

Last name _____ First name _____ SID _____

Choose one essay question from list A and one from B. Circle the ones you chose. Each essay is worth 20 points.

A1. Explain the physics of **artificial earth satellites**. Describe what you think a future president should know. Questions you should address, among others, are: Why don't such satellites fall to Earth? What orbits are used, and for which satellites? Why did the Columbia Space Shuttle burn?

OR

A2. **Waves** come in many forms. Describe the different kinds of waves we have studied in this course, and their properties. What do they have in common? In what ways are they different from each other? Don't forget quantum mechanics.

B1. 65 million years ago, an **asteroid hit the Earth**, creating a huge explosion. Explain this event as if talking to an interested person. You should include relevant information and physics, including (but not limited to) such issues as: Why did it explode? What is an explosion is and why this one had so much energy. Did the orbit of the Earth change?

OR

B2. Most people think **quantum mechanics** is a theory that is used in advanced physics laboratories, and they don't realize that it plays important roles in everyday life. Describe the key features of quantum mechanics that make it different from "ordinary" mechanics. Give examples showing how these features are used in important applications.

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C. 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. Solar power is approximately
 - 1 watt per square km
 - 1 kilowatt per square km
 - 1 megawatt per square km
 - 1 gigawatt per square km
2. Which is a unit of energy?
 - kW-hr
 - horsepower
 - joule per second
 - megawatt
3. A house uses typically
 - 100 Watt
 - 1 kW
 - 10 kW
 - 100 kW
4. Sea level has been rising because:
 - melting ice near the poles
 - the moon is getting closer
 - extra rain from global warming
 - expansion of seawater from heat
5. The most efficient way to heat a room is:
 - pump heat from the cold outdoors
 - burn gasoline
 - burn hydrogen
 - burn CFCs
6. There is no hydrogen in the Earth's atmosphere because
 - it combined with oxygen to make water
 - it is too heavy, and it sunk to the core
 - it had sufficient velocity to escape gravity
 - it was destroyed by ozone
7. The speed of sound at high altitude is
 - less than at low altitude
 - more than at low altitude
 - the same as at low altitude
 - oscillating with a 26 million year period
8. For the gravity of the Earth to be zero, the distance you must travel away from the Earth is
 - about 100 km
 - about 100 miles
 - about 240,000 miles
 - infinite (i.e. you can't get away from it completely)
9. In the ocean, the instantaneous speed of the water molecules is approximately
 - zero
 - whatever speed the water is moving
 - whatever speed the wave is moving
 - the wave speed plus the water speed
 - approximately 1000 feet per second

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10. A rail gun
 accelerates rails
 can shoot bullets faster than ordinary guns
 doesn't really accelerate things
 uses ions for propulsion
11. Fuel cells use
 hydrogen and gasoline
 hydrogen and oxygen
 gasoline and alcohol
 gasoline and solar
12. One rem of radiation dose takes how many gammas per square centimeter?
 about 1
 about 5000
 about a million
 about 2,000,000,000
13. The fraction of the US population that dies from cancer is typically
 about 1 in 10,000
 about 1 in 100
 about 1 in 5
 most of us die from cancer
14. Oxygen and Nitrogen were created
 in the first few million years of the Earth's existence
 within a star
 in the Big Bang
 in a supernova explosion
15. The Hiroshima bomb used
 U-235
 U-238
 Pu-239
 tritium and deuterium
16. The "China Syndrome" refers to
 melting of nuclear fuel
 an uncontrolled chain reaction
 fusion of plutonium and uranium
 illegal nukes in North Korea
17. The most dangerous radioactivity of fallout is
 beta rays
 alpha rays
 gamma rays
 fission fragments
18. We use AC instead of DC because:
 120 Volts AC is less dangerous than 120 Volts DC
 AC is cheaper than DC
 AC can use transformers
 DC can use transformers
19. Superconductors
 require low temperatures
 radiate energy
 have zero current
 have not yet been discovered
20. The most damaging earthquake waves are usually the
 S wave
 P wave
 L wave
 M wave
21. GPS works by:
 sending signal to satellites that then radio back the location
 receiving signals and calculating the position
 detecting the position by using radar reflections
 measuring sound

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22. The sound channel in the ocean carries sound a long distance because

- the ocean doesn't absorb sound at that level
- whales pick listen to the sound and sing it over, increasing its volume
- the pressure of the ocean at that depth makes sound louder
- the sound doesn't spread out in the up or down directions

23. Which signal would give the best number of bits per second in fiber optics?

- red
- white
- blue
- infrared

24. Stress in plastic can be detected by looking at

- the transmission of different colors
- the reflection of different colors
- interference
- polarized light (crossed polaroids)

25. Old people need reading glasses because

- the curvature of their cornea changes
- their retina loses resolution
- their pupils will not squint sufficiently
- their lenses lose flexibility

26. Depleted uranium has been used in weapons because it

- is radioactive
- undergoes a chain reaction
- is very dense
- pollutes the battlefield

27. Heat radiation is also called

- IR
- UV
- white light
- gamma rays

28. Which color star is hottest:

- red
- blue
- yellow
- white

29. Dew forms when grass

- absorbs IR
- absorbs UV
- emits IR
- converts hydrogen to water

30. Sunburn comes from

- UV
- IR
- visible light
- wind

31. Stimulated emission is important for

- integrated circuits
- superconductors
- LEDs
- lasers

32. Xerox machines make use of

- the photoelectric effect
- Cooper pairs
- stimulated emission
- a chain reaction

33. Who is famous for his estimate of extraterrestrial intelligence?

- Moore
- Hubble
- Drake
- Heisenberg

34. In the twin effect, the traveling twin is

- younger
- lighter
- longer

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35. Tachyons

- Have never been observed
- Were discovered in the last 10 years
- Are used for medical imaging
- are the components of protons

36. A light year is

- dilated time
- a distance
- longer than a year
- the same as an ordinary year

37. A galaxy is

- a large collection of stars
- a region of gas
- an exploding star
- a planet-sized object

38. Dark matter is made of

- ordinary stars
- MACHOs
- WIMPs
- we don't know

39. Most of the mass of the Universe is
(be careful)

- hydrogen
- helium
- starlight
- dark matter

40. Neutrinos are believed to have mass

- zero
- small, but not zero
- infinite
- imaginary