Homework 16

1) A ball of mass 50g has a velocity of $v = (-3\mathbf{i} - 2\mathbf{j})ms^{-1}$. It is struck by a bat and the velocity of the ball immediately after the impact is $v = (4\mathbf{i} - \mathbf{j})ms^{-1}$.

   Calculate the impulse of the bat on the ball.   2

2) Two particles A and B have masses $0 \cdot 4kg$ and $0 \cdot 8kg$. They are travelling along a horizontal surface in opposite directions with speeds of 7ms^{-1} and 5ms^{-1} respectively. They collide and coalesce.

   What is the speed after the collision and state the direction of motion?   3

3) a) An object of mass 15kg is pulled by a rope $3 \cdot 2$ m up a slope inclined at 25° to the horizontal at a constant speed.

   If there is also a resistive force of 20N, find the work done by the tension in the rope.   2

   b) A car is travelling on a horizontal surface. The mass of the car is 1200kg and the engine is working at a constant rate of 15Kw. The car is subject to a resistive force of magnitude 500N.

   Find the acceleration of the car when it is travelling at 15ms^{-1}.

        3

4) A car of mass 1.4 tonnes travelling along a horizontal road at 35ms^{-1} comes to rest under constant braking in 800m.

   If there is a resistive force of 200N, calculate the braking force of the car. 3

5) A bag of mass 20kg is dropped from a height of 15m.

   a) Using energy considerations find the speed of the bag when it hits the ground.

   3

   b) State one assumption you have made. 1

6) A conical pendulum consists of a particle of mass 20 grams attached to a light inextensible string of length 0.6m which is attached to a fixed point A. The particle rotates in a horizontal circle whose centre B is 0.4m vertically below A.

   a) Find the **tension** in the string. 2

   b) Find the angular speed of the particle. 3

7) A satellite is orbiting the Earth at a height of 2500Km. By taking the radius of the Earth to be 6400km find the value of the acceleration due to gravity at this height. 3

8) A particle moves with simple harmonic motion. The period of the motion is $\frac{\pi}{6}$ seconds and its amplitude is 30cm.
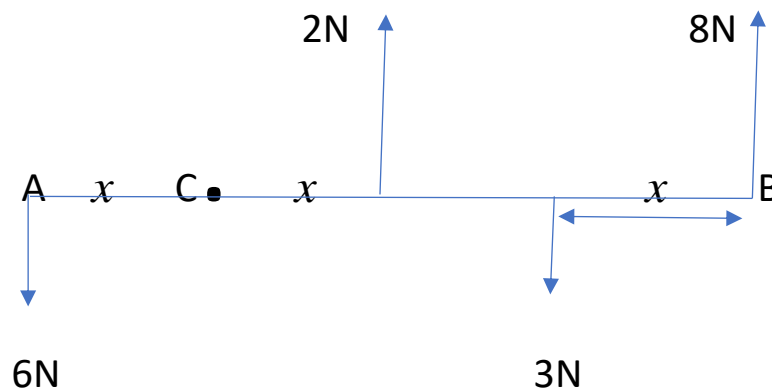
   a) Calculate the speed when it is 20cm from its centre of motion.

         3

   b) Calculate the maximum acceleration of the particle.   1

9) A mass of 1.4kg is suspended from a fixed point by a light elastic string of natural length 0.9m and modulus of elasticity 30N.
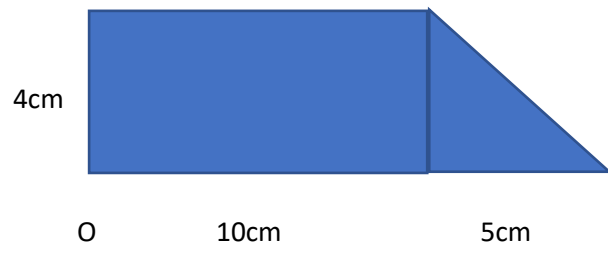
   Find the distance of the new equilibrium position below that of the original.   2

10)

        2N   8N

A x C• x x B

  6N   3N

   The line of AB is $4x$ metres. By taking moments about C find the resultant turning effect of the system and state its direction.

11) Find the coordinates of the centre of mass of the lamina from the origin O.

4cm

O   10cm   5cm   4