1. A rough idea of the relative sizes, masses, and orbital radii of various objects in the Solar System is useful for order of magnitude estimation. Look up the physical parameters for the Solar System objects listed below and compute the quantities requested. Wikipedia and your textbook are good sources. Use the minimum number of significant figures necessary to ensure uncertainties of no more than \( \sim 10\% \).

(a) Mass of Earth in terms of mass of Moon.
(b) Radius of Earth in terms of radius of Moon.
(c) Radius of Moon’s orbit in terms of radius of Earth.
(d) Radius of Earth’s orbit in terms of radius of Moon’s orbit.
(e) Mass of Jupiter in terms of mass of Earth.
(f) Radius of Jupiter in terms of radius of Earth.
(g) Radius of Jupiter’s orbit in terms of radius of Earth’s orbit.
(h) Mass of Pluto in terms of mass of Earth.
(i) Radius of Pluto in terms of radius of Earth.
(j) Radius of Pluto’s orbit in terms of radius of Earth’s orbit.
(k) Mass of Sun in terms of mass of Jupiter.
(l) Radius of Sun in terms of radius of Jupiter.

2. In MKS units, Newton’s gravitational constant \( G \simeq 6.67 \times 10^{11} \text{ m}^{-3} \text{ kg}^{-1} \text{ s}^{-2} \). Astronomers often use non-standard units: the “Astronomical unit” (1 AU \( \simeq 1.496 \times 10^{11} \text{ m} \)) is the average distance between the Earth and the Sun, the year (1 yr \( \simeq 3.156 \times 10^{7} \text{ s} \)) is the time the Earth takes to orbit the Sun, and the “Solar mass” (1 M\( \odot \simeq 1.989 \times 10^{30} \text{ kg} \)).

(a) Find integers \( \alpha, \beta, \gamma \) such that the expression
\[
G^\alpha (1 \text{ AU})^\beta (1 \text{ yr})^\gamma
\] (1)
has units of kilograms (kg).
(b) Evaluate this mass numerically and compare your result to the Solar mass, M\( \odot \).

3. The number of significant figures used to express a number is an informal way of indicating its uncertainty. For example, \( a \simeq 1.5 \) implies that \( a \) is in the range 1.45 to 1.55; thus \( a \) is specified with an uncertainty of \( \sim 3\% \). Let \( x \simeq 1.0 \) and \( y \simeq 10.0 \). Estimate the percentage uncertainty of the following expressions.

(a) \( x \).
(b) \( y \).
(c) \( x + y \).
(d) \( xy \).
(e) \( \sqrt{x} \).
(f) \( e^x \).
(g) \( x^y \).