**BASKETBALL- VERTICAL JUMPING EXAMPLE**

As part of their training, a basketball coach makes his team jump whilst holding medicine balls. To see who is the best, the coach asks each player to jump as high as they can with five different medicine balls. He times how long each of them is in the air (flight time) and writes it down for jumping with each medicine ball. An example of one player’s flight time for jumping with each medicine ball and the mass of each medicine ball is shown in Table 1. The coach has asked you to calculate how high the player jumped with each ball. He gives you the following formula to use:

Equation 1.



***Where: h = jump height***

***g = acceleration due to gravity (-9.81 m/s)***

***t = flight time***

**1.** Using this formula and the flight times in Table 1 calculate the jump height for jumping with each medicine ball and complete Table 1.

**Table 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Ball 1 | Ball 2 | Ball 3 | Ball 4 | Ball 5 |
| Mass (kg) | 5 | 10 | 15 | 20 | 25 |
| Flight Time (s) | 0.63 | 0.57 | 0.49 | 0.40 | 0.28 |
| Jump height (m) |  |  |  |  |  |

**2.** The coach doesn’t like looking at numbers in a table and so asks you to plot a graph of your results. To illustrate your data for the coach, plot a graph of the mass of each ball vs the jump height you calculated and draw a line of best fit through your data points.

How would you describe the relationship between the mass of the medicine ball used and the jump height achieved?

**3.** You should have found that, as the mass of the ball is increased, jump height decreased proportionally and your line of best fit is a straight line. This type of relationship between two variables is called ‘linear’ and an equation such as equation 2 can be used to describe it.

Equation 2.



***Where: y = variable plotted on the y-axis***

***m = gradient (slope) of the line of best fit***

***x = variable plotted on the x-axis***

***c = intercept of the line at the y-axis***

The slope of the line (***m***) can be calculated as: Equation 3.



***Where: dy = the change in y***

***dx = the change in x***

First, use equation 3 and your data in table 1 to calculate the value of ***m***. Then substitute your value for ***m*** along with values for ***x*** and ***y*** from one jump into equation 2 and solve for ***c***.

**4.** Use equation 2 and the values you have calculated for ***m*** and ***c*** (or your graph) to predict the minimum mass that a medicine ball would need be to prevent the player from being able to jump at all.