OCR Mechanics 1 Module Revision Sheet

The M1 exam is 1 hour 30 minutes long. You are allowed a graphics calculator.

Before you go into the exam make sure you are fully aware of the contents of the formula booklet you receive. Also be sure not to panic; it is not uncommon to get stuck on a question (I've been there!). Just continue with what you can do and return at the end to the question(s) you have found hard. If you have time check all your work, especially the first question you attempted... always an area prone to error.

$\mathscr{J}.\mathscr{M}.\mathscr{S}.$

Preliminaries

- Most mistakes in Mechanics tend to be "sign" issues. You must have a clear sense of which way you are 'defining' to be positive. It doesn't matter which way you define positive to be, but you must then be *consistent* through the whole question and interpret your answer in the context of that definition.
- Sometimes it will not be obvious which direction a quantity points; don't worry too much about it, just put an arrow and variable name next to your sketch. If the variable turns out positive then your guess was correct. If negative then it turns out it points the other way to which you guessed.
- This is going to sound somewhat 'new-age', but in Mechanics you must have a "feel" for what your equations are saying. You should be saying to yourself things like "So as t gets bigger, s gets bigger until the quadratic peak and then starts to fall". Quite often you can spot mistakes because the equations you construct simply have the wrong properties.
- In some problems involving surfaces at an angle, instead of explicitly giving the angle ($30°$, say) they will tell you that the angle α is such that $\tan\alpha = \frac{4}{3}$. *Do not* work out α by going to your calculator and typing $\tan^{-1}\frac{4}{3}$. Instead draw a right angle triangle such that $\tan\alpha = \frac{4}{3}$; using Pythagoras' Theorem we see that $\sin\alpha = \frac{4}{5}$ and $\cos\alpha = \frac{3}{5}$. Much nicer!

Forces

- You should not think of it as $F = ma$ and I don't ever want to see it written down. You should think of it as

$$\textit{Resultant}\ \text{Force} = ma.$$

Friction

- Friction always points in the direction opposing the motion or the potential motion (i.e. the motion that *would* occur if there was no friction).
- If a particle is moving or "on the point of moving" or "in limiting equilibrium" then friction is maximal such that

$$F_{\max} = \mu R.$$

  This is lovely in questions because it gives you a concrete equation to work with, rather than a slippery inequality.

"SUVAT" Equations (a.k.a. Kinematics Equations)

- You must know (and be able to use proficiently) the SUVAT equations. Each equation involves four of the five variables s, u, v, a, t. They state (in roughly decreasing order of importance IMHO):

$$\begin{aligned} v &= u + at, \\ s &= ut + \tfrac{1}{2}at^2, \\ v^2 &= u^2 + 2as, \\ s &= \left(\frac{u+v}{2}\right)t, \\ s &= vt - \tfrac{1}{2}at^2. \end{aligned}$$

  I have heard it stated by a person I respect that the last of those five is not a SUVAT equation; for the sake of elegance and symmetry I respectfully disagree.

- You can only use the SUVAT equations if you have a *constant* acceleration. Enough students (even moderately bright students with my poor teaching) balls this up at some point or another that I will say it again:

  "You can only use the SUVAT equations if you have a *constant* acceleration."

- I always insist students draw a table (no matter how simple the question is) and fill in what they know and what they *want* to know. I also demand an arrow to show which way they are defining *positive* to be in the context of the question. For example work out the maximum height reached by a ball thrown from ground level upwards with speed 20ms^{-1} I would expect:

	s	u	v	a	t
($\uparrow$)	x	20	0	-9.8	-

  We have defined up to be positive (therefore $a = -9.8$) and we don't care about time so the equation we need is $v^2 = u^2 + 2as$. You must also start by writing down the equation you are going to use to show anyone reading/marking your work what you are trying to do[1].

General Motion

- Blah

Momentum

- The momentum of a particle is its velocity times its mass. It is a vector quantity.

importance of velocity time graphs
combining and splitting forces
good force diagram vital to success of mechanics.... don't mix force diagrams between objects....draw them as rectangles with forces coming out of the object.
don't simplify within the diagram....take components in the second.
reactions always at right angles to surface (not always equal to the weight!)

[1] Mechanics work, in particular, can turn into a bit of a bombsite if you're not careful.

friction always opposes motion or potential motion. Example ti figure out which out which way in ambiguous case.
strings distribute tensions
forces in equilibrium