As part of an examination a few years ago, a student went through the manipulations on an exam shown at the right. At this point you don't know what the symbols mean, but given the dimensions associated with each symbol, decide whether the conclusion (Eq. D) can possibly be correct.

$[M] = \mathrm{M}$

$[g] = \mathrm{L/T^2}$

$[h] = \mathrm{L}$

$[\omega] = 1/\mathrm{T}$

$[v] = \mathrm{L/T}$

$[R] = \mathrm{L}$

$[I] = \mathrm{ML^2}$

$(A) \quad Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$

$(B) \quad Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}\left(MR^2\right)\omega^2$

$(C) \quad Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}\left(MR^2\right)\left(\frac{v^2}{R}\right)^2$

$(D) \quad gh = \frac{1}{2}v^2 + \frac{1}{2}v^4$

1. Yes
2. No
3. You can't tell without more information

If we agree that (Eq. D) cannot possibly be correct because of dimensions,
is it because the starting equation (Eq. A) is dimensionally incorrect?

$$[M] = \mathrm{M}$$
$$[g] = \mathrm{L/T^2}$$
$$[h] = \mathrm{L}$$
$$[\omega] = \mathrm{1/T}$$
$$[v] = \mathrm{L/T}$$
$$[R] = \mathrm{L}$$
$$[I] = \mathrm{ML^2}$$

$$(A) \quad Mgh = \tfrac{1}{2}Mv^2 + \tfrac{1}{2}I\omega^2$$
$$(B) \quad Mgh = \tfrac{1}{2}Mv^2 + \tfrac{1}{2}\left(MR^2\right)\omega^2$$
$$(C) \quad Mgh = \tfrac{1}{2}Mv^2 + \tfrac{1}{2}\left(MR^2\right)\left(\frac{v^2}{R}\right)^2$$
$$(D) \quad gh = \tfrac{1}{2}v^2 + \tfrac{1}{2}v^4$$

1. Yes
2. No
3. You can't tell without more information