Homework 19

1) An object of mass 15kg is placed on a rough surface inclined at an angle of 40^{o} to the horizontal.

A force of magnitude 30 newtons is applied horizontally, and this is just enough to prevent the object sliding down the slope.

a) Calculate the value of the coefficient of friction. **4**

This 30 newton force is then removed, and the object slides down the slope.

b) Calculate the speed of the object after it has travelled a distance of 3 metres down the slope. **3**

2) An object moves with simple harmonic motion about a fixed point O.

When it has moved 30 cm from O the object has a speed of $5ms^{-1}$. The period of the motion is 1.5 seconds.

a) Determine the amplitude of the motion. **3**

b) Calculate the maximum speed of the object. **1**

3) Use integration by parts to determine the exact value of

$$\int_{0}^{\pi/4} e^{4x} \sin 2x \, dx$$ **7**

4) An object of mass 5kg falls from rest under gravity. As the object falls it experiences a resistive force of magnitude kv^2, where k is a constant and v is the speed in ms^{-1}.

a) Given that the maximum speed of the object is $14ms^{-1}$, determine the value of k. **2**

b) Set up a differential equation and show that when the object has fallen a distance of x metres the velocity v^2 is given by

$$v^2 = 20g(1-e^{-0.1x}).$$ **5**