

Last name _____ First name _____ SID _____

Essay questions: pick **one** and only one to answer. Write a page or two (or whatever is appropriate) in your blue book or on the back of this handout. The essay is worth 30 points. The essay should be clear, organized, and well-written.

1. "I'm not a technical expert, for example, I don't know the difference between fusion and fission." The person who said that was testifying to the senate to be confirmed as the Secretary of Energy.

Show that you do understand the difference. Give several examples of fusion and fission, where they occur, and what they accomplish. Describe what is happening, and how much energy is released. Explain the similarities between the two, and the differences.

2. One of the more intriguing discoveries in physics is the existence of invisible light. Describe the different kinds of invisible light. What are the practical applications of invisible light?
3. Discuss the events of September 11 and following, from the perspective of someone who has studied physics. Your essay might include a discussion of the weapons chosen by the terrorists, airport security (before 9-11 and after), new U.S. military technology used in the war in Afghanistan, and possible threats that we should be concerned about for the future (or not concerned about).

Brief questions (worth 1 point each, 40 points total)

1. Rank the following in order of most energy per gram (with a score of 1) to least energy per gram (with a score of 5):
 - () hydrogen
 - () TNT
 - () battery
 - () meteor
 - () cookie
2. Define, with one sentence each:

Radioactivity _____

Radiation _____

3. 25 people are *each* exposed to 25 Sieverts of radiation. The number of people who are expected to die of cancer is:
- 25
 - 1
 - 625
 - none, since they will all die of radiation poisoning

4. How is a neutron bomb supposed to kill people? (One sentence only.)

—

5. You are an archeologist, and have discovered an old bone that you think is about 5000 years old. Name the method that you would use to measure the age more accurately. Be as specific as possible (although two words will suffice).

—

6. Thunderclouds tend to rise until they reach

- the altosphere
- air that is colder than they are
- the carbon-dioxide layer
- air that is warmer than they are

7. Fiber optics are replacing electrical wires primarily because:

- light travels faster than electricity
- light has a lower frequency and hence is less noisy
- light is less expensive than electricity
- light has a higher frequency

8. If the pinhole camera, more blurring occurs if

- the hole is made very large (but not if it is very small)
- the hole is made very small (but not if it is made very large)
- the hole is either very large or very small
- never, since there is no lens in a pinhole camera

9. The "index of refraction" measures

- the frequency of light
- the speed of light
- the period of light
- density of the glass

10. Sosus refers to

- a method of rescuing pilots designed during WWII
- a project to detect nuclear explosions
- a system for detecting submarines
- a system using many artificial Earth satellites

11. One horsepower can light approximately how many ordinary lightbulbs?

- 1
- 10
- 100
- 1000

12. water waves are

- pure transverse waves
- pure longitudinal waves
- both transverse and longitudinal
- compressional

13. An "octave" refers to two frequencies which differ by a factor of:

- 1.5
- 2
- 7
- 8

14. The velocity of sound is approximately:

- 1000 ft per second
- 1 mile per second
- 5 miles per second
- 186,284 miles per second

15. Land fill is dangerous because:

- the frequency of an earthquake increases
- the wavelength of an earthquake increases
- they can trigger earthquakes
- the amplitude of the earthquake increases

16. The center of the earth, the deepest part, is:

- pure rock
- liquid rock
- liquid iron
- solid iron

17. Beats measure:

- frequency
- the difference between two frequencies
- loudness
- the presence of noise

18. State "Moore's Law"

19. Jupiter is not a star because:
- It isn't made of hydrogen
 - It isn't massive enough
 - It is too far from the Sun
 - It isn't made of helium
20. The "Super" refers to:
- an early attempt to make a thermonuclear bomb
 - an early design for a fission weapon
 - a bomb that was going to kill people but not destroy property
 - a weapon designed to have no "fallout"
21. A radioactive particle has a half life of 1 second. If it moves at $3/5$ the speed of light, its new half life will be _____
22. According to relativity theory, the energy of an object of mass m_0 that is moving at velocity is:
- $1/2 m_0 v^2$
 - $m_0 c^2$ (where c is the velocity of light)
 - $\gamma m_0 c^2$ (where $\gamma = 1/\sqrt{1 - v^2/c^2}$)
 - $m_0 c^2 / \gamma$
23. The observation of neutrino oscillations proves:
- neutrinos do have mass
 - neutrinos violate relativity theory
 - neutrinos have charge
 - neutrinos travel at the speed of light
24. To become a black hole, an object must:
- have a mass much greater than that of the Earth
 - have a size much smaller than that of the Earth
 - have enough mass that the escape velocity exceeds c
 - have been formed in a supernova explosion
25. Mark object that has the highest escape velocity in this list:
- Moon
 - Mars
 - Earth
 - Sun
26. A nuclear submarine uses its nuclear reactor to:
- create Plutonium for its missiles
 - boil water
 - purify U-235 for its missiles
 - create carbon dioxide
27. When the Chernobyl reactor had its accident, the chain reaction
- stopped almost immediately
 - continued for several hours
 - continued for many weeks
 - still continues to this day

28. According to Muller, the safest place for nuclear waste is:
- underground
 - thrown out of the solar system on rockets
 - thrown into the sun to burn up
 - left near the reactors that produced them in water tanks
29. The expected deaths from Chernobyl accident in Russia are approximately:
- none, except for the police and firemen already killed
 - about 255
 - about 24,122
 - about 5,238,191
30. Radioactive fallout is dangerous because it contains
- plutonium
 - uranium
 - tritium
 - fission fragments
31. A typical nuclear power plant produces approximately:
- one kilowatt
 - one megawatt
 - one gigawatt
 - one terawatt
32. Molecular motion stops at:
- 32 C
 - 273 C
 - 0 C
 - 95 C
33. Assuming they could obtain the materials required, the weapon that would be easiest to build for a terrorist is:
- a uranium bomb
 - a plutonium bomb
 - a neutron bomb
 - a thermonuclear bomb
34. When there is an atmospheric “inversion”, then sound tends to:
- become focused
 - bend upwards
 - bend downwards
 - become absorbed
35. Sound waves are:
- transverse
 - compressional (longitudinal)
 - a combination of transverse and compressional
 - neither compressional nor longitudinal

36. The fastest earthquake wave is:

- F wave
- P wave
- S wave
- L wave

37. Because of their warmth, humans emit primarily:

- sonic radiation
- infrared radiation
- ultraviolet radiation
- visible radiation

38. If you sleep under a tree, you won't get wet from morning dew. That's because:

- the tree reduces the wind
- the tree blocks the cold sky
- the tree is colder than your body
- the tree attracts the water vapor

39. The pit of a pit viper can detect:

- ground vibrations
- ultraviolet radiation
- infrared radiation
- weak sound vibrations

40. If the temperature of an object (e.g. a meteor) is doubled (on an absolute scale), then the total power radiated from that object increases by a factor of:

- 2
- 4
- 8
- 16