NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

ENGINEERING MECHANICS – KINEMATICS AND DYNAMICS

TCW 1201

Main Examination Paper

May 2015

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: NONE

Examiner's Name: ENG. K. MUSHUNJE

INSTRUCTIONS

1. Answer ALL questions
2. Each question carries 25 marks

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
TOTAL	100

QUESTION 1

a) Explain the difference between relative motion and absolute motion. State where each is applicable. [5]

b) A particle travels along a straight line such that in 2 s it moves from an initial position $s_A = +0.5$ m to a position $s_B = -1.5$ m .Then in another 4 s it moves from s_B to $s_C = +2.5$ m. Determine the particle's average velocity and average speed during the 6 s time interval. [8]

c) As a train accelerates uniformly it passes successive kilometre marks while traveling at velocities of 2 m/s and then 10 m/s. Determine the train's velocity when it passes the next kilometre mark and the time it takes to travel the 2-km distance. [12]

QUESTION 2

If the car shown in Figure 2 passes point *A* with a speed of 20 m/s and begins to increase its speed at a constant rate of $a_t = 0.5$ m/s^2 , determine the magnitude of the car's acceleration when s = 100 m. [25]

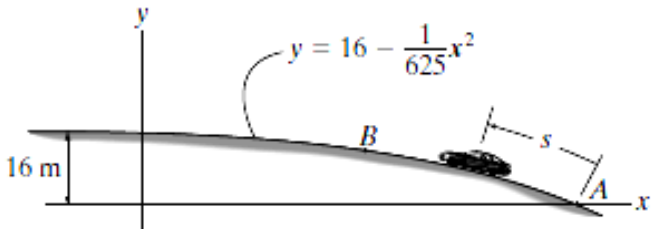

Figure 2

QUESTION 3

The smooth block *B*, having a mass of 0.2 kg, is attached to the vertex *A* of the right circular cone using a light cord as shown in Figure 3. If the block has a speed of 0.5 m/s around the cone, determine the tension in the cord and the reaction which the cone exerts on the block. Neglect the size of the block. [25]

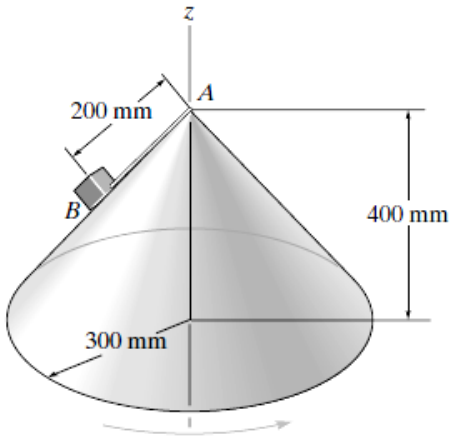

Figure 3

QUESTION 4

The roller coaster car having a mass *m* is released from rest at point *A* as shown in Figure 4. If the track is to be designed so that the car does not leave it at *B*, determine the required height *h*. Also, find the speed of the car when it reaches point *C*. Neglect friction. [25]

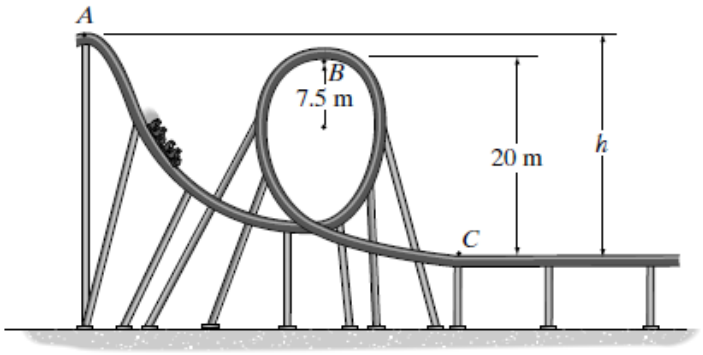

Figure 4

QUESTION 5

a) Explain with the aid of diagrams, were necessary, the following terms used in rigid body kinematics:

i. Translation

ii. Rotation about a fixed axis

iii. General plane motion [9]

b) When only two gears are in mesh, the driving gear *A* and the driven gear *B* will always turn in opposite directions as shown in Figure 5. In order to get them to turn in the same direction an idler gear *C* is used. In the case shown, determine the angular velocity of gear *B* when $t = 5$ s , if gear *A* starts from rest and has an angular acceleration of $\alpha_A = (3t + 2)$ rad/s^2, where *t* is in seconds. [16]

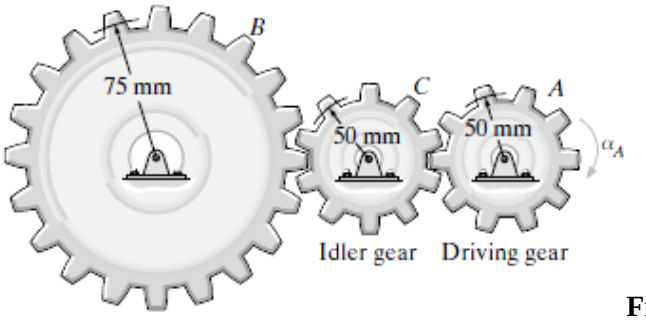

Figure 5