

Last name _____ First name _____ SID _____

Essay questions (20 pts): pick **one** and only one to answer. Write a page or two (or whatever is appropriate) on this sheet. Cover the important points in a clear and concise manner – as if you have only a few minutes to tell the President, Mayor, or your roommate, what that person needs to know. Clear, effective writing is important.

1. Describe the physics behind satellites that orbit the earth. Be sure to relate LEO, GEO, and the moon in your discussion, and note any practical uses for each kind of artificial satellite.
 2. Suppose it is announced that a laboratory in downtown Berkeley accidentally released some radioactive gases into the environment, and this would cause an exposure to people who worked nearby of about 1 millirem (0.001 rem) over the next year for each person who works there. Assume 1000 people work there. The mayor of Berkeley asks you to speak to the public to alert them to the risks they face. What would you say? Give numbers when appropriate.
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Short questions (1 point each, 20 points total). Read the questions carefully so that you don't misinterpret them (e.g. by missing a word such as "not").

- If our sun became a black hole, the Earth would
 - be sucked into it
 - have its orbit drastically changed
 - have its orbit change by 1%
 - have very little change in its orbit
- Water droplets seem to float over hot pan. This is called:
 - convection
 - conduction
 - radiation
 - Leidenfrost effect
- In the tenth stage of a Pu-239 chain reaction, approximately how many fissions have there been? (Careful – possibly a tricky question.)
 - 10
 - 100
 - 2^{10}
 - 3^{10}
- Which of the following heat water to create steam to be run through turbines to make useful energy? Mark **all** that are appropriate:
 - coal power plant
 - nuclear power plant
 - hydrogen fuel cell
 - automobile engine
- The China Syndrome refers to
 - nuclear attack by China
 - terrorist attack on power plant
 - cancer from nuclear radiation
 - terrorist nuclear weapon
- One atom of TNT has an energy which is close to:
 - 1 eV (electron-volt)
 - 1 Calorie
 - 1 calorie
 - 1 joule
- Heated glass cracks when cooled rapidly because:
 - The outside shrinks more rapidly than the inside
 - heat triggers fusion
 - glass expands when cooled
 - atoms shrink when cooled
- At 67 miles per hour, a typical car uses _____ of its fuel to overcome air resistance:
 - a.) less than 1%
 - b.) 10%
 - c.) 50%
 - d.) 99%
- An air conditioner works by:
 - Pumping heat from inside the room to the hot outside.
 - Pumping cold air from the outside into the room.
 - Compressing warm air to make it colder
 - Restricting the amount of heat that can enter from the outside.
- Which one of the following is NOT proven to exist inside the nucleus:
 - quark
 - string
 - proton
 - neutron
- Which of the following cannot be used as a moderator in a nuclear reactor?
 - heavy water
 - water (ordinary)
 - carbon
 - U-238
- What are the waste products of hydrogen fuel cells?
 - water
 - hydrogen gas
 - carbon dioxide
 - ozone

13. Why do geosynchronous satellites need to be placed above the equator?

- the gravitational force is too strong at the poles
- centrifugal force is strongest along the equator
- so that it will stay above the same location as the Earth turns
- provides the strongest point of signal broadcast

14. Why doesn't a car usually explode when it crashes in real life like it does in movies?

- Gasoline has relatively low energy compared to TNT
- Gasoline doesn't explode unless mixed with the right amount of air
- There's not enough gasoline in a car for an explosion to occur
- There isn't enough kinetic energy in a car collision to trigger an explosion of gasoline

15. What is the item in a fission bomb that is left over after explosion which tends to cause harmful radiation

- neutrinos
- protons
- neutrons
- fission fragments

16. Which of the following is a true statement? (Mark all that are true.)

- Hydrogen is a means of transporting energy
- Hydrogen gas is found in natural gas wells
- Hydrogen fuel is produced in nuclear reactors
- Hydrogen as a fuel is expected to be environmentally more harmful than gasoline

17. What is neutron activation?

- Extracting neutrons from a radioactive atom to make it a unique radioactive isotope
- Hitting a radioactive atom with neutrons to make it a unique radioactive isotope
- Hitting a non-radioactive atom with protons to make it a unique radioactive isotope
- Hitting a non-radioactive atom with neutrons to make it a unique radioactive isotope

18. Which of the following, when released into a city, could begin a chain reaction? (Hint: only one right answer.)

- anthrax
- plutonium
- botulism toxin
- smallpox

19. Which of the following correctly describes a nuclear fission:

- $2 \text{ neutrons} + \text{U-235} \rightarrow 2 \text{ fission fragments} + 1 \text{ neutron}$
- $1 \text{ neutron} + \text{P-239} \rightarrow 1 \text{ fission fragment} + 2 \text{ neutrons}$
- $1 \text{ neutron} + \text{P-239} \rightarrow 2 \text{ fission fragments} + 3 \text{ neutrons}$
- $2 \text{ neutrons} + 2 \text{ fission fragments} \rightarrow \text{U-235} + \text{Pu-239}$

20. Which of the following is not a characteristic of temperature?

- It is a measure of the hidden kinetic energy of the molecules
 - At the same temperature, lighter molecules move faster (usually) than heavier ones.
 - If two objects have equal temperatures, then their kinetic energy is the same.
 - If two objects have equal temperatures, the bigger object has more energy.
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