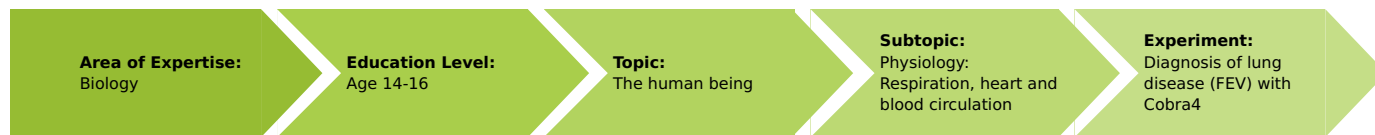


Diagnosis of lung disease (FEV) with Cobra4

(Item No.: P8001360)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



40 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- iPad or Android tablet

Experiment Variations:

- Alternatively, use a PC with measureLAB (14580-61)
- Alternatively, use a Cobra4 Mobile-Link (12620-10)

Keywords:

Pulmonary disease, Forced expiratory volume (FEV), Vital capacity, Tiffeneau value, Obstructive respiratory illness, Restrictive respiratory illnesses

Teacher information

Introduction

Principle

The forced expiratory volume per one second provides information which assists in the diagnosing of whether a patient so tested could possibly have an obstructive lung illness. Therefore it is in regular use in lung illness diagnostics and pulmonary function tests. It is not usable for restrictive lung illnesses as, because of the reduced vital capacity in such a case, a too high quotient of approx. 75% would still be reached.

This experiment is intended to relate to medical diagnostics in the field of pulmonary function tests. The determination of the Tiffeneau value is an important part of pulmonary function testing as carried out in medical diagnostics, but only as an indicator of obstructive respiratory illnesses and not of restrictive ones.



Fig. 1: Using the spirometer to determine various measured values
(left: measurement by using Cobra4 Wireless/USB-Link, on the right: Cobra4 Mobile-Link)

Tasks

1. Determine the inspiratory vital capacity (IVC) in litres.
2. Determine the one-second forced expiratory volume in one second (FEV1) in litres.

Equipment

Experiment with iPad or Android tablet

Position No.	Material	Order No.	Quantity
1	Cobra4 Wireless/USB-Link incl. USB cable	12601-10	1
2	Cobra4 Sensor-Unit Spirometry, Pulmonary volume and Wind Speed	12675-00	1
3	Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)	12675-11	1
4	USB charger for Cobra4 Mobile-Link 2 and Wireless/USB-Link	07932-99	1
Additional material:			
	Android-Tablet or iPad		1
	PHYWE measure App		

Android

iPad



Experiment with PC

Position No.	Material	Order No.	Quantity
1	Cobra4 Wireless/USB-Link incl. USB cable	12601-10	1
2	Cobra4 Sensor-Unit Spirometry, Pulmonary volume and Wind Speed	12675-00	1
3	Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)	12675-11	1
4	USB charger for Cobra4 Mobile-Link 2 and Wireless/USB-Link	07932-99	1
5	Software measureLAB	14580-61	1
Additional material:			
	PC		1

Warning information

Caution!

The apparatus used is not a medical measuring instrument. The measured values obtained with it are only to be used to provide an understanding of spirometry. Deviations in measured values between students or from the values given in the figures which are used here as examples are not to be considered to be a pointer to a possible illness. A pulmonary function test which is carried out by a physician is the only means of obtaining a medically relevant diagnosis.

Notes on procedure

It is essential for the determination of a correct forced breathing measured value that the student abruptly uses his or her muscle power to force air out of his or her lungs. Completely false values result when air is only slowly breathed out. To obtain a true relationship between FEV₁ and IVC, the student carrying out the test must abruptly force out as much air as possible in the first second.

Diagnosis of lung disease (FEV) with Cobra4

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Introduction

Principle and task

Principle

The forced expiratory volume (FEV) in one second is used in the diagnosis of lung illnesses. For the measurement the student carrying out the test breathes normally a few times, exhales all the air he or she can, takes a deep breath and holds it for a moment before (at the beginning of measurement) force-breathing out as much air as he or she can right from the start of the measurement.

Further to this, the vital capacity (as inspiratory VC = IVC) is to be determined here as it is required for the FEV₁ and IVC quotient which is called the Tiffeneau value:

$$(1) \quad \text{Tiffeneau value} = \text{FEV}_1 / \text{IVC} [\%]$$

With healthy young people, this quotient is $\geq 75\%$. In the case of a so-called obstructive respiratory illness, such as bronchial asthma, the value is far below 75%, as the forced expiratory volume per second is greatly reduced. This FEV value, just as the vital capacity, depends on the age of the person, among others, and therefore older people only reach a value of about 70%.

In contrast to the obstructive illnesses, there are also so-called restrictive respiratory illnesses which cannot be determined using this method.



Fig. 1: Using the spirometer to determine various measured values

Tasks

1. Determine the inspiratory vital capacity (IVC) in litres.
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Equipment

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Set-up and procedure

Set-up

- Plug the Cobra4 Sensor-Unit Spirometry onto the Cobra4 Wireless/USB-Link unit.
- Take a turbine out from its packaging and insert it into the opening of the spirometer unit with a brief and gentle turning movement.
- Take a new cardboard tube from its original packaging and plug it into the turbine which was previously fitted in position.
- The resulting apparatus should now be as shown in the Figure 1.

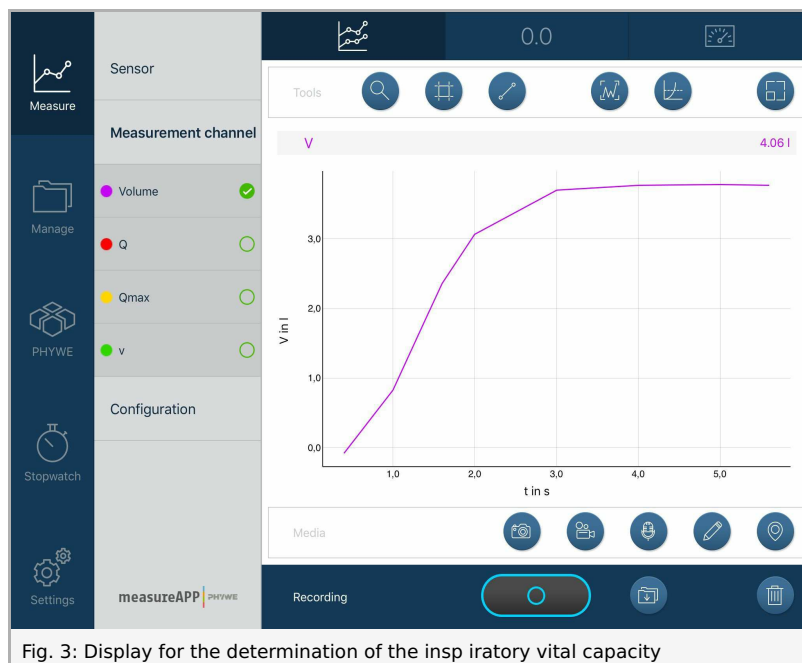
Procedure

The following experiments are all to be carried out in a standing position so that the results of them can be compared with those of the other persons.

- Start PHYWE measure App  and switch on the Cobra4 Wireless-Link. The sensor is detected automatically.
- Select the Cobra4 Sensor-Unit Spirometry in PHYWE measure App . The measurement automatically shows the volume as a function of time.

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- **Measurement 1 (IVC):** Standing up, breathe in and out normally a few times.
 - Now breathe out as much air as you can.
 - Bring the spirometer mouthpiece into your mouth so that it is air-tightly surrounded by your lips. No air is to escape through your nose so pinch your nostrils together if necessary.
 - Start the measurement.
 - Breathe in as much air as you can.
 - Measure the inhaled volume in litres as your inspiratory vital capacity (**IVC**).
 - Stop and save the measurement.

You can either directly read the value for the IVC or determine it from the plot of the graph using the survey tool .



- **Measurement 2 (FEV₁):** Bring the spirometer mouthpiece into your mouth so that it is air-tightly surrounded by your lips and then start the measurement.
- Breathe normally a few times.
- Now breathe in as deeply as you can and hold your breath in your lungs for approximately 1-2 s. If necessary, pinch your nostrils together so that no air escapes through your nose.

- Press out as much air as you can within the first second.
- Stop and save the measurement when you have finished exhaling.

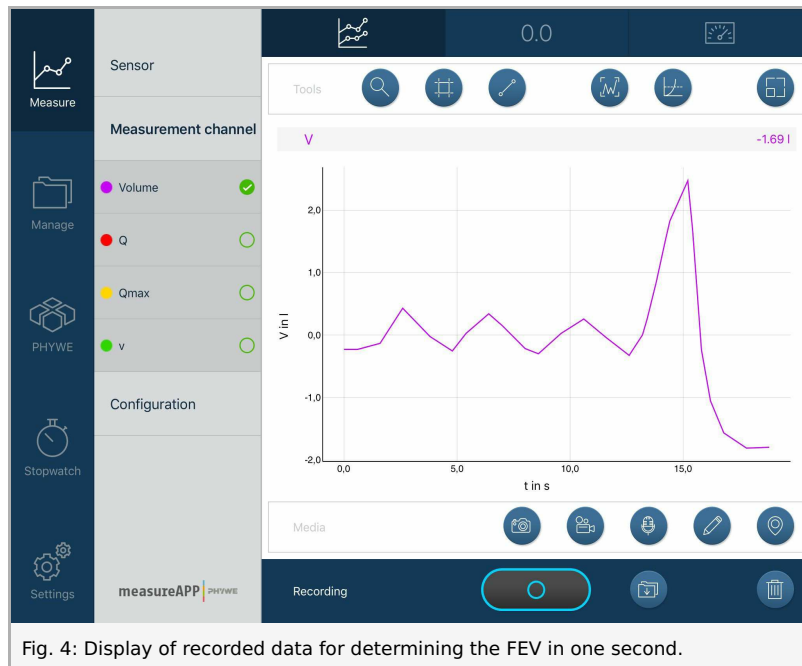



Fig. 4: Display of recorded data for determining the FEV in one second.

Result and evaluation

Results


1. What is the value of your inspiratory vital capacity (IVC) in litres?
You can use the survey tool  to subsequently determine this volume.

IVC =



Fig. 5: Determination of the inspiratory vital capacity

2. What is the value in litres of your forced expiratory volume (FEV₁) in one second?

(You can click here on the magnifying glass symbol  to select and magnify the one second region of forced expiration.)
Now you can determine the volume using the survey tool .

FEV₁ =

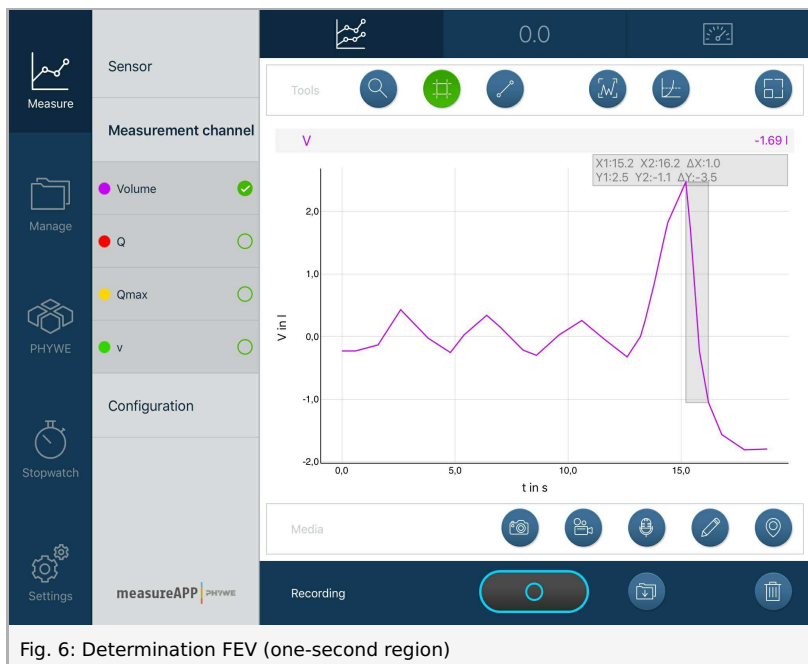


Fig. 6: Determination FEV (one-second region)

Evaluation

1. What is the FEV1 / IVC quotient in percent?

Tiffeneau value = FEV_1 / IVC [%] = =%

Example:

$IVC = 3,8 \text{ L}$

$FEV_1 = 3,5 \text{ L}$

Tiffeneau-Wert = $3,5 \text{ L} / 3,8 \text{ L} = 0,88 = 92 \%$

2. What does the calculated quotient tell you?

Tip: see introduction.

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Introduction

Principle and task

Principle

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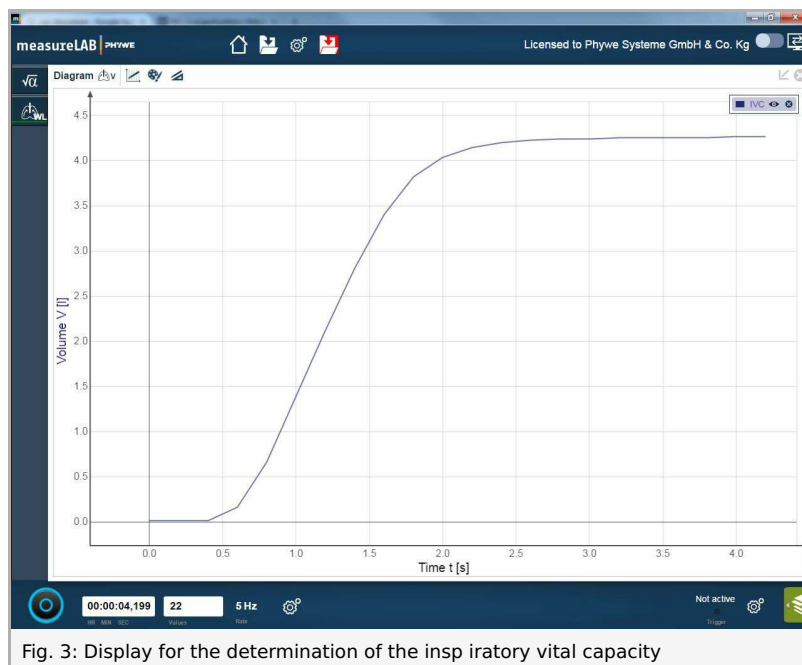
Procedure

The following experiments are all to be carried out in a standing position so that the results of them can be compared with those of the other persons.

- Start PHYWE measureLAB  and switch on the Cobra4 Wireless-Link. The sensor is detected automatically.
- Select the Cobra4 Sensor-Unit Spirometry in PHYWE measureLAB . All pre-settings required for directly recording the measurement readings are now loaded. The measurement automatically shows the volume as a function of time.

-
- **Measurement 1 (IVC):** Standing up, breathe in and out normally a few times.
 - Now breathe out as much air as you can.
 - Bring the spirometer mouthpiece into your mouth so that it is air-tightly surrounded by your lips. No air is to escape through your nose so pinch your nostrils together if necessary.
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- **Measurement 2 (FEV₁):** Bring the spirometer mouthpiece into your mouth so that it is air-tightly surrounded by your lips and then start the measurement.
- Breathe normally a few times.
- Now breathe in as deeply as you can and hold your breath in your lungs for approximately 1-2 s. If necessary, pinch your nostrils together so that no air escapes through your nose.

- Press out as much air as you can within the first second.
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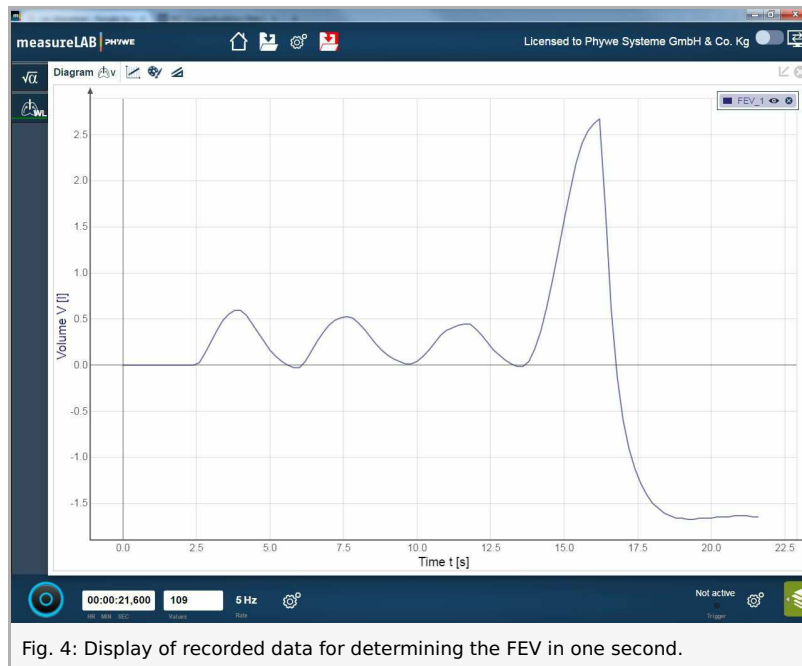



Fig. 4: Display of recorded data for determining the FEV in one second.

Result and evaluation



Results

1. What is the value of your inspiratory vital capacity (IVC) in litres?
You can use the survey tool  to subsequently determine this volume.

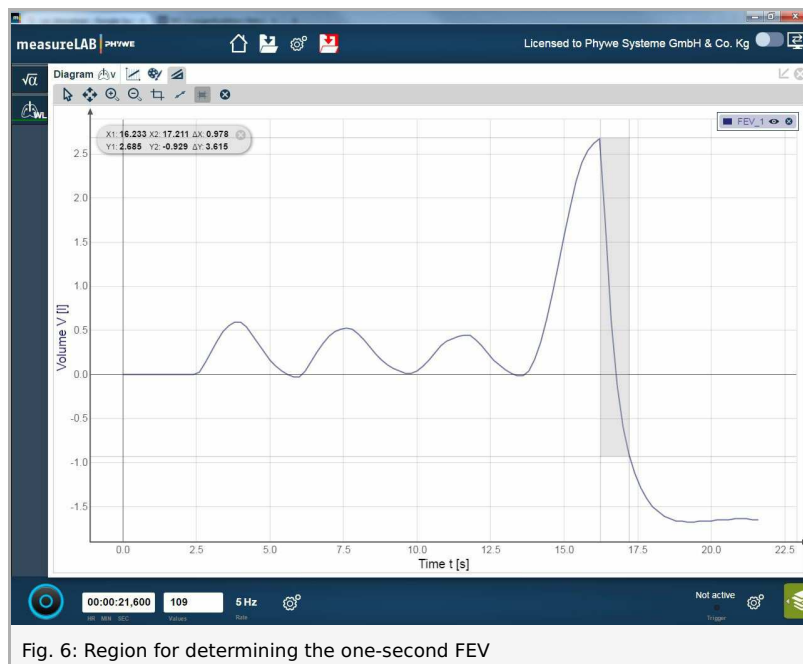
IVC =



2. What is the value in litres of your forced expiratory volume (FEV₁) in one second?

You can click here on the magnifying glass symbol  to select and magnify the one second region of forced expiration (the range from 30 s on in Fig. 3). Now you can determine the volume using the survey tool .

FEV₁=.....



Evaluation

1. What is the FEV₁ / IVC quotient in percent?

Tiffeneau value = FEV_1 / IVC [%] = =%

Example:

IVC = 4,3 L

FEV₁ = 3,6 L

Tiffeneau-Wert = 3,6 L / 4,3 L = 0,88 = 84 %

2. What does the calculated quotient tell you?

Tip: see introduction.

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