Projectile Assignment (30%)

Note: there will be penalties for late submissions

### Write a program that will demonstrate the flight

**of an object moving through a fluid.**

**Note:**

* Demonstrate does not necessarily mean that you show any graphics.
* The object can be any shape, mass etc.
* The fluid can be air, methane, water, olive oil etc.
* The fluid may be static or moving.
* The object may be rotating as it flies through the fluid.
* The user should, at a minimum, have the ability to change the initial conditions of the object i.e. you may assume the existence of a type of gun which will set the object off with particular initial conditions. The user should be able to vary these initial conditions and see the corresponding results.
* A text file should also be produced that prints out the main properties of the object at various moments in time (used for testing purposes). These properties should include: time, position, velocity, acceleration and any other properties that vary with time.

**What we have done to date that might be of help:**

Forces & Method: Gravity, Drag, Magnus, RK4

Testing: Constant Acceleration, Terminal Velocity, by hand

**What you need to create:**

1. A program written any language you see fit – however you should chat with me if you intend writing in a language that is not supported in DkIT.

The name of this file should be **CA\_ your\_names.XXX** e.g. CA2\_shane\_dowdall\_john\_smith.c

1. A word file explaining (by hand and in detail) three **worked examples** and a screen shot of the result of running these examples on your program. Information that should be present include: the object and its properties, the fluid and its properties, the initial conditions of the object and a detailed explanation of the flight. The first of your 3 examples should be a gravity only model where the object starts at the origin at time 0 and the initial velocity is .

Also, in this word file you should have 2 appendices:

Appendix A: “**Assignment Cover Sheet**”

Appendix B: “**Program Overview sheet**” (a template is given at the end of this doc)

The name of this file should be **CA2\_your\_names.docx**  e.g.CA2\_shane\_dowdall\_john\_smith.docx

**What do you do with these files:**

**Upload into moodle** a zip file containing the following 2 files:

1. The word file described in part 2. above
2. The program described in part 1. above

Note 1: **Only one member of the team should upload** material into moodle

Note 2: Compress the files use 7-Zip

**How you may work:**

You must work in pairs (unless you have been given permission to work individually). The project will be marked independently of the number of people who worked on it. If you work on your own then that person will get the project mark. If you work in a pair then both individuals will be given the project mark. Thus, there is no reason not to work in pairs!

**Interview:**

There will be an interview (approximately 10mins) during which you will explain your program in detail. This is compulsory – if you do not do the interview then the mark for this CA will be 0.

**and finally…**

## Keep in mind this is a physics course – you need to demonstrate that you understand the underlying physics. Hence, there are marks for graphics but they only kick in once the physics is correct!

You cannot get more than 70% in this CA unless you have implemented the Runge-Kutta method.

**Program Overview Sheet**

**Name(s):** Vilandas Morrissey (D00218436), Jack Maguire (D00219343)

**Program Features**

In the following table - place a tick in the box beside a question if the answer is **“yes”** to that question (otherwise leave the box blank):

|  |  |  |
| --- | --- | --- |
| Have you included **3 Worked Examples**, in your word file, that  can be used for testing all aspects of the project? | | Y |
| Have you loaded the output of your programme into an excel sheet and compared the answers you got with your worked examples? | | Y |
| Is the object, being simulated, a **ball**? | | Y |
| Does the program simulate: | **1D** motion? |  |
| **2D** motion? |  |
| **3D** motion? | Y |
| Did you implement the **Runge-Kutta** Method | | Y |
| Did you include the effects of **Gravity**? | | Y |
| Did you include the effects of **Drag**? | | Y |
| Did you include the effects of **Wind**? | | Y |
|  | |  |
| Does the object **Spin**? | | Y |
| If yes, does the **Spin vary** as the projectile moves? | |  |
| If yes, does the **Spin** have an effect on the motion (3D case)? | | Y |
| Is the object’s spin evaluated as if it was a sphere? | | Y |
|  | |  |
| Graphics – did you **graphically simulate** the motion? | | Y |
| If yes, did you account for the **range varying** for different projectiles? | | Y |
| If yes, did you account for the **height varying** for different projectiles? | | Y |
| If yes, can the object be **viewed from many angles** (3D case)? | | Y |
| What is your pixel to metre ratio? | |  |
|  | |  |
| When does the **simulation stop**? | after a certain time |  |
| when object hits ground | Y |
| other |  |
|  | |  |
| Are there **multiple objects** being simulated? | |  |
|  | |  |
| **Other noteworthy features:** | |  |
|  | |  |
|  | |  |
|  | |  |
|  | |  |
|  | |  |
|  | |  |

**Which variables can the user vary (in your program)?**

Place a tick in the box beside variables you can vary in your program (otherwise

leave it blank):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Positions | p0i | Y | p0j | Y | p0k | Y |
| Initial Velocities | v0i | Y | v0j | Y | v0k | Y |
| Mass | m |  |  |  |  |  |
| Gravity | g | Y |  |  |  |  |
|  |  |  |  |  |  |  |
| Drag | CD | Y |  |  |  |  |
| FrontalArea | A |  |  |  |  |  |
| Density |  | Y |  |  |  |  |
|  |  |  |  |  |  |  |
| Initial Angular Velocity |  |  |  |  |  |  |
| Radius | r | Y |  |  |  |  |
| Spin axes (3D case) | Ri | Y | Rj | Y | Rk | Y |
|  |  |  |  |  |  |  |
| Wind | wi | Y | wj | Y | wk | Y |
|  |  |  |  |  |  |  |
| Multiple Objects |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **List here any other variables the user can vary:** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Step size |  |  |  |  |  |  |
| Mass is dependent on density and volume |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Below here, include any other special features that you would like to draw my attention to.**