

Row _____ Seat _____

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Essay questions (40 pts): pick **one** and only one to answer; **circle** the one you choose. Write a page **on the back of this sheet**. This side is for your personal notes only. Cover the important points in a clear and concise manner – as if you have only a few minutes to tell the President, your roommate, or your parent, what that person needs to know. *Clear, effective writing is important*. If English is a new language for you, state so at the top of your essay. If you need to re-write the essay, ask for a new copy of this page.

1. **Terrorist Nukes**. Many people fear nuclear weapons carried into the United States by terrorists. Discuss this issue. Emphasize the physics and technical aspects, and *not* political or police or FBI or diplomatic ones. Describe the different kinds of nuclear weapons that people fear terrorists might bring to the US (including dirty bombs), and the difficulties they would have in trying to make such a weapon and use it.

2. **Fluorescent light bulbs**. There is a recent push by environmentalists to discontinue the use of tungsten filament light bulbs in favor of fluorescent bulbs. Give a detailed explanation of how each bulb-type works and the relevant physics. Describe the advantages and disadvantages of each.

3. **The Energy Crisis**. Alternatives to fossil fuels have been in the news recently. What are the advantages and disadvantages of each of these energy sources: fossil fuels, ethanol, and solar. Include in your explanation a discussion of the relevant physics associated with each energy source, an assessment of their availability and the environmental issues associated with their use.

Circle the essay question you chose.

This page is for name and notes only.

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Short questions (1 point each, 40 points total). Read the questions carefully so that you don't misinterpret them (e.g. by missing a word such as "not").

1. Fission fragments
 - come to the earth mostly from space
 - are the source of energy in the sun
 - are a major danger from nuclear weapon fall-out
 - are ghost-like particles that penetrate us every second
2. In the next 100 years, the population of the world is expected to increase from 6 billion to about
 - 9 billion
 - 15 billion
 - 28 billion
 - 94 billion
3. Heavy water usually refers to water that
 - has been frozen, and so is more dense
 - has had its hydrogen removed
 - is radioactive
 - contains deuterium
4. Alexandre Litveneko, the former Russian spy, was poisoned using
 - tritium
 - polonium
 - plutonium
 - uranium
5. "Pipes" for electrons are often made out of
 - copper
 - samarium-cobalt
 - fiber optics
 - insulators
6. The technology that has made small earphones practical is
 - room-temperature superconductors
 - rare-earth magnets
 - the photoelectric effect
 - the dynamo
7. The French use 240 volts and we use 120 volts. One advantage of the French system is:
 - it is safer for humans
 - it allows them to use DC
 - they can use thinner and less expensive wires in their homes
 - it doesn't need a transformer
8. After two half lives, the fraction of nuclei remaining is
 - 1/2
 - 1/9
 - 1/8
 - 1/4
9. Put water in a glass vessel and in a plastic vessel. The plastic one feels warmer. That's because:
 - plastic is warmer than glass
 - heat from the water flows more readily to the fingers through plastic
 - heat from your fingers flows more readily through glass to the water
 - plastic has a chemical reaction with water that releases heat

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more questions

10. In practice, rail guns are limited in the velocity that they can launch humans by
- the velocity of molecules in the fuel used to provide energy
 - friction on the rails
 - the presence of air resistance
 - the g forces that would be put on humans for a short rail gun
11. A refrigerator operating in a room
- warms the room
 - cools the room
 - has no effect on the room temperature
 - cools the room only if the refrigerator door is open
12. A rocket flying straight up reaches an altitude of 100 km. To reach orbit, the energy needed is larger by
- about 10%
 - about 15%
 - about a factor of 2
 - about a factor of 30
13. The country with the largest reserves of fossil fuels is
- United States
 - China
 - Russian Federation
 - Saudi Arabia
14. To locate your position, your GPS receiver must get a signal from how many satellites?
- 1
 - 2
 - 3
 - 24
15. One Sievert is about
- 1/100 rem
 - 1 rem
 - 10 rem
 - 100 rem
16. Balloons rise until
- the surrounding air becomes too dense
 - the surrounding air becomes too cold
 - the surrounding air becomes too thin (not dense)
 - they reach space
17. LD50 is
- 50% of the lethal dose (twice that much will kill)
 - the largest dose that is allowed to be administered safely
 - the dose that will kill 50% of the exposed people
 - the dose that will kill 50 people if 1000 people are exposed.
18. The fraction of the U.S. population that dies from cancer is closest to:
- 1/2
 - 1/5
 - 1/20
 - 1/50
19. A magnitude 7 earthquake releases more energy than a magnitude 6 earthquake by a factor of
- 7/6
 - 2 to 4
 - 100 to 300
 - 10 to 30
20. Weather satellites are usually in
- low earth orbit
 - medium earth orbit
 - geosynchronous orbit
 - lunar orbits
21. Which kind of bomb is also referred to as a fusion bomb?
- plutonium
 - uranium
 - hydrogen
 - radiological

22. Police radar measures the velocity of your auto by
- the frequency of the bounced signal
 - the amplitude of the bounced signal
 - the speed of the bounced signal
 - the time-of-arrival of the bounced signal
23. Fiber optics are used for communication because
- they can send signals at speeds greater than radio waves can
 - they can send signals at speeds greater than wires can
 - they can use higher frequencies than radio
 - they are usually cheaper than wires
24. Which source of energy is currently least expensive, for the same amount of energy?
- oil
 - coal
 - natural gas (methane)
 - solar
25. oxygen Which of the following applications does not make use of quantum phenomena to work?
- solar cells for electricity
 - superconductors
 - lasers
 - radar
26. In the past million years, the climate has been generally
- warm, with short ice ages
 - cold, with short warm periods
 - about an equal amount warm and cold
 - about the same as it was in 1950, with few changes
27. Which of the following is not true?
- Hydrogen can be combined with oxygen in fuel cells to make electricity
 - hydrogen contains more energy per pound than gasoline
 - hydrogen contains more energy per gallon than gasoline
 - when hydrogen gas burns it produces essentially no pollution
28. The Space Shuttle Columbia was destroyed when
- its fuel exploded
 - high winds ripped it apart
 - it was hit by a meteor
 - its own kinetic energy was turned to heat
29. The cost to consumers of one kWh of energy from the wallplug is closest to:
- 0.04¢
 - 10¢
 - 45¢
 - \$300
30. You see a fish under the surface of the water. You want to hit it with a spear. You should aim
- right at what you see
 - above it
 - below it
 - it depends on the depth of the fish
31. The eyes of animals glow when the headlights of your car shine on them. This is an example of
- fluorescence
 - the quantum leap
 - the photoelectric effect
 - retroreflectors

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more questions

32. When we say a man is colorblind, the most common meaning is that
- everything looks black and white
 - he can't see UV or IR
 - he can see only three colors
 - he can not distinguish red from green
33. The name of the galaxy we live in is:
- The Milky Way
 - Andromeda
 - Hubble
 - Drake
34. Superconductors conduct
- electrons
 - heat
 - protons
 - microwaves
35. To detect the amount of hydrogen in different parts of the brain, the usual technique is to use:
- a CAT scan
 - MRI
 - X-ray
 - ultrasound
36. To make controlled thermonuclear fusion, the Livermore Laboratory uses:
- high voltage electric sparks
 - intense currents
 - high power lasers
 - focused microwaves
37. Which of the following is the greenhouse gas of most concern:
- carbon dioxide
 - ozone
 - methane
38. At very high speed, all of these change except:
- electric charge
 - mass
 - length
 - time between events
39. A WIMP is
- a possible source of dark energy
 - a possible form of dark matter
 - a method for detecting distant nuclear explosions
 - particles emitted by the sun that pass through us every second
40. According to Muller, which of the following do NOT cause cancer:
- gamma rays
 - beta rays
 - microwaves
 - they all do.