L3 MECHANICS
CHEAT SHEET

STUDY TIME

ABOUT THE STANDARD

- The mechanics exam will be subdivided into the following four main topics:
  - **Linear mechanics:** distance, velocity and acceleration.
  - **Circular motion:** Centripetal force and acceleration.
  - **Rotational mechanics:** angular distance, velocity and acceleration.
  - **Simple Harmonic Motion:** repeated motion about a fixed point, with an acceleration towards and dependant on the distance from this fixed point.
- You can expect to see two types of questions: calculations and conceptual/writing based questions.
- This 'cheat sheet' consists of tips and tricks aimed to equip you with the right strategies so you can come out on top!

STRATEGIES FOR SUCCESS

- Depending on whether you are faced with a calculation or conceptual/writing based question, there are different strategies you might consider taking.
- Calculation based questions:
  - As a general strategy, the following 3 points should be taken into account:
  1. A good way to approach a question is to draw a picture or free body diagram. This simplifies and summarises the problem.
  2. Next it is good practice to note down all knowns and unknowns, which is the 'stuff' you are trying to find. Label these with their appropriate symbol and make sure you write down their units! This will make it easier to plug the information into equations and check that the units you are using are correct.
  3. Once all the information is down, equations linking the knowns with the unknowns can be chosen from the equation sheet in order to solve the question.
- As a general strategy for **conservation/equilibrium type questions**, it is good to **start with a general equilibrium or equality equation** and expand from there (eg. Ei = Ef, τcw = τccw, Fup = Fdown).
  - For example, consider a satellite orbiting the earth. If it is following a 'geostationary orbit', we know that by definition, it maintains a fixed position with respect to earth. In this case we know that the only force acting on the satellite is the centripetal force, which is fully supplied by and is therefore equal to the force of gravity. By evaluation of these forces, the equality can then be expanded until the variable you are looking for is isolated. Refer to the working below:

    $Fg = Fc$

    $mv^2/r = GMm/r^2$

  - This simple approach gives the question clarity, order, and a direction.
  - Note that for angular mechanics, it is very important to consider linear and angular variables such as energy and momentum separately.
- It is important you **understand the formula sheet inside out** - the units, what each letter means, and how to find each letter.

- Finally, it is very important you **extract all relevant information given in the question before you approach to answer it**. Sometimes a question might include wordy information which gives you the value of an important variable. It is crucial to understand the meaning behind such clues and make a note of them prior to starting the question. Consider the following examples:
  - "At the top of the loop, the force that the track exerts on the car is zero." (circular motion)
    - This means that as there is no reaction force exerted by the track, the force of gravity must equal the centripetal force at this point. (Fg = Fc)
  - "Calculate the time taken for the system to complete one rotation." (angular mechanics)
    - 'One rotation' is 360 degrees, or 2π radians. As by convention angular distance is given in radians, this tells you that Θ = 2π at the time of interest. Similarly, if the question said "three full rotations", you would know that Θ = 6π.
  - "...the object starts from rest."
    This statement means that the initial angular and linear velocity = 0.
- **Conceptual/writing based questions:**
  - As a general strategy, the following approach to questions should be considered:
    In physics it is important to explain ideas using the appropriate physical terms and variables. Most of the time some of these are incorporated into the question itself. Make sure you highlight or write out these terms along with variables related to them and incorporate them into your answer.
  - For example, you might get asked to evaluate how the speed of an object changes over a given scenario. In such case, the variables you might want to note down and incorporate into your answer are speed, force and acceleration, as they all interlink.
- A good approach to take in order to answer conceptual questions is to **link variables through equations:**
  - Quite often you are asked how a change in one variable inflicts a change in another. Make sure you always look at and write down the relevant equations associated with the problem. From there, you can explain what happens based on all of the letters in the equations. Remember you can include equations in your answer directly to aid your explanation.
  - For example, if the question asks how the increase in inertia of a rotating system affects its period of rotation, it is useful to look at the following formula: L = Iω. Assuming angular momentum (L) is conserved, an increase in inertia (I) will cause a decrease in angular velocity (ω), which means that the period of rotation will decrease.

HOW TO PREPARE FOR THE EXAM

- The best way to prepare for physics is to just practice! Make sure you attempt all of the last 3-4 years of past exam papers,
- Make sure you reflect on each question you attempted and note down learning points. Keep a collection of these **learning points** on a sheet, and go through them frequently to avoid making the same mistake twice!
- If you particularly struggle with some questions, make sure you note them down and attempt them again a few days later to see if you can remember the steps. Use your sheet full of 'learning points' for clues if you get stuck again.
- Also check out the StudyTime Walkthrough Guide and Checklist to really check and consolidate your knowledge and feel 100% prepared!