Conceptual assignment for newtonian dynamics essay sample

ASSIGN BUSTER

Part 1: Algorithm for solving problems:

STEP 1: Identify the relevant bodies (particles) constituting the given system.

STEP 2: Visualizing the problem:

a) Look for key words describing the motion of the particles. For example, some questions to be addressed are:

- Is the system moving with a constant velocity? If not, is the system moving with a uniform acceleration? What is the nature of acceleration? (positive or negative?)

- What is the relative motion/acceleration of the different particles in the system?

b) Type of motion: Using answers from a), identify the type of motion. For example, is it uniform circular motion?

c) Identify the initial and final values, or the boundary conditions. For this, identifying words like " dropped" is important. It signifies that the initial velocity of the body is zero. Another example is if a body is said to come to a stop. This signifies that the final velocity of the body is zero.

d) Using a and b, identify the forces in the system (is there friction?). Draw the free body diagram for each body – cover all the forces acting ON a body. Do not forget to cover the relevant reaction forces.

Step 2 helps to qualitatively analyze the problem.

STEP 3: Quantitative analysis:

a) Using answers from 2c, and from the data, identify the values given in the problem. All known initial and final parameter values must be identified,

along with a clear understanding of the unknowns that need to be found out.

b) From the analysis so far, decide how the parameters are related mathematically. For example, if it has been identified that a body is accelerating uniformly, then the equations of motion can be used to solve the problem.

c) From the free body diagram, set up the relevant equations using Fnet = ma in each direction, and solve for the unknowns. Remember that forces are vectors, and need to be resolved in known directions for easier analysis. If not, vector algebra using the parallelogram and triangle laws need to be used. Further, the equations must be set up based on a sign conventions used uniformly throughout the problem. For instance, rightward vectors can be considered negative and leftward vectors positive. It is also important to check the units for all parameters. It is advisable to convert them to one single standard – SI units, for example.

STEP 4: Interpretation:

It is important to note that if the required parameter is a vector quantity, then both its magnitude and direction need to be found out. If the answer is negative, it implies that the direction is opposed to the assumed direction. Also, you can cross check values to see if they coincide with the qualitative analysis. For example, if a body comes to a stop, you can expect that the acceleration must be negative (deceleration).

Part 2: Worksheet

EXAMPLE PROBLEM:

A body of mass 20kg is moving initially with a speed of 15m/s on a smooth surface. A constant retarding force of 50N is applied to it. When will it stop?

Step 1: Single body system

Step 2: smooth surface – implies no friction; constant retarding force – implies uniform deceleration (negative); stop – implies final velocity is zero.

Step 3: Data identification: Only force acting: -50N; mass = 20kg; initial velocity = 15m/s; final velocity = 0. Constant acceleration implies equations of motion can be used.

Fnet/m = a = -2. 5m/s2

v = u + at gives t = 6 seconds

Step 4: The body's speed is reducing at the rate of 2. 5 m/s. This means that in 6 seconds, its speed will become 0. This is verified by step 3.

Problems:

1) Two bodies of masses 5kg and 10 kg are connected at the two ends of a string of negligible mass, over a smooth pulley system. Find the tension in the string when the bodies are released.

2) What is the maximum acceleration that a bus can have so that a bag on its floor will remain stationary? (The co-efficient of static friction between the two surfaces is known to be 0. 15)

3) A circular track of 100m is banked at an angle of 15 degrees. If μs between the wheels of a bus and the road is 0. 2, find the maximum allowed

speed for the bus so that it does not slip. Also, what is the optimum speed to avoid wear and tear of the tyres?