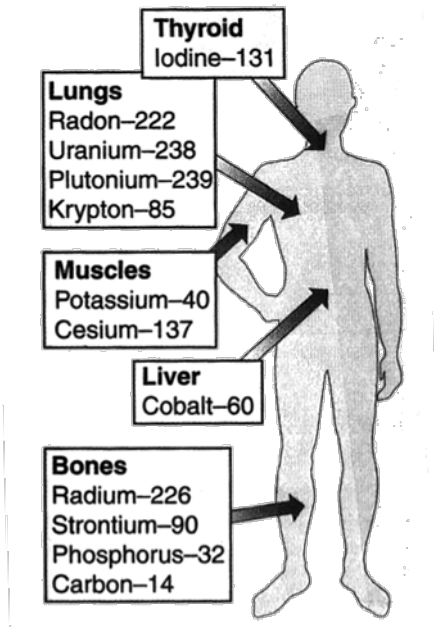
Name Answer Key
Period _____ Date _____

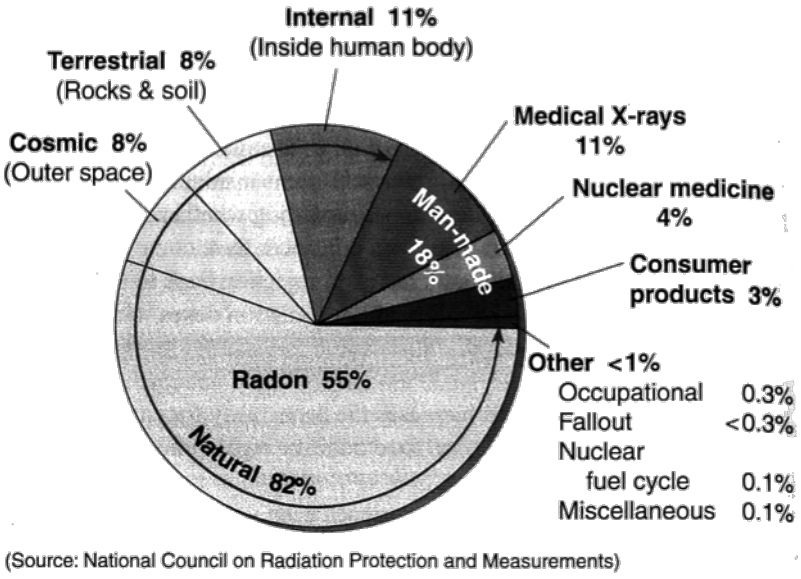
Read pp. 713-715 in the textbook.

1) Fill in the following chart to determine your annual exposure to radiation:

Factors	Common sources of radiation	Your annual dose (mrems)
Where you live	**Cosmic radiation** (from outer space) Exposure depends on your elevation. Amounts are in millirems per year. At sea level .....26 mrem 0–1000 ft .....28 1000–2000 .....31 2000–3000 ..... 35 3000–4000 .....41 4000–5000 ft .....47 mrem 5000–6000 ....52 6000–7000 .....66 7000–8000 .....79 8000–9000 96	28 mrem
	Terrestrial (from the ground) If you live in a state that borders the Gulf or Atlantic coasts, add 16 mrem. If you live in the Colorado Plateau (around Denver), add 63 mrem. If you live anywhere else in the continental United States, add 30 mrem.	15 mrem
	House construction If you live in a stone, adobe, brick or concrete building, add 7 mrem.	_____ mrem
	Power plants If you live within 50 miles of a nuclear power plant, add 0.009 mrem. If you live within 50 miles of a coal-fired power plant, add 0.03 mrem. Staten Island & Jersey City	0.03 mrem
Food, Water, Air	**Internal radiation** (based on average values) From food (Carbon-14 and Potassium-40) and from water (radon dissolved in water)	40 mrem
	From air (radon)	200 mrem
How you live	Weapons test fallout (less than 1) 1 mrem Travel by jet plane 0.5 mrem per hour in the air If you have porcelain crowns or false teeth 0.07 mrem If you wear a luminous wristwatch 0.06 mrem If you go through security inspection at airport (each time) 0.002 mrem If you watch TV (only if tube — not flat screen) 1 mrem If you use a video display (computer screen) 1 mrem If you have a smoke detector 0.008 mrem If you use a gas camping lantern 0.2 mrem If you wear a plutonium-powered pacemaker 100 mrem	1 mrem _____ mrem 0.14 mrem _____ mrem _____ mrem _____ mrem _____ mrem 0.006 mrem _____ mrem _____ mrem
Medical Tests	**Medical diagnostic tests** *Number of millirems per procedure* X-Rays: Extremity (arm, hand, foot, or leg) .....1 Dental .....1 Chest .....6 Pelvis/hip .....65 Skull/neck .....20 Barium enema .....405 Upper GI .....245 CAT Scan (head and body) .....110 Nuclear Medicine (e.g., thyroid scan) 14	4 mrem
	Your Estimated Annual Radiation Dose	289.176 mrem

2) In contrast, the workers at the Chernobyl accident received dosages of 1,600,000 mrem. What factor of your yearly exposure is this?
1,600,000/289.176 = 5500



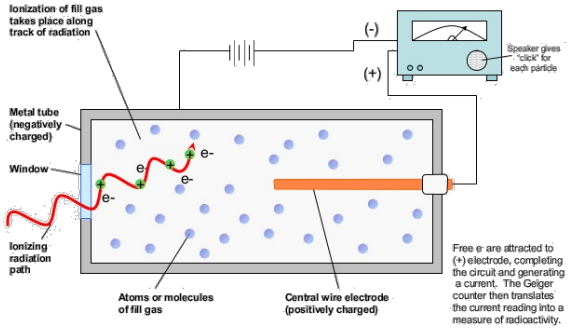


(Source: National Council on Radiation Protection and Measurements)

3) What are some sources of radiation found in living tissues? What percentage of radiation in the typical yearly exposure is from artificial sources?
See chart above. Typically only about 18% of radiation exposure is from artificial sources.

4) Why is radiation harmful to humans?
Because it can ionize (remove electrons from) atoms, it can cause cell damage and death: somatic damage such as cancer in non-reproductive cells or genetic damage such as birth defects or mutations in reproductive cells.

5) How does a Geiger counter work? Draw a diagram. Indicate two additional methods of detecting radiation and describe how they work. (see larger diagram on website)
Alpha, beta or gamma radiation enters the chamber through the front window and ionizes the gas (typically Ar) in the chamber. Electrons are collected at the central anode and create current that is detected at the meter, causing a "beep" for each ionization.



Other methods: (1) Photographic film is exposed by interaction to ionizing radiation (including also X-rays and some high-energy UV light). Film badges worn by professionals working with radiation act as a passive measurement of exposure. (2) Scintillation counters (Rutherford's Gold Foil experiment): a fluorescent material emits light when struck with a charged particle, and the flashes can be counted.

6) What are some beneficial uses of radioactive isotopes?
- Radiation treatments for cancer
- Radiotracer experiments in medical diagnostics or chemical reactions
- Radioisotopic dating of geologic and anthropologic artifacts
- Nuclear energy
- Positron Emission Tomography