

Top Hat Monacle Questions

Lecture 4/16:

-Viruses: What characteristics of life do viruses not have?

Which of the following makes viruses in between living and non-living organisms?

- A: ability to react to environment
- B: ability to grow by taking in nourishment and processing it into energy
- C: ability to reproduce, with offspring having some characteristics of parent
- D: ability to evolve

Answer: B or C

-Life in solar system: Where in our solar system, other than Earth, is there a (small) chance that life exists?

- A: Venus
- B: Mars
- C: Europa (moon of Jupiter)
- D: Titan (moon of Saturn)
- E: Callisto (moon of Jupiter)

Answer: B, C, D

-Rate of Star Formation: How many stars per year have been formed, on average, in the Milky Way since its formation?

- A: 1,000
- B: 100
- C: 10
- D: 1
- E: less than 1

Answer: C

Lecture 4/11:

Hydrogen/helium ratio: What should be the ratio by mass of hydrogen to helium in the Universe?

- A: 7:1
- B: 6:1
- C: 4:1
- D: 3:1
- E: 2:1

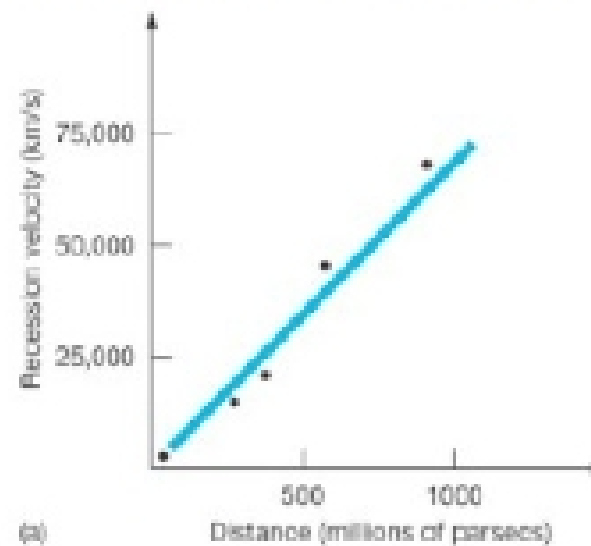
Answer: D

Lecture 4/9:

-Hubble's Law: How far away is a galaxy with a recessional speed of 40,000 km/s?

- A: 400 Mpc
- B: 575 Mpc
- C: 750 Mpc
- D: 925 Mpc

Answer: B

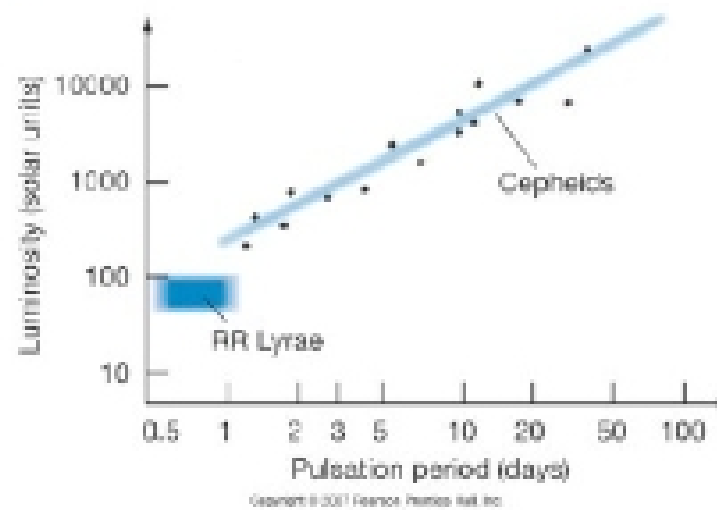


Tutorial 4/6:

-RR Lyrae Star: How far away is an RR Lyrae star that appears as bright as the Sun would be at 10 parsecs?

- A: 10 pc
- B: 30 pc
- C: 90 pc
- D: 800 pc

Answer: C



-Cepheid variable star: A Cepheid variable star with a period of 20 days appears 100 times brighter than the Sun would be at 10 parsecs. How far away is it?

Answer: B

Lecture 4/4:

-Density of a neutron star: What is the density of a 1.5 solar mass neutron star of radius 10 km? ($V_{\text{sphere}} = \frac{4\pi R^3}{3}$)

- A: $7.2 \times 10^{26} \text{ kg/m}^3$
- B: $2.3 \times 10^{18} \text{ kg/m}^3$
- C: $7.2 \times 10^{17} \text{ kg/m}^3$
- D: $2.4 \times 10^{17} \text{ kg/m}^3$

Answer: C

-Grain of neutron star material: What is the mass of a 1 mm grain of neutron-star material?

- A: 720 million kg
- B: 720,000 kg
- C: 720 kg

Answer: A

-Twin paradox: How much older are you than your twin who visits Proxima Centauri in a 0.8 c spaceship?

Your twin gets in a spaceship and heads to the nearest star, Proxima Centauri, 4.3 light years away, orbits it for a year, and then heads home. Both interstellar journeys are made at $v = 0.8 c$. How much older are you than your twin when she returns?

- A: you are the same age
- B: 2.9 years
- C: 5.7 years
- D: 4.7 years

Answer: D

-Cosmic-ray muons: How far do muons made by cosmic rays in the upper atmosphere travel in their 2.2 microsecond lifetime, if they are moving at $v=0.9999 c$?

When 'at rest' in the lab, a muon (a heavy electron) has a lifetime of 2.2 microseconds ($2.2 \times 10^{-6} s$) for its (weak) decay to an electron and a neutrino. Muons are made by collisions of cosmic rays with atomic nuclei in the upper atmosphere. Without time dilation, even if they are traveling at $v = 0.9999 c$, they should only travel $d = v t = 3.0 \times 10^8 m/s (2.2 \times 10^{-6} s) = 660 m$ before they decay, and so would not reach us. With time dilation, how far do they travel before decaying?

- A: 6600 km
- B: 66 km
- C: 47 km

Answer: C

Lecture 3/28:

-Neutrinos from a core-collapse supernova:

Assume that an 8 solar mass star collapses, and that half of its mass is protons. If all of these protons combine with electrons to form neutrons during the collapse, via the electron capture process, how many neutrinos are emitted? The Sun's mass is 2.0×10^{30} kg, and one mole ($N_A = 6.0 \times 10^{23}$) of protons has a mass of 1.0 g

- A: 1.3×10^{10}
- B: 4.8×10^{54}
- C: 9.6×10^{54}
- D: 4.8×10^{57}