

Last Name: \_\_\_\_\_ First Name \_\_\_\_\_ Network-ID \_\_\_\_\_

Writing Lab Section: \_\_\_\_\_ Writing Lab TA Name: \_\_\_\_\_

**Turn off your cell phone and put it out of sight.**

**Calculators cannot be used.**

**This is a closed book exam. You have eighty (180) minutes to complete it.**

1. Use a #2 pencil. Do not use a mechanical pencil or pen. Darken each circle completely, but stay within the boundary. If you decide to change an answer, erase vigorously; the scanner sometimes registers incompletely erased marks as intended answers; this can adversely affect your grade. Light marks or marks extending outside the circle may be read improperly by the scanner. Be especially careful that your mark covers the **center** of its circle.
2. **This Exam Booklet is Version A.** Mark the **A** circle in the **TEST FORM** box near the middle of your answer sheet. **DO THIS NOW!**
3. Print your **NETWORK ID** in the designated spaces at the *right* side of the answer sheet, starting in the left most column, then **mark the corresponding circle** below each character. If there is a letter "o" in your NetID, be sure to mark the "o" circle and not the circle for the digit zero. If and only if there is a hyphen "-" in your NetID, mark the hyphen circle at the bottom of the column. When you have finished marking the circles corresponding to your NetID, check particularly that you have not marked two circles in any one of the columns.
4. Print **YOUR LAST NAME** in the designated spaces at the *left* side of the answer sheet, then mark the corresponding circle below each letter. Do the same for your **FIRST NAME INITIAL**.
5. Do not write in or mark the circles in any of the other boxes (STUDENT NUMBER, DATE, SECTION, SCORES, SPECIAL CODE).
6. Sign your name (**DO NOT PRINT**) on the **STUDENT SIGNATURE line**.
7. On the **SECTION line**, print your **Writing Lab Section**. You need not fill in the COURSE or INSTRUCTOR lines.

*Before starting work, check to make sure that your test booklet is complete. You should have 26 numbered pages.*

**Academic Integrity—Giving assistance to or receiving assistance from another student or using unauthorized materials during a University Examination can be grounds for disciplinary action, up to and including dismissal from the University.**

*Exam Grading Policy—*

The exam consists of **17** questions, worth a total of **457** points, composed of **5** types of questions and an essay.

**Rules for partial credit**

**Note: there will be no partial credit for problems with multiple correct answers. These problems are marked and all correct answers need to be marked correctly on the answer sheet in order to obtain credit.**

**MC5:** *multiple-choice-five-answer questions, each worth 6 points.*

**Partial credit will be granted as follows.**

- (a) If you mark only one answer and it is the correct answer, you earn **6** points.
- (b) If you mark *two* answers, one of which is the correct answer, you earn **3** points.
- (c) If you mark *three* answers, one of which is the correct answer, you earn **2** points.
- (d) If you mark no answers or the wrong answer, or more than *three*, you earn **0** points.

**MC4:** *multiple-choice-four-answer questions, each worth 4 points.*

**Partial credit will be granted as follows.**

- (a) If you mark only one answer and it is the correct answer, you earn **4** points.
- (b) If you mark *two* answers, one of which is the correct answer, you earn **2** points.
- (c) If you mark a wrong answer or no answers or more than two, you earn **0** points.

**MC3:** *multiple-choice-three-answer questions, each worth 3 points.*

**No partial credit.**

- (a) If you mark only one answer and it is the correct answer, you earn **3** points.
- (b) If you mark a wrong answer or no answers, you earn **0** points.

**MC2:** *multiple-choice-two-answer questions, each worth 2 points.*

**No partial credit.**

- (a) If you mark only one answer and it is the correct answer, you earn **2** points.
- (b) If you mark the wrong answer or neither answer, you earn **0** points

**A. Nuclear Physics**

- 1) Which isotope has the highest average binding energy per nucleon (the most stable nucleus)?
  - A. He-3
  - B. Fe-56
  - C. U-235
  
- 2) What isotope of uranium is most common in nature?
  - A. U-235
  - B. U-238
  - C. U-233
  - D. U-239
  
- 3) The nuclide  ${}^4_2\text{He}$  has...
  - A. 4 neutrons and 2 protons
  - B. 2 neutrons 4 protons
  - C. 2 neutrons and 2 protons
  
- 4) Select the process that is responsible for the creation of Pu-239 from Np-239 in nuclear reactors.
  - A. Alpha decay
  - B. Beta decay
  - C. Spontaneous fission
  - D. Gamma decay
  
- 5) Which of the following fundamental forces are known to have both attractive and repulsive components? **[Mark all correct answers.]**
  - A. Electro-magnetic
  - B. Strong nuclear
  - C. Weak nuclear
  - D. Gravitational
  
- 6) What allows a neutron to interact directly with a nucleus?
  - A. A neutron weighs much less than a proton
  - B. A neutron is much smaller than a proton
  - C. A neutron has no charge
  
- 7) A proton is composed of three:
  - A. quarks
  - B. electrons
  - C. gammas
  - D. atoms

- 8) How are visible light and gamma rays different? [Mark all correct answers.]
- A. They have different wavelengths
  - B. They have different energies
  - C. They are composed of different elementary particles
  - D. None of the above
- 9) Which fundamental force is responsible for planetary motion?
- A. Electro-magnetic
  - B. Strong nuclear
  - C. Weak nuclear
  - D. Gravitational

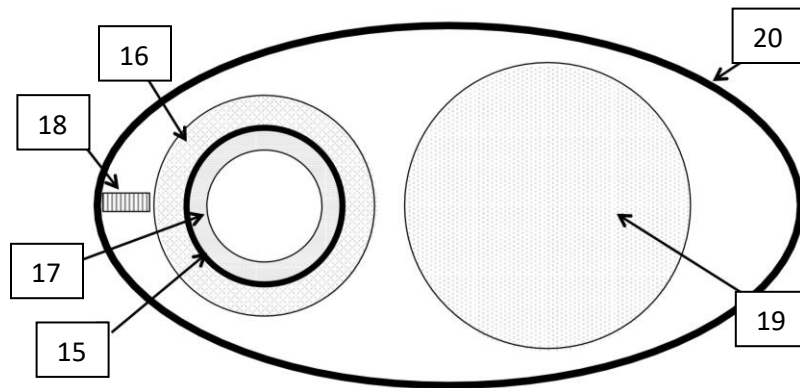
### B. Nuclear weapons

- 10) What role does the bomb casing play if it is made of uranium?
- A. Starts the fission reaction in the primary
  - B. Contributes additional energy to the yield via fission reactions
  - C. Adds generations to the fission chain reaction
  - D. Initiates the fusion reaction in the secondary
- 11) What is the main reason plutonium is not used in gun-type weapons?
- A. Neutrons released from the plutonium might set off the weapon prematurely
  - B. Plutonium is more dangerous to handle than uranium
  - C. The materials used in a gun-type weapon cannot handle the heat emitted from plutonium
  - D. Plutonium is used in gun-type weapons
- 12) What fundamental force of nature do nuclear weapons derive their energy from?
- A. Weak nuclear force
  - B. Gravitational force
  - C. Electromagnetic force
  - D. Strong nuclear force
- 13) To be used in a nuclear weapon, uranium must be enriched to at least what percentage U-235?
- A. 10%
  - B. 20%
  - C. 62%
  - D. 80%
  - E. 93%

14) What two nuclides fuse together to release energy in a thermonuclear weapon?

- A. Hydrogen and helium
- B. Hydrogen and lithium
- C. Deuterium and tritium

Use the diagram below to answer questions 15-20.



**Questions 15-20** Match the weapon components identified by numbers in the figure above, 15-20, with the correct answer keys, A-E and AB, provided in the list below. The key "AB" requires you to bubble both answers A and B. [2 points each]

- A. Neutron-emitting initiator
- B. High-explosive lens assembly
- C. Tamper/reflector
- D. Hollow "pit"
- E. DU (depleted uranium) shell
- AB. Fusion packet

21) What percentage of "weapons-grade" plutonium is the isotope Pu-239?

- A. 10%
- B. 20%
- C. 62%
- D. 80%
- E. 93%

22) What is a “fizzle?”

- A. An atom that is occasionally fissile depending on its electron spin
- B. A weapon that detonates but grossly fails to meet its expected yield
- C. A non-fissile isotope of an element that has fissile isotopes
- D. A weapon that detonates with a yield grossly higher than expected

23) The country of Assumeria has no nuclear weapons or enrichment capability and operates a single nuclear reactor to power its largest city. Uranium fuel (5% U-235) has been provided for several years by an international consortium, and spent fuel stays in-country for disposal. Assumeria’s leader, Victor Von Doom, announces that Assumeria has successfully tested a nuclear weapon. How did Assumeria obtain nuclear-explosive material?

- A. The Assumerian reactor was modified to selectively fission U-238, leaving an enriched U-235 component in nuclear waste.
- B. Assumeria melted down several years of new fuel and manufactured a very large but low-yield nuclear weapon.
- C. Instead of disposing of its spent fuel, Assumeria has been covertly extracting plutonium from its spent fuel.

### C. Nuclear Explosions

24) Scientists of the CTBTO detected unusual seismic activity in North Korea. They also detected traces of radioactive noble gasses in the air over the Chinese Sea, but no radioactive fallout is present on the ground. Is it likely that North Korea tested a nuclear weapon, and if so, which type of burst did they use?

- A. Yes, North Korea tested a weapon using a surface burst.
- B. Yes, North Korea tested a weapon using a partially contained underground burst
- C. Yes, North Korea tested a weapon using a fully contained underground burst.
- D. Yes, North Korea carried out an underground weapon test that fizzled.
- E. No, North Korea did not test a nuclear weapon.

25) The correct order in which the effects from a large airburst are felt are:

- A. Thermal radiation, EMP, blast wave, fallout
- B. Fallout, blast wave, thermal radiation, EMP
- C. EMP, thermal radiation, blast wave, fallout
- D. EMP, blast wave, thermal radiation, fallout
- E. Blast wave, thermal radiation, EMP, fallout

26) An effective way to disable an enemy’s communications is to detonate a nuclear device, which emits a/an \_\_\_\_\_ pulse.

- A. Electro-muonic
- B. Electro-magnetic
- C. Hadronic
- D. Electro-multiplied

- 27) True or false: A nuclear weapon has never been detonated in space.
- A. True
  - B. **False**
- 28) When the energy released by a nuclear explosion is stated in “kilotons”, what other explosive material is it being compared to?
- A. Astrolite
  - B. **TNT**
  - C. Nitroglycerin
  - D. Gunpowder
- 29) A nuclear weapon test is carried out in space. A satellite 20 miles away is used to measure the energy released from the explosion. What does it find?
- A. The low energy gamma rays have been absorbed by the weapon debris and almost all energy is in the kinetic energy of the debris.
  - B. **80% of the energy is carried by low energy gamma rays.**
  - C. At the distance of the satellite the debris has slowed and all energy is carried by low energy gamma rays
- 30) What is the correct distribution of energy of a large, 1 Megaton explosion from high to low?
- A. **Blast, Thermal radiation, Residual radiation, Prompt neutron/neutrino radiation**
  - B. Thermal radiation, Blast, Residual radiation, Prompt neutron/neutrino radiation
  - C. Thermal radiation, Blast, Prompt neutron/neutrino radiation, Residual radiation
- 31) Which of the following effects of a 1 Megaton explosion would be felt last 5 miles away?
- A. Blast
  - B. Electromagnetic Pulse (EMP)
  - C. Thermal radiation
  - D. **Residual Nuclear Radiation (Fall Out)**
- 32) What types of radiation are present in the residual nuclear radiation experienced by an individual years after the explosion of a 1 Megaton explosion?
- A. X-Ray and UV
  - B. Neutron
  - C. Alpha
  - D. **Gamma and Beta**
- 33) True or False: The effects of thermal radiation on a person 15 miles away from the blast of a 1 Megaton explosion are different if the explosion occurs on a clear day or if it happens on a clear night.
- A. **True**
  - B. False

34) Which of the following can be experienced from the fireball of a nuclear explosion?

[Mark all correct answers.]

- A. Ultraviolet (UV) radiation
- B. Visible light
- C. Infrared (IR) radiation

#### D. Nuclear Terrorism

35) What type of nuclear weapon design would be the easiest for a terrorist group to construct?

- A. Gun type
- B. Implosion
- C. Levitated-pit implosion
- D. Two-point hollow-pit implosion

36) What type of nuclear explosive material would the terrorist group need to make this design work?

- A. Enriched uranium
- B. Plutonium

37) What is the most pressing action required to prevent terrorists from going nuclear?

- A. Ensuring that other countries do not directly sell bombs to any terrorist organizations or non-state actors
- B. Implementing the “Star Wars” strategic defense initiative that Reagan put into place in the 80s
- C. Increasing security on HEU stockpiles in places like Russia and Pakistan that are most vulnerable to theft so that they cannot build a bomb
- D. Improving the protection of nuclear weapons in the United States from possible theft

38) According to Richardson, when terrorists act, they seek three immediate objectives (the “3 Rs”), which are:

- A. Revenge, Renown, Reaction
- B. Relevance, Retribution, Reconciliation
- C. Righteousness, Redress, Redemption
- D. Revenge, Retribution, Reaction

39) Which of the following is NOT a defining characteristic of terrorism?

- A. The act must be violent or threaten violence.
- B. The violence must be against civilians.
- C. The individual victims must be randomly chosen.
- D. The violence must be deliberate.
- E. The violence must have a political purpose.



- 40) Which of the following is the definition of state terrorism?
- A. The state sponsorship of terrorist acts against inhabitants of other countries as an instrument of foreign policy.
  - B. The use of terrorism by a government against its own citizens, to coerce them into accepting the government's authority.
  - C. The use of terrorism by a government against the civilians of another country with which it is at war.
  - D. The sponsorship of terrorist acts by a private organization that is not recognized as a nation by the rest of the international community.
- 41) How do the United States, France, the UK, and China secure their nuclear weapons?
- A. They use Permissive Action Links to prevent non-authorized users from triggering the detonation mechanism.
  - B. Their weapons are dismantled unless needed, when they are then assembled.
  - C. They secure their weapons by placing them in fortified bunkers across their territory.
  - D. The weapons are not always secured, only a portion of the devices at any one time are especially guarded.
- 42) What is the most likely way terrorists would carry out a nuclear attack on the U.S. and why?
- A. Missile Delivery because it would be the least costly, easiest to acquire, and most reliable and accurate.
  - B. Missile Delivery because it would instill the most fear, bring about the most renown, and cause the most chaos.
  - C. Non-Missile Delivery because it would be the least costly, easiest to acquire, and most reliable and accurate.
  - D. Non-Missile Delivery because it would instill the most fear, bring about the most renown, and cause the most chaos.
- 43) Which one of the following is NOT considered as a challenge that a terrorist organization faces when it intends to build a nuclear weapon?
- A. Handling radiation and chemicals
  - B. Acquiring nuclear explosive materials
  - C. Assembling a team of technical personnel
  - D. Meeting military safety requirements
- 44) Is this statement true or false?: "No terrorist organization currently have the ability to produce weapons-usable enriched uranium or plutonium for a weapon."
- A. True
  - B. False

- 45) Which of the following is **NOT** considered as a method that would reduce the threat of nuclear terrorism?
- A. Border security
  - B. Nuclear forensics
  - C. Healthcare security
  - D. Nuclear attribution
- 46) The three initiatives to secure vulnerable nuclear materials under the Global Threat Reduction Initiative include all **EXCEPT**:
- A. Convert research reactors and isotope production facilities from the use of highly enriched uranium to low enriched uranium
  - B. Protect high priority radiological materials from theft
  - C. Remove the disposition of excess nuclear materials
  - D. Share nuclear weapons technology with other states with higher security facilities
- 47) Which of the following are considered the principles that would reduce the threat of nuclear terrorism according to Harvard Professor Graham Allison? **[Mark all correct answers]**
- A. No new nuclear reactors
  - B. No loose nuclear weapons
  - C. No new nuclear weapon states
  - D. No new nascent nuclear weapons
- 48) Which of the following countries have given up all the highly enriched uranium it had?
- A. South Korea
  - B. Ukraine
  - C. Saudi Arabia
  - D. Israel
- 49) What of the following is NOT a primary mission of the International Atomic Energy Agency (IAEA)?
- A. The IAEA inhibits the use of nuclear power for any military purpose.
  - B. The IAEA inhibits the use of nuclear energy for war-torn states.
  - C. The IAEA seeks to promote the peaceful use of nuclear energy.
  - D. The IAEA promotes and implements nuclear security standards.
  - E. The IAEA administers international safeguards to verify that states party to the NPT fulfill their non-proliferation commitment.

**E. Nuclear Weapon Delivery Methods**

- 50) Which one of the following strategic nuclear delivery vehicles can be recalled after launch?
- A. Submarine-launched ballistic missiles
  - B. Land-based intercontinental ballistic missiles
  - C. Land-based intercontinental bombers
- 51) Which of the following is **NOT** an important attribute of delivery systems?
- A. Range
  - B. Speed
  - C. Size
  - D. Survivability
  - E. Recallability
- 52) The US is more vulnerable to CMs than Russia
- A. True, due to the proximity of potential targets to the sea shores
  - B. False, the US and Russia are both equally vulnerable to CMs
  - C. False, CMs do not pose a threat
  - D. False, Russia is more vulnerable to CMs than the US
- 53) Which set of performance parameters characterizes the US Tomahawk cruise missile best?
- A. speed: 350 mph, payload: 500 lbs, range: 2500 miles
  - B. speed: 1200 mph, payload: 2000 lbs, range: 3200 miles
  - C. speed: 550 mph, payload: 1000 lbs, range: 1550 miles
  - D. speed: 350 mph, payload: 1000 lbs, range: 1550 miles
- 54) Which of the following is not an attribute of ballistic missiles?
- A. Use either liquid or solid propellant
  - B. Can be launched by fixed or mobile bases
  - C. Can have single or multiple warhead payloads
  - D. Can operate only endo-atmospherically
- 55) Which are the nuclear armed heavy bombers in the US air force at this time?
- A. B-1, B-2 and B-52
  - B. FB-111, B-1, B-2, and B-52
  - C. B-1, B-2, and FB-111
  - D. B-2 and FB-111
  - E. B-1 and B-21

- 56) If Iran was to acquire medium and intermediate range missiles it could reach targets in the following set of countries?
- A. Saudi Arabia and Israel.
  - B. Saudi Arabia, Israel and the United Kingdom.
  - C. Saudi Arabia, Israel, the United Kingdom and the United States of America.
- 57) What is CEP?
- A. Circular Estimated Precision, a measure for the targeting error of missiles.
  - B. Circular Estimated Precision, a measure for the targeting error of gravity bombs.
  - C. Circular Error Probable, a measure for the targeting accuracy of gravity bombs
  - D. Circular Error Probable, a measure for the targeting accuracy of missiles.
- 58) Which of the following are the correct phases of flight for an ICBM in the correct order?
- A. Boost, Strategic, Re-entry, Engagement
  - B. Ascension, Midcourse, Boost, Post-Boost
  - C. Boost, Engagement, Strategic, Terminal
  - D. Ascension, Stellar, Midcourse, Engagement
  - E. Boost, Post-Boost, Midcourse, Terminal
- 59) Which one of the following delivery vehicles was **NOT** considered a leg of the Cold War nuclear "Triad"?
- A. Submarine-launched ballistic missiles
  - B. Land-based intercontinental ballistic missiles
  - C. Ship-launched ballistic missiles
  - D. Land-based intercontinental bombers
- 60) Which one of the following technologies was **NOT** crucial in developing militarily useful cruise missiles?
- A. GPS and other methods for more accurate guidance
  - B. More efficient engines
  - C. Light carbon fiber materials for the airframes
  - D. Stealth technologies to make them harder to detect
- 61) What does MRV stand for?
- A. Multiple Re-Entry Vehicles
  - B. Multiple Independently targetable Re-Entry Vehicles
  - C. Maneuverable Re-Entry Vehicles

**F. Defense**

- 62) What were the three “Nitze Criteria” an anti-ballistic missile defense system needed to fulfill before deployment? **[Mark all correct answers.]**
- A. The system must be effective.
  - B. The systems interceptor rockets must reach 6.5 km/s or more
  - C. The system must be able to survive an attack.
  - D. The system must be cost effective at the margin.
  - E. The systems X-Band radar must be capable of distinguishing RVs from decoys
- 63) Which of the following are important challenges for a boost-phase intercept system? **[Mark all correct answers.]**
- A. ICBM boost phases are short
  - B. Geographical constraints require high interceptor speeds
  - C. ICBMs in powered flight accelerate unpredictably
  - D. A successful intercept is unlikely to destroy the warhead
- 64) Tests of the U.S.-based midcourse system have been carried out under scripted test conditions. Under this favorable conditions, what is the percentage of tests that have been declared successful?
- A. 70%
  - B. 50%
  - C. 60%
  - D. 25%
- 65) Which issue does the term “Shortfall Management Problem” refer to in context of Ballistic Missile Defense?
- A. Shortfall of resources from under-funding the federal Missile Defense Agency
  - B. RVs continuing to travel after their rocket has been destroyed by a boost phase defense system
  - C. The impact ICBM failures under battle conditions have on the credibility of nuclear deterrence
- 66) The flight of a ballistic missile is separated into the boost phase, mid-course phase and terminal phase. Which of the following options characterizes best the length of these three sections of ballistic missile flight?
- A. Boost Phase: 30-40 sec. - Mid-Course: ~20 min. - Terminal phase: 1-4 min.
  - B. Boost Phase: ~5 min. - Mid-Course: ~15 min. - Terminal phase: ~5 min.
  - C. Boost Phase: 1-4 min. - Mid-Course: ~20 min. - Terminal phase: 30-40 sec.

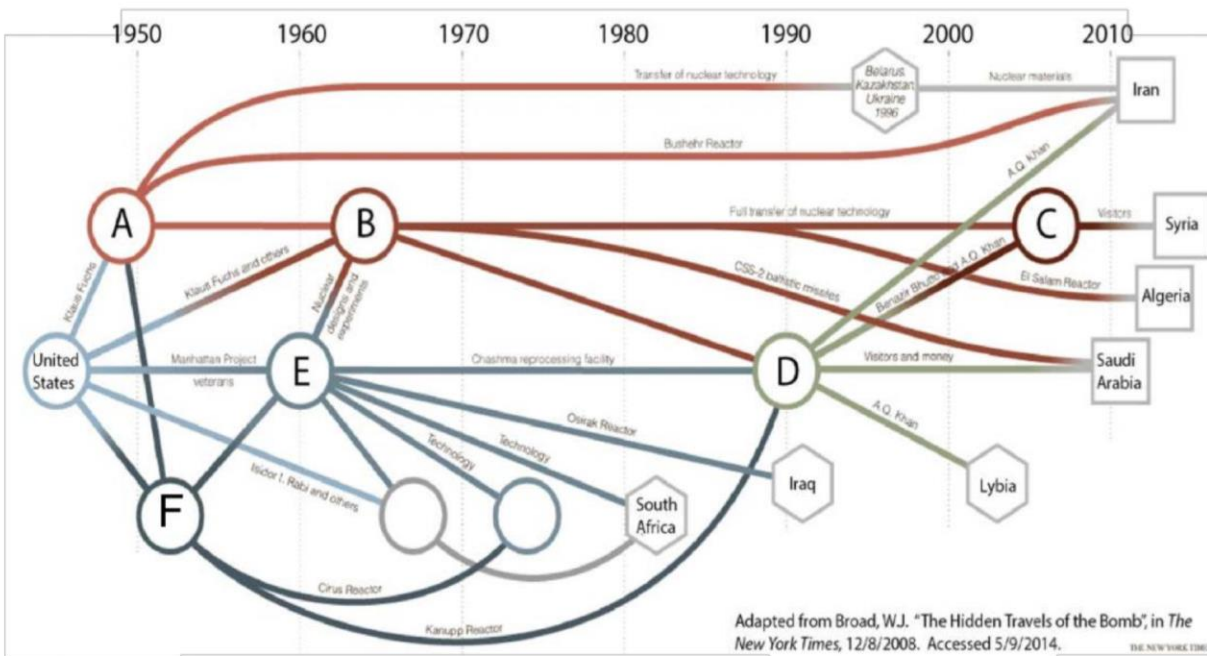
- 67) Suppose the year is 2040, the United States has just revealed that it has developed a ballistic missile defense system that is 100 percent effective, and meets all of the Nitze Criteria. True or False, the United States is now safe from nuclear attack?
- A. TRUE, because it meets all the Nitze Criteria, the system will be cost effective at any scale.
  - B. TRUE, because now no matter how many missiles an aggressor nation has, the US will be able to stop them striking home.
  - C. FALSE, because states or non-state actors could still deliver a nuclear weapon using non-standard means.
  - D. FALSE, because the more powerful missiles of the Soviet Union could still penetrate such a defense.
- 68) Which is **NOT** a characteristic of a highly capable kill vehicle?
- A. Extremely small and light for ease of portability and broader applications
  - B. Sensors capable of tracking the cool missile body in the face of the bright exhaust plume which is displaced from it
  - C. Ability to fully compensate for changes in the flight of the target missile
- 69) Passive defenses aim to defeat an attack rather than to mitigate or deter.
- A. True
  - B. False
- 70) Which of the following was not a criteria established by President Clinton to be considered in addition to the Nitze criteria for deciding whether to move forward with deploying a GMD system?
- A. The threat
  - B. The expected cost
  - C. The technological maturity of the system
  - D. The impact on arms control efforts
  - E. All of the above were established criteria
- 71) Active defenses are weapons that:
- A. Seek to prevent nuclear weapons from detonating at their targets
  - B. Requires destruction of delivery vehicles
  - C. Must be nearly perfect to avoid enormous death and destruction
  - D. All of the above
  - E. A&B
- 72) What are the two types of defenses against nuclear attacks?
- A. Passive and Active
  - B. Active and Aggressive
  - C. Active and Passive Aggressive
  - D. Active is the only type of defense

73) Programs to intercept nuclear-armed ballistic missiles would not be controversial if an effective defense system was clearly possible (i.e. not decreasing security or cause distractions from taking steps that would be more effective in increasing security) using near-term technology at an acceptable cost.

A. True

B. False

## G. Nuclear Arsenals



Use the graphic above and your knowledge to answer questions 74-78.

The place of each circle on the timeline represents the year of the country's first nuclear test.

"Circles" represent states with known nuclear weapons capabilities.

"Squares" represent states thought to be developing nuclear weapons.

"Hexagons" represent states with abandoned nuclear weapons programs.

74) Which country is represented by circle "A?"

A. North Korea

B. USSR

C. China

D. Pakistan

75) Which country is represented by circle "F?"

A. France

B. Russia/USSR

C. China

D. United Kingdom

76) Which country is represented by circle “E”?

- A. France
- B. Russia/USSR
- C. China
- D. United Kingdom

77) Which statements describe the country represented by circle “D”?

[Mark all correct answers.]

- A. It is North Korea
- B. It is Pakistan
- C. It shared uranium centrifuge technology with several other countries
- D. It shared ballistic missile technology with many other countries
- E. It is an NPT weapons state.

78) Which statement best describes the relationship between countries “B” and “D”?

- A. Pakistan shared centrifuge technology with North Korea.
- B. Pakistan shared centrifuge technology with India.
- C. China shared missile technology with Iran.
- D. China helped India developing its nuclear program.
- E. China helped Pakistan in developing its nuclear program.

79) Which statement best describes the strategy behind the Chinese nuclear program?

- A. China wishes to build a program on par with the programs of the US and Russia
- B. China is de-emphasizing its nuclear program
- C. China is primarily concerned with internal threats
- D. China is mostly concerned with maintaining a second-strike capability

80) Israel’s Negev Nuclear Research center operates an IRR-2 research reactor, as well as a uranium purification and fuel fabrication facility. No activities at the site are subject to IAEA inspections. Which of the following statements is the most likely role this facility has in Israel’s weapons complex?

- A. The site is for peaceful research applications only.
- B. The on-site uranium facilities are used to create fuel which is then used to breed weapons-usable plutonium in the reactor.
- C. The uranium enrichment facilities are used to enrich natural uranium to HEU usable for nuclear arms, with the process being run by power from the research reactor.
- D. The research reactor’s spent fuel is used in the creation of radiological weapons.

81) What state currently maintains the largest nuclear arsenal?

- A. United States
- B. United Kingdom
- C. Russia
- D. France
- E. China



82) Which state(s) formerly maintained a nuclear arsenal? [Mark all correct answers.]

- A. Ukraine
- B. Japan
- C. South Africa
- D. Egypt
- E. Germany

83) Which of these following four countries are Non-NPT Nuclear Weapons States?

- A. Pakistan, Israel, India, and North Korea
- B. China, France, India, UK
- C. India, South Africa, Pakistan, Israel
- D. Iran, North Korea, Pakistan, Israel
- E. Pakistan, Israel, Japan, South Africa

84) What statement best describes the motivation behind India's 1998 nuclear test?

- A. It was the first demonstration of India's nuclear capability.
- B. It was a response to Pakistan's development of nuclear weapons.
- C. It was a response to increased tensions with China.
- D. It was a test of new technological developments in India's arsenal.
- E. It was an announced joint exercise with Russia.

85) What element is used for the majority of NEM in US nuclear weapons?

- A. Uranium
- B. Plutonium

## H. Arms Control

86) From the date it went into force, the New Start Treaty is in force for...

- A. Five years
- B. Ten years
- C. Fifty years
- D. Indefinitely

87) Atoms for Peace was established under which American President?

- A. Eisenhower
- B. Nixon
- C. Carter
- D. Reagan

88) Which of the following statements concerning the NPT is correct?

- A. It has the broadest scope of any arms control agreement.
- B. It includes all of the nuclear weapons states with the exception of North Korea.
- C. It relies on the IAEA as organization to enforce safeguard agreements.
- D. All of the above.

- 89) What is the main goal of the IAEA safeguards system?
- A. To establish a “freeze” on existing levels of nuclear delivery systems.
  - B. To limit the number of MIRVed missiles and Heavy Bombers (HB) armed with cruise missiles.
  - C. To prohibit defenses against non-strategic ballistic missiles or cruise missiles.
  - D. To detect and deter diversion of nuclear materials from the civilian nuclear fuel cycle.
- 90) What is the difference between horizontal and vertical proliferation?
- A. Horizontal Proliferation is the increase in the number or capabilities of nuclear weapons, while Vertical Proliferation is the spread of technology to new states.
  - B. Horizontal Proliferation is the spread of technology to new states, while Vertical Proliferation is the increase in the number or capabilities of nuclear weapons.
  - C. Horizontal Proliferation is the increase in the number of bilateral nuclear deals, while Vertical Proliferation is the spread of nuclear technology within a country.
  - D. Horizontal Proliferation is spread of nuclear technology within a country, while Vertical Proliferation is the increase in the number of bilateral nuclear deals.
- 91) Which sequence has the following arms control agreements in the correct chronological order?
- A. START, SORT, NPT, SALT
  - B. NPT, SORT, SALT, START
  - C. NPT, SALT, START, SORT
  - D. NPT, START, SORT, SAL
- 92) What are the two components of the SALT treaty
- A. Anti-Ballistic Missile Treaty (ABMT) and Interim Agreement on Offensive Forces
  - B. Anti-Ballistic Missile Treaty (ABMT) and the Lisbon Protocol
  - C. Comprehensive Test Ban Treaty (CTBT) and Interim Agreement on Offensive Forces
  - D. Comprehensive Test Ban Treaty (CTBT) and the Lisbon Protocol
- 93) Which of the following help constraint *horizontal* proliferation? [Mark all correct answers.]
- A. IAEA
  - B. SALT
  - C. NPT
  - D. Atoms for Peace

- 94) Which of the following help constraint *vertical* proliferation? [Mark all correct answers.]
- A. START
  - B. CTBT
  - C. SALT
  - D. CWC
- 95) Which of the following statements about the 1963 Limited Test Ban Treaty is **not** true?
- A. It was created largely as a response to world-wide public outcry against fallout from atmospheric testing.
  - B. It bans any nuclear weapons test explosion (or any other nuclear explosion) in the atmosphere, outer space, and underwater.
  - C. It contained detailed nuclear test verification provisions, including specifications for how to detect an underground explosion.
  - D. It was the first sign of hope for controlling nuclear weapons, but in practice was primarily an environmental protection measure.
- 96) Which of the following statements are true about Nuclear-Weapon-Free Zones (NWFZ)? [Mark all correct answers.]
- A. Almost the whole southern hemisphere is a NWFZ
  - B. NWFZs did not exist before the New Start Treaty in 2011
  - C. There are no NWFZs
  - D. Outer space is a NWFZ

## I. Nuclear Materials

- 97) Identify the two most common fissile isotopes used for making fission weapons
- A. U-238 and Pu-239
  - B. U-238 and Pu-240
  - C. U-235 and Pu-239
  - D. U-235 and Pu-238
- 98) All techniques for enriching uranium depend on
- A. The mass difference between uranium isotopes
  - B. The binding energy per nuclear difference between uranium isotopes
  - C. How different uranium isotopes behave in a magnetic field
  - D. How different uranium isotopes behave chemically

- 99) What properties are important for evaluating the use of isotopes as NEM for the purposes of nuclear weapons?
- A. Heat from radioactive decay
  - B. Radiation damage from radioactive decay
  - C. Neutrons from spontaneous fission
  - D. All the above
- 100) Weapons-grade HEU contains what percentage of U-235?
- A. greater than 20%
  - B. greater than 60%
  - C. greater than 80%
  - D. greater than 93%
- 101) Which of the following methods is used to obtain U-238?
- A. Breeding in a nuclear reactor
  - B. Mining
  - C. Gas centrifuge separation
  - D. Laser isotope separation
- 102) \_\_\_\_\_ was used to produce \_\_\_\_\_ at Oak Ridge National Laboratory during WWII. Complete this sentence.
- A. Gaseous diffusion isotope separation, Pu-239
  - B. Gaseous diffusion isotope separation, U-235
  - C. Laser isotope separation, Pu-239
  - D. Laser isotope separation, U-235
- 103) Which isotope should be avoided if trying to construct a nuclear weapon?
- A. U-235
  - B. U-238
  - C. Pu-239
  - D. Pu-240
- 104) Which of the following methods is used to obtain Pu-239?
- A. Breeding in a nuclear reactor
  - B. Mining
  - C. Gas centrifuge separation
  - D. Laser isotope separation

- 105) Which isotope is used to store the tritium needed for a fusion reaction?
- A. U-235
  - B. Pu-239
  - C. He-4
  - D. Li-6

### J. Current events and reading assignments

- 106) Which of the following best describes the current US nuclear policy under Trump administration?
- A. Trump announces his will to maintain the status quo and forming peaceful relationships with nuclear powers.
  - B. Trump calls for an expansion in missile defense systems and plans for a major upgrade in missile interceptor systems.
  - C. Trump emphasizes the role of international organizations in regulating nuclear weapons and aims to strengthen cooperation among nuclear powers under the IAEA.
  - D. Trump's accepts US role in Israel's obtaining nuclear weapons and vows to investigate the US role in nuclear proliferation.
  - E. Trump announces US plan to give more funds to nuclear states to secure nuclear facilities.
- 107) Which of the following best describes the reaction to the current nuclear plans of Trump?
- A. Experts warn that current US nuclear policy can trigger an arms race with China and Russia
  - B. Experts believe that the current US nuclear policy will deter terrorists from attacking the US.
  - C. Experts believe that current US nuclear policy should focus on increasing the number of submarine warheads.
- 108) Which of the following option(s) is **NOT** true regarding Saudi Arabian nuclear agenda? **[Mark all correct answers.]**
- A. President Trump's administration has approved six authorizations for US companies to do nuclear work in Saudi Arabia.
  - B. Saudi leaders claim that they need nuclear energy to wean their country of its dependence on fossil fuels.
  - C. Saudi Arabia supports JCPOA and asks the US to keep the agreement to limit Iran's ability to become nuclear power in the Middle Eastern region.
  - D. Saudi Arabia denied allegations of building a nuclear reactor and invites inspectors from IAEA to prove it.

- 109) Which one of the following is true regarding China's reaction to the US deployment of Terminal High Altitude Area Defense System (THAAD) in South Korea?
- A. China supports THAAD as it will normalize relations with South Korea.
  - B. China is opposed to THAAD fearing that the US can use nuclear weapons against China.
  - C. China supports THAAD as it can deter North Korea from building nuclear weapons.
  - D. China is opposed to THAAD fearing that its nuclear second-strike capability is degraded.
- 110) Which of the following option(s) is an example of using nuclear techniques for civilian use?
- A. China uses nuclear techniques in crop production to feed its population.
  - B. Iran attempted to hide its uranium enrichment facility underground to avoid harming civilians.
  - C. Israel covertly acquired nuclear weapons to protect its civilian population from a potential attack.
- 111) Which of the following is not considered as a source of revenue for North Korea?
- A. North Korea sells coal to China
  - B. North Korea sells nuclear warheads
  - C. North Korea sells forced labor
  - D. North Korea uses cyber-attacks and hacks banks
- 112) Which of the following countries currently do not have nuclear weapons? **[Mark all correct answers.]**
- A. Israel
  - B. India
  - C. Pakistan
  - D. Libya
  - E. South Africa
- 113) What would be the reaction of Russia, according to Putin, if the US deploys intermediate-range nuclear missiles in Europe as the INF treaty unravels?
- A. Russia would respond by supporting the Iranian nuclear program as a retaliation.
  - B. Russia would respond by placing hypersonic nuclear missiles on submarines near US waters.
  - C. Russia would not risk the possibility of a nuclear attack and use a pre-emptive nuclear strike against the US.
  - D. Russia would double the budget spent for defensive missile systems to be able to counter potential attacks.

- 114) The U.S. Missile Defense Agency, announced on March 25, 2019, that Ground-Based Interceptors successfully conducted a test today against an Intercontinental Ballistic Missile (ICBM) target. Which one of the following is NOT true about this test?
- A. This defense system is expected to deter nuclear powers from engaging in a nuclear arms race.
  - B. The test is important because it was the first salvo engagement of a threat-representative ICBM target by Ground-Based Interceptors.
  - C. The test is important because it demonstrates that the US has a credible deterrent against an ICBM threat.
  - D. This defense system provides commanders the capability to destroy intermediate and long-range ballistic missiles in an attack against the U.S.
- 115) Which of the following is NOT true for Israel's nuclear program?
- A. Israel was able to build a multi-tiered defense system with assistance from the US.
  - B. Israel's four-layered active defense network includes Iron Dome, David's Sling, Arrow II and Arrow III.
  - C. Israel is a party to Treaty on the Non-Proliferation of Nuclear Weapons (NPT).
  - D. David Sling's system is a short/medium-range system designed to counter potential missiles fired from the Middle East.
- 116) Is this statement true or false?: "The Comprehensive Nuclear-Test-Ban Treaty Organization confirmed North Korean nuclear test in 2013 by detecting radioactive noble gasses in the atmosphere"
- A. True
  - B. False

**K. Essay Question – 70 points of 457 (Limit Answer to two pages on the next two sheet)**

117) Please answer the prompt below based your reading of the Congressional Research Service (CRS) report on the Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty, which was discussed in the writing labs, and your knowledge from class. Use the three empty sheets attached to the exam booklet for your answer. Write your name and netID at the top of each page of your essay.

**Prompt:**

Please write at least one paragraph for each other following points. The audience for your essay are Phys 280 students:

- i. Describe the Intermediate-Range Nuclear Forces (INF) Treaty, specifying the relevant parties and the main agreement of the treaty. Make sure to specify a missile range and what kind of missiles are included (ballistic, cruise, land-based, sea-based, air-based, etc.). Also summarize the recent events concerning the INF Treaty (i.e., who is accused of violating the treaty and by whom, and who has suspended their participation in the treaty)
- ii. Provide a brief argument for why Russia may have violated the INF treaty
- iii. Provide a brief argument for why Russia may not have violated the INF treaty
- iv. Provide a brief argument for why the U.S. may have violated the INF treaty
- v. Provide a brief argument for why the U.S. may not have violated the INF treaty
- vi. Please explain why Russia may be “uncomfortable with the limits in the INF Treaty” and thus may have developed intermediate-range missiles in violation of the treaty
- vii. Do you think the US was right to withdraw from the INF treaty?



Written Answer to question 62 – limit hand written answer to space on this page and the next page. Note it is important to write your name and writing lab – this page will be separated from the exam for grading:

Name:

Your Writing Lab:

**Check to make sure you bubbled in all your answers.  
Did you bubble in your name, exam version and network-ID?**

Name:

Your Writing Lab:

**Check to make sure you bubbled in all your answers.  
Did you bubble in your name, exam version and network-ID?**