LIT
DEPARTMENT OF
INFORMATION TECHNOLOGY

Semester: Semester 1 (Winter 2015/16)

Date/Time: Friday 18th December 2015, 2 PM – 4 PM

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

Stage: Year 4

Module: GAME PHYSICS

COMP 08030

Time Allowed: 2 hours

Instructions: Attempt any four (4) questions

Additional Attachments: Formula Sheet

External Examiners: Derek O'Reilly
Internal Examiners: Janice O'Connell, Eugene Kenny

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

(a) In a soccer game, the player is attempting a penalty kick at a distance of 11 meters from the goal. The ball reaches the goal in a straight line after 1 second. What was the average acceleration of the ball? *(10 marks)*

(b) A missile is launched at a height above ground of $10m$ at a speed of $35\ m/s$ and at an angle of 30 degrees to the horizontal. At what height will it impact a castle wall $110\ m$ distant? *(15 marks)*

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

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

(a) Outline the *Explicit Euler*, *Implicit Euler* and *Verlet* numerical integration algorithms. *(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 each of the numerical integration methods mentioned above.

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

(a) *Spatial partitioning* data structures are commonly used to make the fast selection of models to test in a collision detection system. Outline in detail two such data structures. *(10 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? *(15 marks)*

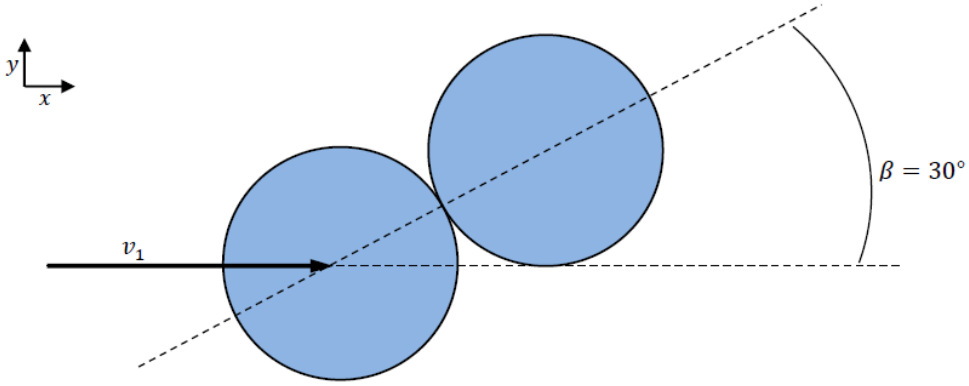
Question No. 4 **(25 Marks)**

(a) Explain how conservation laws are used to model collision resolution. *(10 marks)*

(a)

(b) Assuming the following objects, in which direction and with what speed do the two balls move after the collision? *(15 marks)*

The left ball speed is 10 m/s, the coefficients of restitution are both 0.5, and the two masses are each 1 kg.



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

(a) Describe a physics model that is sometimes used to represent cloth and other soft bodies. *(10 marks)*

(b) What in your opinion are the advantages and disadvantages of writing your own physics engine as compared to using a commercial one? *(15 marks)*