



Semester: Winter 2013

Date/Time: Tuesday 7th January 2014, 10AM

Programme: Bachelor of Science (Honours) in Computing (Games Design and Development)

Stage: Year 4

Module: Game Physics

COMP08030

Time Allowed: 2 Hours

Instructions: Attempt any four (4) questions

Additional Attachments:

External Examiners:
Dr Michael English

Internal Examiners:
Mr Seamus Hoyne, Mr Eugene Kenny

Question No. 1**(25 Marks)**

- (a) You are writing a game set in classical times that involves using a large trebuchet catapult to launch missiles against the walls of an enemy castle. (10 marks)

Describe in detail the physical forces that must be considered in launching the missile, calculating the trajectory and the effect on the castle walls upon impact. Your answer should take into account also the relevant characteristics of the catapult, the missile and the castle wall. If you were simulating this in a game what real world physics elements do you think you would ignore or simplify and give your reasons?

- (b) If one of the missiles above is launched at a height above ground of 10m at a speed of 35m/s and at an angle of 30 degrees to the horizontal at what height will it impact the castle wall assuming it is 110m distant? (15 marks)

Note: $\cos(30) = 0.866$, $\sin(30) = 0.5$

Question No. 2**(25 Marks)**

- (a) Briefly compare the numerical methods: Explicit Euler, Implicit Euler and Verlet. (10 marks)
- (b) For a time dependent variable, $x(t)$, satisfying the equation: (15 marks)

$$x(t) = 100t - 2t^2$$

and with $x = 0$ at $t = 0$ show how you would solve for x using

- (i) Semi-implicit Euler
- (ii) Verlet

Question No. 3**(25 Marks)**

- (a) How would you detect if two circles were overlapping given their respective centres and radii? (5 marks)
- (b) State the *Separating Axis Theorem* (SAT). Illustrate how it works for two polygon shapes such as a triangular object and a rectangular object. If one of the objects was curved would SAT be of any use? (10 marks)
- (c) What is a Minkowski sum and when would it be used? Illustrate your answer by drawing a Minkowski sum of a circle and a triangle. (10 marks)

Question No. 4**(25 Marks)**

- (a) What is meant by the term coefficient of restitution and it applies to objects involved in a collision? (5 marks)
- (b) Explain how conservation laws are used to model collision resolution. (10 marks)
- (c) Describe a physics model that is sometimes used to represent cloth. (10 marks)

Question No. 5**(25 Marks)**

- (a) What is your view of doing physics on the GPU such as with PhysX or on the CPU such as with Havok? (10 marks)
- (b) What in your opinion are the pros and cons of writing your own physics engine compared to using one off the shelf? (15 marks)