

1. (4 points) According to the story in *The Algebraist*, arteria (usable wormhole) mouths need to be located

- (a) **Away from strong gravitational fields, in “flat” spacetime**
- (b) In orbit around white dwarf stars
- (c) In spaceships traveling very close to the speed of light
- (d) Close to the surface of a star, such as Ulubis
- (e) Within the brain circuitry of ancient artificial intelligences

2. (4 points) According to our current physical understanding, usable wormholes would require

- (a) Black hole implosions
- (b) Extremely high electric charge
- (c) Supersymmetric axions
- (d) **Materials with negative mass**
- (e) Billions of years of evolution

3. (4 points) Humans must “delve” in order to communicate with slow species such as Dwellers. Which of the following is true about delving?

- (a) It requires a delving human to be converted to antimatter
- (b) It involves time dilation, where the human approaches speeds very close to that of light
- (c) It is an extension of breathing techniques used in meditation
- (d) **It is a plot device; the author is never specific about how it is done**
- (e) It could be accomplished with present technology, if we could shield against the radiation

4. (4 points) Do you think artificial intelligence will be achieved through future technology? Give *one* brief reason for your answer.

**Answer:** Reasons will vary. Possible pro-AI reasons may include continuing progress in computer technology today, and the fact that the human brain is, fundamentally, a physical system. Anti-AI reasons might be things like the difficulty of imagining machines being creative or emotional, or intellectual traditions that consider mind to be something beyond matter.

5. (4 points) In the very low gravity conditions on Third Fury, Fassin can move the otherwise very heavy flyer on his own. But he still has to be careful. Similarly, if you were to move house in microgravity, you'd find large items very easy to lift, but you'd still have to be just as careful as on Earth about banging the furniture into walls and doorways. Of the following two explanations, pick the true and the false, and briefly explain where the false explanation goes wrong.

- (a) Very low weight does not mean very low mass, and the effect of a massive object crashing into something is the same regardless of gravity. So carelessness will still cause damage as usual.
- (b) Low gravity means that all fundamental forces are weak, and so the binding forces between an object's molecules also become smaller. This makes them exceptionally brittle, so you must take care.

**Answer:** Variation in local gravity has no effect on other forces. In particular, the electromagnetic forces that bind objects are not affected. So it's nonsense to talk about objects becoming more brittle.