Grading scheme

#4
Describe the evolution of the atmosphere of...

Earth: Right distance from the Sun **(1)**
Greenhouse effect just right **(1) + (3 for explanation)**

Mars: Too far from the Sun **(1)**
Runaway glaciation **(1) + (3 for explanation)**

Venus: Too close to the Sun **(1)**
Runaway greenhouse effect **(1) + (3 for explanation)**

Greenhouse effect:
Molecules like H2O, CO2, CH4, NH3 and CFCs trap the heat radiation from the surface of the planet to keep the planet warm. For the Earth, liquid water helps dissolve CO2 to avoid excessive greenhouse effect, but still the effect is non-negligible to avoid runaway glaciation.

Runaway greenhouse effect:
Since H2O locates at high altitude, the H2O gas is dissociated by the UV radiation creates more CO2 gas in the atmosphere to cause further greenhouse effect. Also, the rack of the liquid H2O prevents CO2 to dissolve into the ocean and the Venus ends up with the thick atmosphere with high pressure that accelerates the greenhouse effect.

Runaway glaciation:
Thin atmosphere causes less greenhouse effect to lower the temperature of the planet until it freezes some of the gases crucial to the greenhouse effect. Even though temperature is not low enough to freeze H2O, the low pressure of the atmosphere doesn't allow the existence of the liquid water.

What signature of life on a planet could be searched by spectroscopy? **(5)**
Detect the existence of the molecules like H2O, O2, CH4 simultaneously. You may mention the planned space mission (TPF/Darwin).

#5
What location in our solar system other than the Earth is most likely site for life?

Mars: Conditions were similar to the Earth early in its history. Detection of liquid water by Odyssey. Organic molecules on the Martian meteorites.
Europa: Liquid water and the deep see vents.
Titan: Life possible if we allow liquid solvents other than water.

Jupiter: Sagan-Salpeter arguments of the possible life forms in the Jupiter

Choose either of them or anything else as long as the reasoning is solid. **(10)**

Describe a mission that would test your idea.

Any scientifically justifiable mission. The mission should be relevant to your arguments above. **(7)**

Your estimates on "f_l"

If your mission can detect the possible formation of life, f_l tends to be large, and if not, small. Any number $0 < f < 1$ with reasonable argument is acceptable. **(3)**