

I. Multiple choice -- circle the one best answer.

- 4) The common US commercial light water reactors use
- a) ^{235}U for fission
 - b) ^{238}U for fission
 - c) ^{239}Pu for fission
 - d) graphite moderators
 - e) all of the above
- 5) The functions of the water in a light water reactor include all **but**
- a) providing steam to drive the turbines
 - b) slowing down the neutrons
 - c) washing away radioactive waste
 - d) cooling the core
 - e) providing emergency cooling for the core
- 8) As a result of the Chernobyl accident the following was **not** true:
- a) Serious levels of delayed fallout ranged as far as Britain.
 - b) The number of cancer deaths in the fallout area were expected to reach hundreds of thousands.
 - c) The reactor was repaired and restarted.
 - d) The reactor was encased in concrete and lead.
 - e) Hundreds of thousands of residents in the local area were evacuated.

2. A ball is dropped off the roof of a building. It hits the ground in 2 seconds.

- a) How tall is the building ?
- b) What is the vertical speed of the ball just before it hits the ground?

A second ball is thrown **horizontally** from the roof, with a horizontal velocity of 20 m/sec.

- c) How long does the ball take to reach the ground?
- d) How far from the building (the horizontal distance) does it land?

3. An Israeli intermediate range missile is launched from a launching tube on the ground and travels to a target in Iraq 1000 Km away in 10 minutes. Assume the missile achieves its burnout velocity by the time it leaves its launching tube (i.e. thereafter there is no further rocket fuel). Ignore the curvature of the earth.

- a) What is the missile's horizontal velocity (in units of m/sec or Km/sec)?
- b) How long will the missile take to reach the highest point on its trajectory? How does that compare with the time it takes to fall from its highest point to the target?
- c) How high does the missile go above the ground? The atmosphere is approximately 100 Km high. Does the rocket leave the atmosphere?
- d) What is the **vertical** velocity as the missile nears the end of its range?
- e) An interceptor rocket is aimed at a point, the interception point, near the end of the incoming missile's trajectory. Suppose the payload of the incoming rocket is 2 meters long. For what approximate time period will the payload pass through the interception point?

4. Suppose an *hypothetical* Medford reactor had an accident one year after it was put into operation. It released various radionuclides into the area. You are going to estimate how much ^{239}Pu (Plutonium) could have been released had the reactor vessel been breached. Medford produces 420 MegaWatts of electrical power. Recall that **power** is the rate at which energy is produced: 1 Watt = 1 Joule/sec.

- a) How much electrical energy is produced by the Medford reactor in one year (in units of Joules)?
- b) Express the electrical energy released in one year (part a.) in units of MeV.
- c) Each fission reaction in the reactor core, involving ^{235}U , releases about 200 MeV. How many fission reactions are necessary to produce the requisite electrical energy (part b.), assuming that the Medford reactor has an efficiency of 20% (i.e. 20% of the total energy released gets converted to electrical energy).
- d) If each fission reaction leads to an average of 2.5 neutrons and 1.7 of the resulting neutrons get absorbed by ^{238}U to form ^{239}Pu , how many ^{239}Pu nuclei are formed in one year?
- e) What is the activity in Curies of that amount of Plutonium? The half life of ^{239}Pu is 24,400 years.
- f) What is the mass of ^{239}Pu formed in one year?