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UNIT 1

"FUNDAMENTALS"

(2 hours of theory and 2 hours of exercises)

Preparatory activities

The teacher will present CLIL to the students

What is CLIL?
CLIL offers opportunities to allow youngsters to use another language naturally, in such a way that they soon forget about the language and only focus on the learning topic.
It is usually done through putting aside some time in the school week for learning subjects or special modules through another language. In CLIL the learning of language and other subjects is mixed in one way or another. This means that in the class there are two main aims, one related to the subject, topic, or theme, and one linked to the language. This is why CLIL is sometimes called dual-focussed education.

Imagine learning to play a musical instrument such as a piano without being able to touch the keyboard. Consider learning football without the opportunity to kick a ball yourself. To learn how to
master a musical instrument, or a football, requires that we gain both knowledge and skill simultaneously. In other words, we learn effectively by experiencing both learning about the instrument, and having hands-on practice at using the instrument, at the same time. This is as true of music and football as of language. (from USING LANGUAGES TO LEARN AND LEARNING TO USE LANGUAGES David Marsh)

Students will be invited to speak about this CLIL project.

This CLIL unit that deals with Newton's Laws o one of Newton's laws? is part of the physics plan of the class. It will occur in the second term of the school year and will last.....hours.

Some Physics concepts used in this topic are part of the curriculum of the first term so it will be needed to revise the following:

- Physics quantities and their units

- How to express derived units like m/s or m/s^2
- Maths operator and its expression
- How to express verbally a formula, or a Physics Law
- Scalar and vector quantities;
- Operations with vectors
- Making a graph with Physics quantities
- Average velocity and instantaneous velocity
- Force as vectorial quantities

Maths and Physics Fundamentals

a/b a divided by b

a/b a upstairs b downstairs

a^2 a squared

a^3 a to the power Three

a + b a plus b

a-b a minus b

ΔT delta T

ΔS displacement

> larger

< smaller

0.5 “o point five”

± Plus or minus

= equals or “to find as” or “would be”

Order of magnitude

“the mass has disappeared” (per dire che la massa è stata semplificata in una formula)

I can loose.. (semplificare una variabile)

An object is at rest

To make the assumption (fare l’ipotesi)

To evaluate (calcolare)

Unknown (incognita)

Get smaller or get larger

To take it into account

Concept of Graph or Plot, axis of the Graph, x axis and y axis,

What the value of….is?

Frame of reference (sistema di riferimento)

Tilt (inclinazione)

Unit of time, unit of mass ecc
Concepts of “convert it to” for instance m/s to km/h

Physics quantities	**Units**
Length	meter
Time	second
Mass	kg

Concepts of “convert it to” for instance m/s to km/h

This video will help the students to revise the concepts described here above and will introduce them to the next step:

http://www.youtube.com/watch?v=8WThnNzPsvo&feature=player_embedded#!

Vector quantities

If in Italian Physics texts a vector quantity needs 3 pieces of information to be defined (magnitude or size, direction and versus) in English books it only needs 2 (magnitude or size and direction).

A Vector can be shown by an arrow.

Vectors can be “added together” or subctrated “from each other” or a vector can be multiplied by a scalar.

A · B (leggi ei dot bi:) represents the scalar product

AxB (leggi ei cross bi:) represents another vector (we have to call it prodotto vettoriale)

Let’s see and comment on this video together (about 2.50 minutes).

http://www.youtube.com/watch?v=xJBGfPfE4fQ&feature=player_embedded#at=68

Important cinematic concepts:

distance travelled by an object or “displacement”

time taken to travel a distance

Distance graph: distance travelled vs. Time

Velocity graph: Velocity vs. (versus) Time

Difference between velocity and speed: we have to know that velocity can be negative or positive but speed is the absolute value of velocity, so for instance a speed of - 100 m/s is higher than 30 m/s, while for velocity we find the opposite case.

The distance between 2 points is called “separation”

Friction force

This force we have just studied is very important in order to understand Newton's Laws

This short video will show the students how to face the problem using English language

http://www.youtube.com/watch?v=bWabHxouJW4&feature=player_embedded

Let's have a look at the English text (Newtonian Phisycs Benjamin Crowell) digital version free of charge from www.lightandmatter.com).

Motion with constant velocity

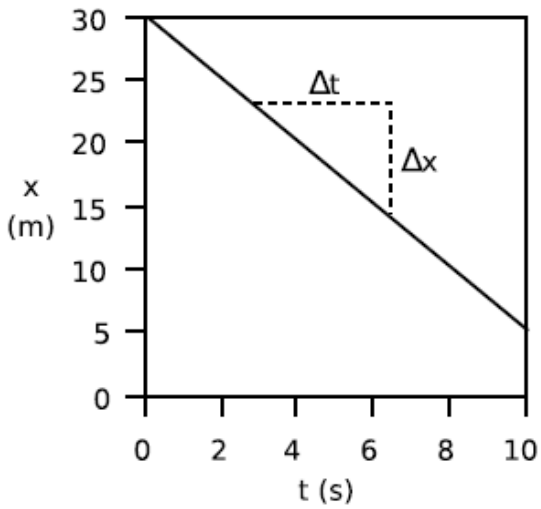
In example o, an object is moving at constant speed in one direction. We can tell this because every two seconds, its position changes by five meters.

In algebra notation, we'd say that the graph of x vs. t shows the same change in position, $\Delta x = 5.0$ m, over each interval of $\Delta t = 2.0$ s. The object's velocity or speed is obtained by calculating $v = \Delta x/\Delta t = (5.0\text{ m})/(2.0\text{ s}) = 2.5$ m/s. In graphical terms, the velocity can be interpreted as the slope of the line. Since the graph is a straight line, it wouldn't have mattered if we'd taken a longer time interval and calculated $v = \Delta x/\Delta t = (10.0\text{ m})/(4.0\text{ s})$. The answer would still have been the same, 2.5 m/s.

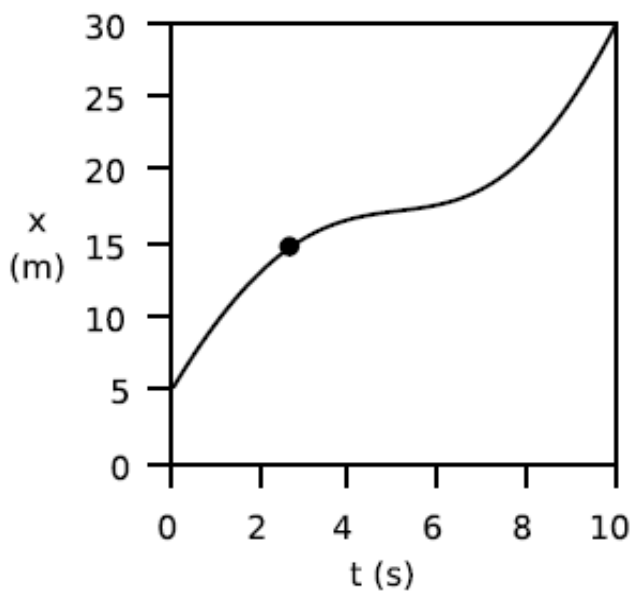
Note that when we divide a number that has units of meters by another number that has units of seconds, we get units of meters per second, which can be written m/s. This is another case where we treat units as if they were algebra symbols, even though they're not.

In example p, the object is moving in the opposite direction: as time progresses, its x coordinate decreases. Recalling the definition of the Δ notation as "after minus before," we find that Δt is still positive, but Δx must be negative. The slope of the line is therefore

negative, and we say that the object has a negative velocity, $v = \Delta x/\Delta t = (-5.0\text{ m})/(2.0\text{ s}) = -2.5$ m/s. We've already seen that the plus and minus signs of Δx values have the interpretation of telling us which direction the object moved. Since Δt is always positive, dividing by Δt doesn't change the plus or minus sign, and the plus and minus signs of velocities are to be interpreted in the same way. In graphical terms, a positive slope characterizes a line that goes up as we go to the right, and a negative slope tells us that the line went down as we went to the right.



p / Motion that decreases x is represented with negative values of Δx and v.



q / Motion with changing velocity.

Example q is similar to example o in that the object moves a total of 25.0 m in a period of 10.0 s, but it is no longer true that it makes the same amount of progress every second. There is no way to characterize the entire graph by a certain velocity or slope, because the velocity is different at every moment. It would be incorrect to say that because the car covered 25.0 m in 10.0 s, its velocity was 2.5 m/s. It moved faster than that at the beginning and end, but slower in the middle. There may have been certain instants at which the car was indeed going 2.5 m/s, but the speedometer swept past that value without "sticking," just as it swung through various other values of speed. (I definitely want my next car to have a speedometer calibrated in m/s and showing both negative and positive values.)

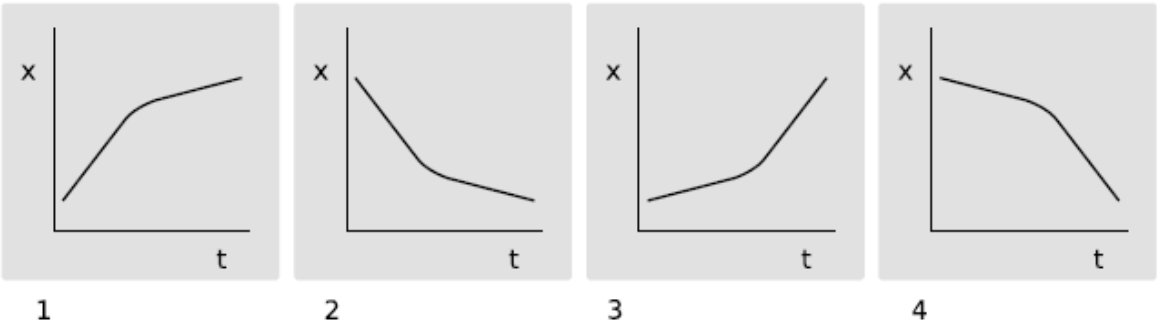
We assume that our speedometer tells us what is happening to the speed of our car at every instant, but how can we define speed mathematically in a case like this? We can't just define it as the slope of the curvy graph, because a curve doesn't have a single well-defined slope as does a line. A mathematical definition that corresponded to the speedometer reading would have to be one that attached a different velocity value to a single point on the curve, i.e., a single instant in time, rather than to the entire graph. If we wish to define the speed at one instant such as the one marked with a dot, the best way to proceed is illustrated in r, where we have drawn the line through that point called the tangent line, the line that "hugs the curve." We can then adopt the following definition of velocity:

definition of velocity

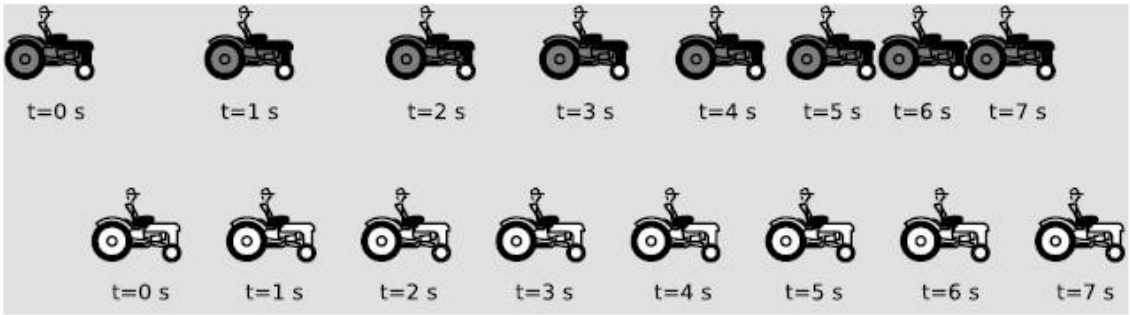
The velocity of an object at any given moment is the slope of the tangent line through the relevant point on its $x - t$ graph.

Exercises (2 hours)
Exercises from A to G from (Newtonian Phisycs Benjamin Crowell) digital version free of charge from www.lightandmatter.com).

A Park is running slowly in gym class, but then he notices Jenna watching him, so he speeds up to try to impress her. Which of the graphs could represent his motion?



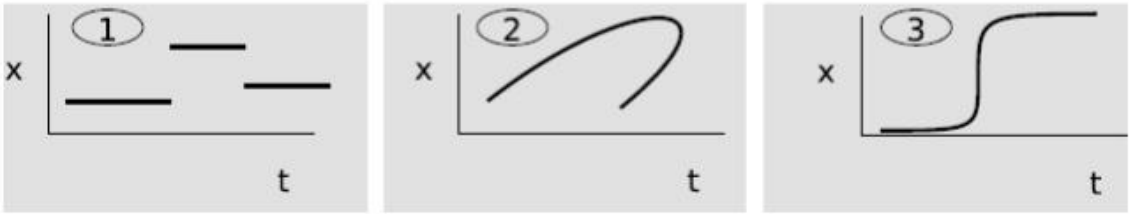
B The figure shows a sequence of positions for two racing tractors. Compare the tractors' velocities as the race progresses. When do they have the same velocity? [Based on a question by Lillian McDermott.]



C If an object had an $x - t$ graph that was a straight line with $\Delta x=0$ and $\Delta t \neq 0$, what would you say about its velocity? Sketch an example of such a graph. What about $\Delta t=0$ and $\Delta x \neq 0$?

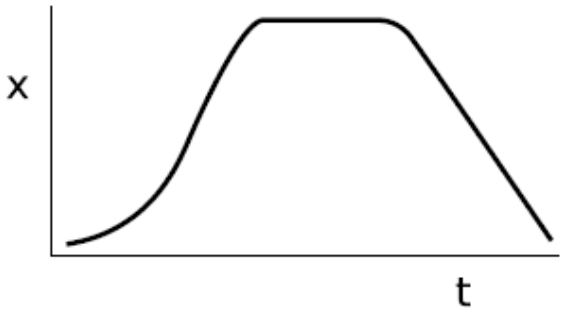
D If an object has a wavy motion graph like the one in figure t on the previous page, which are the points at which the object reverses its direction? What is true about the object's velocity at these points?

E Discuss anything unusual about the following three graphs.



F I have been using the term "velocity" and avoiding the more common English word "speed," because introductory physics texts typically define them to mean different things. They use the word "speed," and the symbol "*s*" to mean the absolute value of the velocity, $s = |v|$. Although I've chosen not to emphasize this distinction in technical vocabulary, there are clearly two different concepts here. Can you think of an example of a graph of *x*-versus-*t* in which the object has constant speed, but not constant velocity?

G For the graph shown in the figure, describe how the object's velocity changes.



H What is the average speed of a sprinter who does the 100 m dash in 11.45 seconds?

I. A police car takes off from rest, reaching a speed of 87.7 mph in 2.11 seconds. What is the average acceleration of the car?

L . A police car takes off from rest with a constant acceleration of 0.007917. How much time does it take to reach a speed of 76.1 mph?