

LAB 01-2 – VPython Spaceship

1. Open a web browser, go to our course web site, and click the link to `VPython` on the left side of the page.
2. Right-click the file `01-vpython-spaceship.py` and save it to a folder on your hard drive. If you have not done so already, create a folder in My Documents with your name. Save your files to this folder. **Note: you should always copy these files to your personal USB flash drive to use as a backup.**
3. Double-click the file `01-vpython-spaceship.py` to run it.
4. The spaceship is a cube, with thrusters that can fire in the $+x$, $-x$, $+y$, and $-y$ directions, as shown in Figure 1, with a constant magnitude thrust.

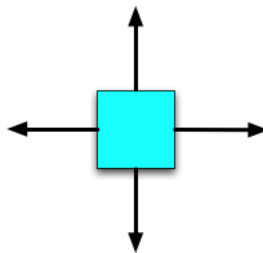


Figure 1: A spaceship with four thrusters.

5. You are now ready to operate the spaceship. The spaceship has four engines that fire to the right, to the left, upward, and downward, respectively. These engines are controlled using the arrow keys on the keyboard. **Note that the fire and exhaust from the engines are not shown. Each arrow represents the direction of the thrust by an engine, not the direction of motion of the exhaust.**
6. At the beginning, the spaceship is at rest. Make the spaceship speed up to the right by pressing and holding the right arrow key (\rightarrow) for a few seconds and then let go.
After the engine stops firing, what is the net force on the spaceship (i.e. net interaction of the spaceship with its surroundings)?

Describe the motion of the spaceship after the engine stops firing. Is it speeding up, slowing down, or is its speed constant?

7. Now, with the spaceship moving at a constant speed, fire two opposite thrusters simultaneously by pressing the **shift** and **left** and **right** arrow keys simultaneously (for programmatic reasons, the shift key is required). Describe the motion of the spaceship in this case. Is it speeding up, slowing down, or moving with a constant speed?

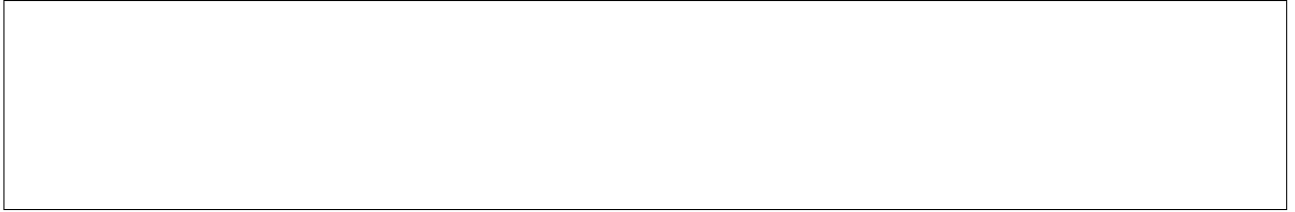
8. Fire the appropriate engine(s) for the appropriate time interval(s) to make the spaceship come to a stop and remain stopped (exactly stopped, not drifting whatsoever).

Describe the motion of the spaceship after the engine stops firing. Is it speeding up, slowing down, or is its speed constant?

9. Write the most general statement possible that describes the motion of an object if there are no forces on the object (or if the net force on the object is zero). Your statement should be something like “If there are no forces on an object or if the net force on an object is zero, then...”

10. Can the spaceship move along a curved path if no engines fire? Try your best to make this happen. After experimenting, make your conclusion. Explain your conclusion.

11. If an object is moving and the net force on the object is zero, what must be the shape of its path?



12. Two students are discussing the so-called natural state of things.

Student 1 “The natural state of things is to be at rest. If there are no forces on an object, then it will be at rest or at least eventually come to rest.”

Student 2 “The natural state of things is to have uniform motion. If there are no forces on an object, then its motion will be uniform which means that it could be at rest or it could move in a straight line with a constant speed.”

Do you agree or disagree with each student? Explain.