

Physics 180
Nuclear Weapons, Nuclear War,
and Arms Control

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Midterm Examination
2001 March 7

Name _____

ID No. _____

- This is a closed book examination.
- You have the full class period (80 minutes) to complete it.
- Answer all questions on all five topics. Each topic is worth 20 points. The point value of each question within a topic is indicated.
- Write your answers in the space provided on these pages. Do not submit any additional pages. (If you need more room, write on the back of the page.)
- For full credit on definitions, give numbers where appropriate.

SCORES

1. _____

2. _____

3. _____

4. _____

5. _____

TOTAL _____

1. Nuclear Physics

Define *induced fission*. [2 points]

Define *non-fissile* nuclide. [2 points]

Name two *fissile* isotopes. [2 points]

Explain the difference between a *subcritical* and a *supercritical* assembly of fissile material. [2 points]

1. Nuclear Physics (Continued)

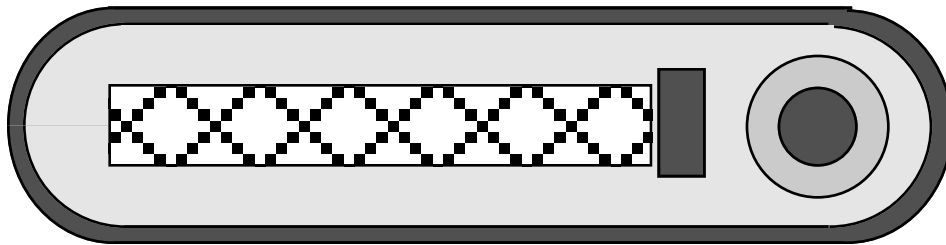
What is *reactor-grade* plutonium? *Weapons-grade* plutonium? Why is weapons-grade plutonium preferred for making nuclear weapons? [6 points]

The famous “curve of binding energy” (the binding energy of one nucleon in the given nucleus) first rises as the number of nucleons in the nucleus increases and then decreases. What two fundamental forces are responsible for the shape of the curve? What portion of the curve is related to nuclear fission? To nuclear fusion? [6 points]

2. Thermonuclear Weapons

a) Shown here is a schematic diagram of a modern nuclear weapon. Indicate on the diagram the locations of the following key components:
[2 points each]

- ${}^6\text{LiD}$ fusion packet
- U-238 case
- Fission trigger
- Blast shield for the fusion packet
- Styrofoam and reflectors



b) Describe briefly the roles of each of these five components. [2 points each]

${}^6\text{LiD}$ fusion packet:

U-238 case:

Fission trigger:

Blast shield for the fusion packet:

Styrofoam and reflectors:

3. ICBMs

- a) List the four phases in the flight of a MIRVed ICBM and indicate the approximate duration of each in minutes. [8 points]

PHASE

DURATION (MINUTES)

i)

ii)

iii)

iv)

- b) Explain one “strength” and one “weakness” of each of the following two strategic nuclear delivery systems. [8 points]

ICBMs:

SLBMs:

- c) Explain why MIRVing of silo-based ICBMs increases the danger of war in a crisis. [4 points]

4. Weapon Effects

a) Give brief (one- or two-sentence) definitions of the following terms. [2 points each]

- Air burst

- Surface burst

- Slant range

- Electromagnetic pulse (EMP)

- Ground zero

- Fireball

b) List the four main effects of a 1 Mt surface burst in the order in which they would be experienced by a person located 5 miles from ground zero. Describe each effect in one or two sentences. [8 points]

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5. Arsenals and Acronyms

About how many strategic nuclear warheads does the U.S. currently have on alert?
[2 points]

About how many strategic nuclear warheads does Russia currently have on alert?
[2 points]

Name all the countries *other than the U.S. and Russia* that acknowledge having nuclear weapons and having tested them. [6 points]

Name one country that is considered to have nuclear weapons today but does not openly acknowledge having them. [2 points]

Name one country *other than Iraq* that is considered to be attempting to acquire nuclear weapons but does not have them yet. [2 points]

Decode each of the following acronyms and explain in one sentence what each refers to.
[2 points each]

SAC —

ALCM —

SSBN —