PHY100 – "Magic of Physics" – Assignment 1

Write your answers on paper. Show calculations. List any information that you obtained from Google searches at the end of each question. Put your name and UTORID on the top of the page. Both online submission (a photo would suffice) and paper submission are required. Only the paper submission will be used for marking.

This assignment is due on May 14th at 1:10 pm SHARP in class, and it is worth 10% of your final grade. The total marks for each problem/question is 5.

1. Scientists have estimated that at least 10% of all stars host planets, and that at least 1% of all planets have similar temperatures as the earth. If we assume that on such a planet, there is one-in-a-million chance an alien civilization can emerge, make a *rough estimation* on how many alien civilizations there should be in our own Galaxy. (Hint: Google for the number of stars in the Milky Way Galaxy.)
2. How many years would it take the Voyager 1 Space Probe to travel 2 light-years? If an alien civilization built a spaceship that can travel 2 *light-years* in 1000 years. How many kilometers does this spaceship travel in 1 second?
3. How many minutes would it take the alien spaceship in the previous question to go from the Earth to the Moon? How many minutes would it take Voyager 1 to travel the same distance? (Hint: Google for the average distance between Earth and Moon.)
4. If we were to make a model of the Milky Way Galaxy that can fit into a 100km-wide desert, approximately how many times do we have to shrink everything? Under that scale, what would be the size of our Earth? Briefly explain why no one on the Earth have made a to-scale model of the Milky Way Galaxy. (Hint: Google for the diameter of the Milky Way Galaxy.)
5. When we describe something small, we often compare it to the width of a hair or the weight of a grain of sand. How many carbon atoms lined up would equal to the width of a hair? How many silicon atoms piled up would equal to the weight of a grain of sand? (Hint: Google for the missing information. The estimation will be very rough. Approximate answers will be good enough.)
6. The Earth is moving around the Sun along an orbit that is approximately circular. The radius of the orbit is 150 million kilometers. The Earth can complete a full circle in approximately 365.25 days (that is, one year). Within half a year, what is the average velocity and the average speed of the Earth relative to the Sun? (Hint: draw a diagram of the orbit.)
7. A car accelerates from 0 to 65 km/h in 5 seconds. How much is the average acceleration of the car? Assuming the acceleration is indeed constant, how far has the car moved by the end of the 5-second acceleration period?
8. Spider-Man jumped off a building that is 112 meters tall with zero initial vertical velocity. If he fell without the aid of air resistance and his superpower (which is NOT the actual case), how much time would it take before he hit the ground? How much distance would he have moved in the last one second of the fall? (Hint: The second question builds on the first question.)