**Specialist Mathematics Unit 4 Investigation 4, 2016**

**Simple Harmonic Motion**

**Take Home Section – due \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**SOLUTIONS**

**Simple harmonic motion and differential equations**

**Part A—The acceleration**

A body is said to oscillate with simple harmonic motion in a straight line if the acceleration on the body is given by the differential equation:

 ,………. (1)

Where X is the distance of the body from the origin x=0 and at points  the body is stationary.



1. Let acceleration = a

X = A a = n2A — meaning it is acting to the right.

X = 0 a = 0 — meaning there is no acceleration on the body.

X = -A a = -n2A – meaning it is acting to the left.

1. ‘The acceleration always points *towards the centre of motion*’

‘The magnitude of the acceleration is at a maximum *at the extremes of displacement’*

‘The magnitude of the acceleration is at a minimum *at the central point of the motion.’*

**Part B—The velocity**

1. Complete the solution to the differential equation above to show : 

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1. Let the velocity be v
   * X= -A v = 0 meaning the body is stationary. Also it is changing its direction of motion.
   * X= 0 v =  the magnitude of the velocity is the same at this point but the direction is opposite.
   * That is the body has a given speed as it passes through a given point.
   * X = -A v = 0 meaning the body is stationary and it is changing its direction of motion.
2. ‘At a given point the magnitude of the velocity is *same as but the direction is opposite to that the last time it passed the point* ‘

**Part C—The displacement**

1. 

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**Part D—The phase shift**

1. Investigate the displacement equation (3)

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**Part E—The change of origin**



1. Show equation for the velocity of the body is given by .

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