

Last name _____ First name _____ SID _____

Essay questions (30 pts): pick **one** and only one to answer. Write a page or two (or whatever is appropriate) in on the last sheet or in your blue book. Cover the important points in a clear and concise manner – as if you have only a few minutes to convey the important information to the President (or your roommate). Clear, effective writing is important.

1. It was once said, “The trouble with most folks isn’t their ignorance; it’s that they ‘know’ so many things that aren’t true.” Describe common misperceptions about radioactivity, and what the truth really is.
2. Technology continues to change the way that the United States will fight future wars. Describe the methods that are likely to be used in future military confrontations, and the physics on which they are based.
3. Everybody knows that water waves are waves, but in fact, there are many different kinds of waves in the world that are not so obviously waves. Describe these waves, and for each, give evidence that you might present to a skeptic to show that they are really waves.

Multiple-choice questions (1 point each, 40 points total). Note: read the questions carefully so that you don’t misinterpret them (e.g. by missing a word such as “not”).

An astronaut Alice makes a round trip at $3/5$ the speed of light. Her twin Bob stays on Earth. When Alice returns, Bob is:

- younger than Alice
- older than Alice
- the same age as Alice

Check all which are not examples of the doubling rule?

- Moore’s Law
- atomic bomb chain reaction
- expected population growth in the next 100 years
- spread of a computer virus

When an object’s velocity approaches the speed of light, its energy approaches:

- mc^2 , where m is the rest mass
- $(1/2) mc^2$, where m is the rest mass
- $mc^2 + (1/2) mc^2$ where m is the rest mass
- infinity

When an electron is emitted from a radioactive nucleus, the electron is often called:

- an alpha ray
- a beta ray
- a gamma ray
- a cosmic ray

Mark *all* that are not units of energy:

- kWhr
- Calorie
- joule
- watt
- horsepower

How fast do molecules of air move, approximately?

- 1 foot every nanosecond
- 1000 feet every second
- 5 miles every second
- 186,000 miles every second

Which is slowest?

- L wave
- S wave
- P wave
- they all travel at the same speed

Which process is most often used to find the age of old bones

- potassium-argon dating
- iridium dating
- carbon dating
- DNA dating

The cost of using electricity from batteries is closest to:

- 15 cents per kWhr
- 1 cent per kWhr
- 1 dollar per kWhr
- 1000 dollars per kWhr

Nuclear waste comes primarily from:

- plutonium
- tritium
- fission fragments
- carbon-14

For fusion to take place, we need:

- high temperatures
- a critical mass
- a moderator
- implosion

If you double the speed of a bullet, its kinetic energy

- doubles
- triples
- increases by a factor of four
- increases by a factor of sixteen

Trick question: Each of 1000 people are exposed to 100 rem of radiation. The number of these people who will eventually die of cancer is closest to:

- 0.4
- 4
- 40
- 200

The ozone layer is created by:

- CFCs (chloro-fluoro-carbons)
- carbon dioxide from fossil fuels
- cosmic rays
- ultraviolet radiation

The colors of an oil slick indicate that

- light is a wave
- light bends when entering material
- light changes its wavelength when passing through oil
- oil is made of many different chemicals with different colors

Which of the following was true about project Mogul?

- It was concerned with the atmosphere
- It resulted in the first nuclear bomb
- It led to the discovery of nuclear fission
- It involved the invention of integrated circuits

The probability of a U-235 nucleus capturing a neutron goes up when the neutron speed:

- decreases
- increases
- it doesn't matter what the neutron speed is
- the U-235 nucleus does not capture neutrons

A fiber can send much more information per second than a wire because:

- light has a very high frequency
- electricity travels better in glass than in a wire
- sound travels very rapidly in glass
- light travels faster than electricity

The moderator in a Canadian reactor is:

- boron
- carbon
- heavy water: D₂O
- ordinary "light" water H₂O

"Red eye" in a camera photo comes from a reflection off the

- cornea
- lens
- air
- retina

Global warming may be caused by (pick the most worrisome)

- destruction of the ozone layer
- burning of fossil fuels (e.g. coal and oil)
- release of radioactivity from nuclear reactors and nuclear tests
- the bending of heat waves by the upper atmosphere

If you double the absolute temperature of an object, the wavelength of the emitted light

- gets longer by a factor of 2
- gets longer by a factor of 16
- gets shorter by a factor of 2
- gets shorter by a factor of 16

Sound travels fastest in:

- air
- water
- rock
- vacuum

Beats demonstrate that

- sound is a wave
- sounds bends
- sound bounces
- sound spreads

The source of dangerous fallout from a nuclear bomb is:

- soil made radioactive by neutrons from the bomb
- plutonium from the bomb
- air made radioactive by neutrons from the bomb
- the nuclei which underwent fission and became radioactive

The Calutron was named after:

- The University of California
- Calories released
- Calvin and Hobbes
- Ernest O. Calutron

Which of the following has the most energy per gram:

- TNT
- chocolate chip cookies
- fusion
- battery
- fission

Which type of bomb is effective at killing life but does little damage to buildings?

- neutron bomb
- plutonium bomb
- uranium bomb
- TNT

According to Muller, the “Flying Disks” of Roswell were:

- advanced space vehicles
- nuclear weapons
- microphones
- alien devices of undetermined purpose

A wave passes through a small opening. It spreads more if (mark all that are true):

- The opening is larger.
- The opening is smaller.
- The wavelength is smaller.
- None of the above.

In a standard television set (CRT, or “Cathode Ray Tube”), the image is produced by:

- electrons hitting a phosphor
- protons hitting a phosphor
- xrays
- ultraviolet radiation

A smart terrorist who wants to build an atomic bomb would most like to obtain:

- U-235
- Li-D (lithium deuteride)
- plutonium
- U-238

If you double the temperature of the tungsten filament of a light bulb, the energy emitted

- remains approximately the same
- increases by a factor of 2
- increases by a factor of 4
- increases by a factor of 16

Most of the energy of an ordinary tungsten-filament light bulb is emitted in the color:

- ultraviolet
- green
- red
- infrared

If c is the speed of light in vacuum, then the speed of light in glass is approximately:

- $1.5 c$
- $(2/3) c$
- c
- $0.999 c$

Alcoholic beverages have their radioactivity tested by the U.S. government to

- make sure they won't cause cancer
- make sure they were not manufactured from oil
- make sure they were not imported
- make sure they weren't stored in radioactive containers

The dose of radiation that gives you a 50% chance of dying from radiation poisoning is approximately (careful: I said radiation poisoning, not cancer):

- 100 rem
- 300 rem
- 2500 rem
- 10,000 rem

If you travel at 50% of the speed of light, your mass is increased by a factor of:

- 1.15
- 1.50
- 2
- 1

Old people (e.g. Prof. Muller) need reading glasses because:

- their pupils can't contract as well
- their eyes become less sensitive to visible light
- their lenses become less flexible
- they forget how to read

In one millionth of a second, light will travel (caution: possibly a trick question):

- about 1 foot
- about 1000 feet
- from one side of a computer chip to the other
- from the Earth to the Moon

