Equations: \( E = m \cdot c^2 \)

**Question 1:** The Sun is a stable star because
1. gravity balances forces from pressure. (!) ➜ Miniquiz 6, Q3
2. the rate of fusion equals the rate of fission.
3. radiation and convection balance.
4. mass is converted into energy.
5. fusion doesn’t depend on temperature.

**Question 2:** What is thought to cause Io’s volcanism?
1. Jupiter’s magnetosphere
2. Tidal stresses from both Jupiter and Europa (!) ➜ HW7
3. Jupiter’s rapid rotation
4. Radioactive decay from its core
5. Io’s large mass and tectonic activity

**Question 3:** The magnetic fields of which two planets are most unusual?
1. Jupiter and Neptune
2. Jupiter and Saturn
3. Jupiter and Earth
4. Saturn and Earth
5. Uranus and Neptune (!) ➜ Review

**Question 4:** Rigel has an apparent magnitude of +0.18 and Betelgeuse an apparent magnitude of +0.45. What can you conclude from this?
1. Rigel must be closer to Earth.
2. Betelgeuse must be closer to Earth.
3. Rigel is brighter than Betelgeuse. (!) ➜ Review
4. Betelgeuse is brighter than Rigel.
5. Both stars are brighter than the full Moon.
Question 5: Some regions along the plane of the Milky Way appear dark because
1. there are no stars in these areas.
2. stars in that region are hidden by interstellar gas.
3. stars in that region are hidden by dark dust particles. (!) → HW9
4. many brown dwarfs in those areas absorb light which they turn into heat.
5. many black holes absorb all light from those directions.

Question 6: The critical temperature the core must reach for a star to shine by fusion is
1. 5,800 K.
2. 11,000 K.
3. 127,000 K.
4. 10 million K. (!) → Review
5. 100 million K.

Question 7: Interstellar dust clouds are best observed at what wavelength?
1. Visible only
2. Radio and infrared (!) → Review
3. UV and infrared
4. Radio and X-ray
5. Visible and UV

Question 8: Which are the four Galilean moons of Jupiter?
1. Europa, Titan, Ganymede, and Callisto
2. Io, Ganymede, Callisto, and Titan
3. Europa, Ganymede, Io, and Triton
4. Io, Europa, Ganymede, and Callisto (!) → HW7
5. Io, Titan, Triton, and Charon

Question 9: Inside the Roche Limit
1. large moons are torn apart. (!) → Miniquiz 6, Q4
2. is where large moons form.
3. ring systems cannot exist.
4. there is a gap in a planet’s magnetic field.
5. hydrogen can only exist in its liquid metallic form.
Question 10: A cloud fragment too small to collapse into a main sequence star becomes a
1. white dwarf.
2. pulsar.
3. T Tauri object.
4. planet of another star.
5. brown dwarf. (!)

Question 11: A moon with a smooth, uncratered surface would imply
1. meteorites have never struck the moon.
2. a strong magnetic field surrounds the moon.
3. the surface is very young. (!)
4. the moon lies within the planet’s Roche limit.
5. the surface is completely liquid.

Question 12: How do the atmospheres of Earth’s Moon and Mercury compare?
1. Mercury’s is more dense with carbon dioxide.
2. They are similar, only 1% as dense as ours.
3. The cooler Moon retains a thicker nitrogen atmosphere.
4. As no spacecraft has yet landed there, no information exists about Mercury’s.
5. Neither body has a permanent atmosphere. (!)

Question 13: On the H-R diagram, red supergiants like Betelgeuse lie
1. at the top right. (!)
2. at the top left.
3. about the middle.
4. to the lower left edge.
5. on the bottom, coolest portion of the main sequence.

Question 14: The reason the Jovian planets lost very little of their original atmosphere is due to their
1. rapid rotation.
2. strong magnetic fields.
3. ring systems.
4. many moons.
5. large mass. (!) ➔ Review
**Question 15:** A solar-mass star will evolve off the main sequence when
1. it completely runs out of hydrogen.
2. it expels a planetary nebula to cool off and release radiation.
3. it explodes as a violent nova.
4. it loses all its neutrinos, so fusion must cease.
5. it builds up a core of inert helium. (!) ➜ Miniquiz 8, Q1

**Question 16:** Today, the primary source of the Sun’s energy is
1. oxidation of carbon in the core.
2. gravitational collapse of the helium coreward.
3. dark energy.
4. the strong force fusing hydrogen into helium. (!) ➜ HW8
5. the weak force creating energy from uranium decay.

**Question 17:** Of the elements in your body, the only one not formed in stars is
1. Carbon
2. Calcium
3. Iron
4. Aluminum
5. Hydrogen (!)

**Question 18:** A star will spend most of its life
1. as a protostar.
2. on the main sequence. (!) ➜ HW9
3. inside its planetary nebula.
4. in repeated swellings to the red giant.
5. in a sustained helium flash lasting billions of years.

**Question 19:** Emission nebulae like M-42 occur only near stars that emit large amounts of
1. visible light.
2. microwaves.
3. ultraviolet radiation. (!) ➜ HW9
4. infrared heat.
5. x-rays and gamma rays.
**Question 20:** Stellar parallax is used to measure the

1. sizes of stars.
2. distances of stars. (!)
3. temperatures of stars.
4. radial velocity of stars.
5. brightness of stars.

**Question 21:** The speed of light is $3 \cdot 10^8$ m/s. If 2.00 kg of mass is converted to energy, how much energy will be produced?

1. $1.8 \cdot 10^{17}$ J (!) ➔ HW8
2. $6.0 \cdot 10^8$ J
3. $1.5 \cdot 10^8$ J
4. $6.0 \cdot 10^4$ J
5. $9.0 \cdot 10^{16}$ J

**Question 22:** A star’s apparent magnitude is a number used to describe how our eyes measure its

1. distance.
2. temperature.
3. brightness. (!)
4. absolute luminosity.
5. radial velocity.

**Question 23:** What would Jupiter have needed to be a star?

1. More mass to make the planet hotter (!)
2. A larger satellite system
3. More uranium to ignite nuclear fission chain reactions in its core
4. A slower spin, similar to the Sun’s 25 days, instead of its present 10 hours
5. A different chemical composition
**Question 24:** The parallax of a certain star was found to be 0.01 arc-seconds. Find the distance to this star in pc.
1. 0.01 parsecs
2. 0.1 parsecs
3. 1 parsec
4. 10 parsecs
5. 100 parsecs (!)  → HW8

**Question 25:** The temperature of the Sun’s photosphere is about
1. 3,200 K
2. 5,800 K (!)  → Miniquiz 6, Q1
3. 11,000 K
4. one million K
5. ten million K

**Question 26:** A star’s color index directly tells us its
1. temperature. (!)  → Miniquiz 7, Q4
2. proper motion.
3. distance.
4. radial velocity.
5. age.

**Question 27:** Many astronomers believe Pluto is perhaps best classified as
1. a cold terrestrial planet.
2. a small Jovian planet.
3. a large Kuiper Belt object. (!)
4. a wandering moon.
5. a captured comet.

**Question 28:** The number of sunspots and solar activity in general peaks
1. every 27 days, the apparent rotation period of the Sun’s surface.
2. once a year.
3. every 5 1/2 years.
4. every 11 years. (!)  → Review
5. approximately every 100 years.
Question 29: Which moon in the solar system shows a dense atmosphere?
1. Our Moon
2. Titan (!)  → Miniquiz 6, Q5
3. Phobos
4. Europa
5. Triton

Question 30: Interstellar gas is composed primarily of
1. 90% hydrogen, 9% helium, and 1% heavier elements. (!)  → HW9
2. molecules including water and CO₂.
3. 50% hydrogen, 50% helium.
4. hydrogen, oxygen, and nitrogen.
5. 99% hydrogen, and 1% heavier elements.

Question 31: Stars are often born within groups known as
1. clans.
2. spiral waves.
3. aggregates.
4. clusters. (!)
5. swarms.

Question 32: What can be said with certainty about a red star and a blue star?
1. The red star is more massive than the blue star.
2. The blue star is hotter than the red star. (!)  → Miniquiz 7, Q2
3. The red star has a greater radial velocity than the blue star.
4. The blue star has a greater proper motion than the red star.
5. The red star is closer to Earth than the blue star.

Question 33: A star near the lower right of the H-R diagram is likely to be
1. red, with high luminosity.
2. blue, with high luminosity.
3. hot, bright, and very large.
4. yellow, with luminosity similar to our Sun’s.
5. red, with low luminosity. (!)
**Question 34:** Why is the sky blue?

1. It’s not blue, just an optical illusion.
2. Air particles are moving towards us due to gravity. We observe a Doppler shift.
3. Tiny particles in the air are more efficient at scattering short-wavelength light than they are at scattering long-wavelength light. (!) → Attendance question
4. Most polluting gases and dust particles in the air are bluish in color and lend their color to that of the sky.
5. Air molecules absorb red light more efficiently than they do blue light because of their electron orbitals.

**Question 35:** Type II supernovae occur when their cores start making

1. Carbon
2. Oxygen
3. Silicon
4. Iron (!)
5. Uranium