

Last name \_\_\_\_\_ First name \_\_\_\_\_ SID \_\_\_\_\_ GSI \_\_\_\_\_

---

**Essay questions** (40 pts): pick **one** and only one to answer and **circle** it. Start your essay on this side, and continue it on the other side. 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 not your first language, state so at the top of your essay. The essay may be up to a page and a half long. If you need to re-write your essay, ask for a new sheet.

- 1. The eye:** Describe how the eye works. Talk about imaging, color, and poor vision. Describe other relevant effects, such as redevye in camera photos.
- 2. Terrorist nuclear weapon.** Is it feasible that a well-funded but small organization like Al-Qaeda could build a nuclear weapon? Discuss what types of weapons are more likely than others. What would they need to do? What are the hardest steps?
- 3. Misinformation.** "The trouble with most folks isn't so much their ignorance; it's knowing so many things that aren't so." -- Josh Billings. Give three examples of common scientific misperceptions that could people to reach incorrect conclusions on important public issues. Describe what you would tell them to correct their misinformation.

*Circle the question, and begin your essay here.*

---

**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"). Enter all your answers on the Scantron form.

---

1. Your electric company bills you each month for the amount of \_\_\_\_\_ you use.
  - current
  - voltage
  - power
  - energy
2. We do not yet have solar powered automobiles because:
  - solar has a low energy per square meter
  - solar cells are too expensive
  - sunlight can't be made into electricity
  - solar cells contain dangerous chemical
3. Typical flashlight batteries supply energy at what cost per kilowatt-hour (kWh):
  - 1 cent
  - 10 to 20 cents
  - \$1
  - \$1000
4. Which fuel should not affect "Greenhouse" warming?
  - natural gas (methane, from oil wells)
  - gasoline
  - coal
  - nuclear
5. A metal doorknob feels cooler than a wooden table top because
  - metal doesn't absorb energy as fast as wood
  - metal radiates its heat faster
  - metal conducts heat rapidly from your warm hand
  - metal has heavier atoms, so its temperature is lower
6. When the Space Shuttle Columbia exploded, it was traveling at about Mach (pick the closest)
  - 0.7
  - 1
  - 20
  - 100
7. The New Orleans Levees failed right at
  - expansion joints
  - thermal hot spots
  - water flow cracks
  - electrical conduits
8. A heat pump is often used
  - to heat a house in winter
  - to heat an automobile engine
  - to create hydrogen gas
  - warm a gasoline pump so the fuel will flow more readily
9. Why does one feel weightless when in orbit around the Earth?
  - there is no gravity
  - you are constantly falling.
  - there is no air
  - your mass goes to zero
10. Medium Earth orbit (MEO) is used for
  - most spy satellite
  - GPS
  - TV broadcasting
  - SETI
11. Airplanes fly by
  - making themselves lighter than an equal volume of air
  - pushing fuel downward

- pushing fuel upward  
 pushing air downward
12. Black holes have
- escape velocity greater than the speed of sound
  - escape velocity greater than the acceleration of gravity  $g$
  - escape velocity greater than the velocity of light  $c$
  - infinite escape velocity
13. An RTG (Radioisotope Thermal Generator) is used primarily to
- provide thrust for rockets
  - provide electricity for satellites
  - provide heat to warm a satellite
  - generate a magnetic field
14. Muller wears a tritium watch because
- the watch never needs a battery
  - the tritium provides a safe source of energy to make the hands glow
  - he is foolish but brave
  - tritium is not radioactive
15. According to Muller, which of the following is the most dangerous to human health (per pound):
- botulism toxin
  - depleted uranium
  - helium
  - plutonium
16. If a "dirty bomb" is blown up in the middle of San Francisco, and the radioactivity spreads over a square mile, the expected number of deaths from radiation illness (don't include cancer) is about
- less than one
  - about 120
  - about 1000
  - about 24,000
17. Polymerase Chain Reaction (PCR) was used to:
- reduce the growth of cancer
  - produce fission in the Gabon natural reactor
  - reduce waste at Yucca Mountain
  - deduce the behavior of Thomas Jefferson
18. A reprocessing plant
- enriches U-235
  - separates Pu-239
  - destroys radioactive waste
  - can trigger the China Syndrome
19. A plutonium bomb
- was used on Hiroshima
  - uses a gun design
  - follows Moore's Law
  - requires implosion
20. The danger China syndrome comes from
- a possible nuclear explosion
  - keeping the chain reaction going
  - release of radioactivity into the environment
  - release of huge amounts of energy into the Earth
21. A Van de Graaff generator (the sphere with sparks) makes
- high voltage but low current
  - high voltage and high current
  - high current but low voltage
  - low voltage and low current
22. The technology that made small earphones and computer motors possible is
- the Tesla Coil
  - superconductivity
  - vacuum tubes
  - rare-earth magnets
23. Electricity is carried through wires primarily by
- molecules
  - protons
  - electrons
  - quarks

24. If charges are moved twice as far apart, the force between them
- increases by a factor of 2
  - decreases by a factor of 2
  - increases by a factor of 4
  - decreases by a factor of 4
25. Light is a
- transverse wave
  - longitudinal wave
  - circular wave
  - L wave
26. Beats occur because waves
- cancel and reinforce
  - bend towards the slow direction
  - bend towards the fast direction
  - change their wavelength but not their frequency
27. A "fifth" in music means the frequency changes by a factor of
- five
  - eight
  - two
  - 1.5
28. Most stop signs use
- multispectral reflection
  - CZ (cubic zirconia)
  - retroreflectors
  - holograms
29. LCD laptop computer displays use
- polarizers
  - light-emitting diodes (LEDs)
  - UV
  - IR
30. The ozone layer is protects us from
- intense visible light
  - IR
  - UV
  - microwaves
31. MRI was formerly called
- CAT
  - PET
  - NMR
  - ultrasound
32. An example of "invisible light" is
- x-rays
  - alpha rays
  - beta rays
  - cathode rays
33. The photoelectric effect is used in
- Xerox machines
  - light-emitting diodes (LEDs)
  - spectral fingerprinting
  - fiber optics
34. Tachyons
- were first discovered in 1996
  - are known to be impossible
  - have not yet been discovered
  - Were predicted by Einstein
35. A moving object, according to relativity theory, has
- time slow down and distances get shorter
  - time slow down and distances get longer
  - time speed up and distances get shorter
  - time slow down and distances get longer
36. According to Hubble's Law
- we are at the center of the Universe
  - there is no center to the Universe
  - particles can not go faster than the speed of light
  - the memory of a computer chip doubles every 18 months
37. The best evidence for the Big Bang, was which discovery:
- microwaves from all directions
  - dark energy

- dark matter
- black holes

38. Light emitted by the sun arrives at the Earth

- about 1 second later
- about 8 minutes later
- about 5 years later
- about 1 million years later

39. The expansion of the Universe is

- slowing down
- remaining constant
- speeding up
- we don't know

40. The Drake equation attempts to predict

- the number of stars in the universe
- the amount of dark matter
- the number of WIMPs and MACHOs
- the number of planets with intelligent life