MONTY PYTHON'S GALAXY SONG

Whenever life gets you down, Mrs. Brown,
And things seem hard or tough,
And people are stupid, obnoxious, or daft,
And you feel that you've had quite enough,
Just remember that you're standing on a planet
That's evolving and revolving at 900 miles an hour.
It's orbiting at 90 miles a second, so it's reckoned,
A sun is the source of all our power.
The sun and you and me and all the stars that we can see,
Are moving at a million miles a day,
In an outer spiral arm at 40 thousand miles an hour,
Of the galaxy we call the Milky Way.
Our galaxy itself contains a hundred billion stars,
It's a hundred thousand light years side to side,
It bulges in the middle sixteen thousand light years thick,
But out by us, it's three thousand light years wide.
We're thirty thousand light years from galactic central point,
We go round every two hundred million years,
And our galaxy is only one of millions and billions
In this amazing and expanding universe.
The universe itself keeps on expanding and expanding
In all of the directions it can whiz,
As fast as it can go, the speed of light, you know,
Twelve million miles a minute,
And that's the fastest speed there is.
So remember, when you're feeling very small and insecure,
How amazingly unlikely is your birth,
And pray that there's intelligent life somewhere out there in space,
Because there's bugger all down here on earth.

The lyricist for Monty Python's Galaxy Song probably found his information in an astronomy textbook. Your task in the following exercise is to use your textbook (*Astronomy Today b*y Chaisson & McMillan, 4th Ed.) to verify the accuracy of the lines of the song which are printed in bold type above. The textbook page references are intended only as a guide, and you should feel free to use information from other sources or from other pages in the text. **You should cite all references used in writing your answers even if your reference is one of those listed in the exercise.**

For the purpose of this exercise, you are to assume that the “true” answer is the best answer you can come up with from your reading. Don't worry if your answers disagree with information found in the song.

1. Monty Python (M. P.) says, "Earth **revolves** at **900 mph**."

   a) By "revolve," M. P. means _____.

   b) The "true" speed is _____ mph. [p. 170, Appendix 2 (hereafter "A2"), A3 (Table 1)] (Hint: Speed = distance/time; Circumference = □ □ diameter)
   Show calculations.

2. M. P. says, "Earth **orbits** at **90 mi/sec**."

   a) By orbit, M. P. means _____.

   b) The "true" speed is _____ mi/sec. [p. 170, A2, A3 (Tables 1, 3A)]
   Show calculations. (See hint for #1b)

3. M. P. says, "the sun is the source of all our power."
Was M. P. correct in this statement? _____ [pp. 406-408] **Explain** your answer briefly.

4. M. P. says, "the sun moves a **million miles per day**."

   a) To what motion does M. P. refer?

   b) The "true" speed is _____ miles/day [p. 609, A2, A3 (Table 1), Glossary] **Show calculations.**

5. M. P. says the Milky Way Galaxy contains **100 billion stars**. On p. 616, the book states that the mass of the Milky Galaxy is some 10^{11} solar masses or so, thus M.P. would be correct **if all stars had the same mass as the sun**. Comment on the validity of this assumption. [pp. 457-461]

6. M. P. says, "the diameter of the galaxy is **100,000 light years**."

   a) One light year is the distance that _____. (pp. 4,)

   b) Given that the speed of light is 3×10^8 meters/sec (A1, A2), show that one light year is about 9.46×10^{12} km. **Show calculations**. (Hint: distance = speed × time) [A2, A3 (Table 1), Glossary]

   c) The "true" diameter of the galaxy is _____ light years. [pp. 608, A2, A3 (Table 1)]. **Show calculations.**

7. M. P. says, "the Earth is **30,000 light years** from the center of the galaxy." The "true" distance to the center of the galaxy is _____ light years. [pp. 608 A2, A3 (Table 1)]
Show calculations.

8. M. P. says, "the earth goes around the center of the galaxy once every **2×10^8 years**." The "true" time for the earth to orbit the galactic center is _____ years. [p. 609]

9. M. P. says, "the universe is expanding." Cite one piece of evidence in support of this statement and **explain** briefly. [pp. 651-652, Glossary]

10. M. P. says, "the speed of light is **Twelve million miles a minute**" (1.2×10^7 miles/minute).

a) The "true" speed of light is _____ miles/minute. [A2, A3 (Table 1), Glossary)] **Show calculations.**

b) Other than light, what other forms of radiation move at this speed? [p. 65]

11. M. P. says there are "**billions** of galaxies in the universe." The "true" number of galaxies in the universe is _____ galaxies. The number of the galaxies in the universe can be estimated from the mass of the universe if the mass of an "average" galaxy is known. For this calculation, assume a spherical universe [Volume = $(4\pi/3)$ $(\text{radius})^3$] with a radius equal to the speed of light multiplied by the age of the universe [about 15 billion years, p. 705]. Also assume that the Milky Way, which has a mass of about 10^{11} solar masses [p. 616], is an "average" galaxy. The mass of such a hypothetical universe would be equal to the density of the universe, 3×10^{-28} kg/m^3, multiplied by the volume of the universe. **Show calculations.** [p. 705, A2, A3 (Table 1)]