1. A (hypothetical) rocket launched from the Earth at 6500 meters per second will take how long (in seconds, or hours) to reach the Moon?

2. NASA's Pioneer space probe moved at 52,000 km/hr for the first portion of its orbit. How long (hours or days) did it take to reach the orbit of:
a. the Moon?

b. Mars?
(1.5 AU from sun, assume when it's at its closest to Earth)

3. The fastest manmade objects have been probes in close orbit to the Sun; Voyager I achieved 17km/s and the HELIOS probes from the 1970s achieved 70 km/s when slinging close to the Sun. (similar to how planets orbit faster when near the sun; there's more gravitational acceleration there).
The fastest outward-bound spacecraft we've ever made is the New Horizons spacecraft, which should reach Pluto in 2015, and is moving at almost 16 km/s away from the Sun/Earth. Assuming that we could get astronauts moving this fast, **how long (in days) would a (one-way) trip be to:**
a. Mars, assuming Mars is at its closest?

b. our nearest star, Proxima Centauri, at 4.4 light years(ly) away?

4. The last radio signal (speed of light) received from the Pioneer 10 was in 2003. This signal took 11 hours and 20 minutes (11.33 hours) to reach Earth. How far was Pioneer away from Earth? (answer in A.U.s or in meters)

5. If you send a TV signal of "Jersey Shore" or some other awful representation of our society into space, and it is received by an alien civilization 200 light-years away...
a. What Earth year would the aliens receive the broadcast?

b. If the aliens responded back with their own terrible TV, how long would we have to wait to see it?

c. When we look into space for beacons from other life forms or signs of life, we don't see anything (so far). If there are other life forms on the same timeline as those on our planet scattered throughout the universe, why haven't we heard from them yet? (or them from us?

Answers:
1. A (hypothetical) rocket launched from the Earth at 6500 meters per second will take how long to reach the Moon?
(Earth - Moon distance in notes is 384,000km)
(1km = 1000m)
2 significant figures
384,000km (1000m/1km) (1s/6500m) = **59000s = 5.9x10^4s**

OR a bit further: 5900s(1min/60s) (1hr/60min) = **16 hours**

2. NASA's STEREO program has two satellites orbiting the sun at Earth's orbital distance, moving in opposite directions from one another. If they were launched in October 2006, and in January 2011 they reached a point where they were on opposite sides of the Sun from each other (each had covered ¼ of Earth's orbital circumference), how fast are they moving relative to Earth?
(Earth's orbital circumference must be approximated as a circle for this problem - 2*pi*r (6.28 radius units - remember pi day???) = circumference.
(Earth's orbital radius = 1AU, or 1.50x10^11m, 1.50*10^8km)
(4 years, 3 months = 4.25 years)
(significant figures in this problem are hazy; months are broad measurements. We will therefore assume one significant figure in the final answer)
Distance: 1.50x10^11m x 2 x pi = circumference = 9.42*10^11 meters. x 1/4 = 2.36x10^11m

Time: 4.25 years (365days/1year) (24h/1day) (3600s/1hr) = 1.3x10^8s

Speed: Distance / time, so 2.36x10^11m / 1.3x10^8s = 1.76x10^3 m/s.
With one significant figure, this is 2x10^3, or **2000 m/s. (2km/s)**

3. NASA's Pioneer space probe moved at 52,000 km/hr for the first portion of its orbit. How long did it take to cross the orbit of:
(2 significant figures)
(Moon distance in notes: 384,000km)
a. the Moon?
384,000km (1hr/52000 km) = **7.4 hours**

b. Mars?
(Mars orbits at 1.5AU, so its orbit would have been 0.5 AU from the Earth)
(still 2 significant figures)
0.5AU (1.5x10^8km / 1AU) (1 hour / 52000 km) = **1400 hours** … 1400h(1d/24h) = **58 days**
4. The fastest manmade objects have been probes in close orbit to the Sun; Voyager I achieved 17km/s and the HELIOS probes from the 1970s achieved 70 km./s when slinging close to the Sun. (similar to how planets orbit faster when near the sun; there's more gravitational acceleration there).
The fastest outward-bound spacecraft we've ever made is the New Horizons spacecraft, which should reach

Pluto in 2015, and is moving at almost 16 km/s away from the Sun/Earth. Assuming that we could get astronauts moving this fast, how long (in days) would a (one-way) trip be to:

a. Mars, assuming Mars is at its closest?
(assume 2 significant figures)

0.5AU (1.5x10^8km/1AU) (1s/16km) (1hr / 3600s) (1d / 24h) = **54 days**

b. our nearest star, Proxima Centauri, at 4.4 ly away?

4.4ly(365d/1y)(24h/1d)(3600s/1h)(3.00x10^8m/1s = distance = 4.2x10^16m.
4.2x10^16m(1km/1000m)(1s/16km)(1hr / 3600s) (1d / 24h) = **3.0x10^7 days** ← whoa, better express this one in lifetimes!!!
3.0x10^7 days(1y/365d)(1lifetime/75 years) = 1100 lifetimes. *Looks like unless we find faster travel, like a lot faster, we won't be traveling to other star systems.*

5. The last radio signal (speed of light) received from the Pioneer 10 was in 2003. This signal took 11 hours and 20 minutes (11.3 hours) to reach Earth. How far was Pioneer away from Earth? (answer in A.U.s or in meters)
(there are multiple ways to solve this one, including some clever cheats using the 8:20 approx. time for light to travel from the sun to Earth at 1AU.) I will show the other ways here; you can check your own.
(2 significant figures)
11.3 hours (3600s / 1hr)(3.00x10^8m/1s) = **1.2x10^13m**
1.2x10^13m(1AU/1.5x10^11m) = **81 AU**

6. Radiation (EM waves) received on the Earth that are evidence of a Big Bang are not in visible light; they are not in Infrared or UV rays, but in Microwaves. Explain how these could be remnants of visible light, with the Doppler Effect.
These are radiated from material moving away so fast that they have been red-shifted all the way past visible red light and infrared, into microwave wave lengths (much longer)

7. If you send a TV signal of "Jersey Shore" or some other awful representation of our society into space, and it is received by an alien civilization exactly 200 (2.00x10^2) light-years away...
a. What Earth year would the aliens receive the broadcast? 2012+200 = 2210
b. If the aliens responded back with their own terrible TV, how long would we have to wait to see it? 2212+200 = 2410
c. When we look into space for beacons from other life forms or signs of life, we don't see anything (so far). If there are other life forms on the same timeline as those on our planet scattered throughout the universe, why haven't we heard from them yet? (or them from us?
We are looking out into the PAST. Other life forms (if they exist) haven't received our radio signals that we've been sending out for the past 100 years, and if they have been sending waves to us, we haven't received them. It's a BIG space out there. We don't have a whole lot of stars within 50 light-years of us, which is about the maximum distance from our oldest (1920s) radio broadcasts to have traveled, been received, and sent back at the speed of light.