

NAME:

SECTION:

**1.** Velocity  $v$  is defined as  $v = \frac{\Delta x}{\Delta t}$  where  $\Delta x$  is the *displacement* and  $\Delta t$  is the *time interval*. We denote the dimensions of a quantity by the bracket symbol around that quantity. For example  $[\Delta x] = L$ ; that is to say, the dimension of displacement is length, denoted  $L$ . Other relevant dimensions include time  $T$ , mass  $M$ , and charge  $Q$ . A *system of units* associates with every dimension a unit value against which all other quantities in that dimension are measured (e.g, in SI units, the unit of length is the meter  $m$  and all other lengths are measured in meters).

i) What are the dimensions of velocity  $v$ ? What are its units in SI?

ii) Momentum is defined as  $p = mv$  where  $m$  is mass and  $v$  is the velocity. What are the dimensions of  $p$ ? What are its units in SI?

iii) Force is defined as  $F = ma$  where  $a$  is the acceleration and  $m$  is the mass. What are the dimensions of  $a$  and  $F$ ? What are the units of  $a$  and  $F$  in SI?

iv) Work is defined as  $W = F\Delta x$  where  $F$  is the force and  $\Delta x$  is the displacement. What are the dimensions of  $W$ ? What are its units in SI?

**2.** SI units include prefixes to denote the what power of 10 a quantity is measured in. For example, centimeters are one hundredths of a meter, denote  $cm$ . This is consistent with our method above:  $1cm \frac{1m}{100cm} = 0.01m = 10^{-2}m$ . Hence a  $c$  prefix before a unit is equivalent to a coefficient of  $10^{-2}$  on that unit.

i) Convert meters  $m$  to kilometers  $km$ . Given:  $kilo = k = 10^3$ .

ii) Convert milligrams  $mg$  to kilograms  $kg$ . Given:  $milli = m = 10^{-3}$ .

iii) Convert microseconds (s) to megaseconds (Ms). Given:  $micro = \mu = 10^{-6}$ ,  $mega = M = 10^6$ .

**3.** To convert between systems of units you multiply by the ratio of the new unit to the old. For example, if you want to convert meters to feet, you multiply one meter *by the ratio of one foot to one meter*. This ratio is known as a *conversion ratio*, and can be measured. Since there are  $3.28ft/m$  (measure it),  $(1m) \frac{3.28ft}{1m} = 3.28ft$ . As another example, say you want to convert minutes to seconds;  $(1min) \frac{60s}{1min} = 60s$ .

ii) Convert one meter to miles. Given:  $(1mile = 1609.344m)$ .

ii) Convert one mile per hour ( $mile/hr$ ) to meters per second ( $m/s$ ).

iii) Convert one kilogram meter per second ( $kg \cdot m/s$ ) to one pound mile per hour  $lb \cdot mile/hr$ . Given:  $1lb = 0.45359237kg$ .