

SPH3U UNIVERSITY PHYSICS

REVIEW: MATH SKILLS
 Measuring & Estimating
 (P.651)

Making Precise Measurements

*In order to make precise measurements you need to use a device that has a double scale. A double scale consists of a **main scale** that is an ordinary metric scale with centimetres and millimetres and a sliding or **vernier scale**.*

vernier scale

main scale

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Making Precise Measurements

If you look at the diagram carefully you will see there are 10 graduations on the vernier scale that occupy the same space as 9 graduations on the main scale. Therefore, only one graduation on the vernier can line up with a graduation on the main scale.

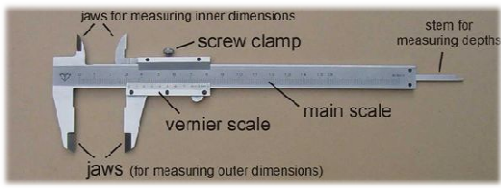
vernier scale

main scale

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Making Precise Measurements


A double scale can be placed on various types of instruments. One common instrument is the **vernier caliper**. It is used to measure the outside diameter of a cylinder, the inside diameter of a hollow cylinder, or the depth of a hole.



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Making Precise Measurements


Another instrument with a double scale is the **outside micrometer caliper**.



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Using a Vernier Caliper


Vernier calipers are precision measuring instruments used to make accurate measurements. The bar and movable jaw are graduated on both sides, one side for taking outside measurements and the other side for inside measurements. Vernier calipers are available in metric and in inch graduations, and some types have both scales. Digital models are also available.



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Using a Vernier Caliper

NOTE!
 When using high-precision instruments, such as the vernier caliper or outside micrometer caliper, it is necessary to check the zero setting before taking a reading. If, for example, the instrument is supposed to read 0.000 cm but instead reads 0.002 cm, the error must be taken into consideration with each reading.



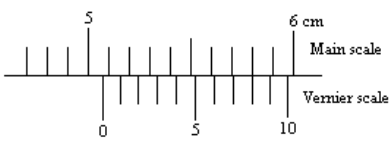
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Using a Vernier Caliper

HOW TO READ A METRIC VERNIER CALIPER

1. Find the first line (the **ZERO** line) on the **vernier** (sliding) scale. Look on the main (stationary) scale and record the number you just passed (or are currently on) as #.# cm.

5.0 cm



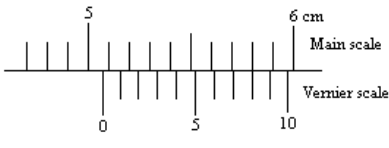
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Using a Vernier Caliper

HOW TO READ A METRIC VERNIER CALIPER

2. Find the **FIRST** pair of lines that match up perfectly. Read the line number off the **vernier** (sliding) scale and **add** this to the measurement.

5.08 cm



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Using a Vernier Caliper

HOW TO READ A METRIC VERNIER CALIPER

3. Determine the **error** – half of the smallest measurement possible. In our case the smallest measurement possible is 1 mm so the error is 0.5 mm or 0.05 cm. **Add** this to your measurement.

5.08 ± 0.05 cm

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Using a Vernier Caliper

PRACTICE

1. What is the reading (including the error) of the following metric vernier calipers?

(a) **0.69 ± 0.05 cm**

(b) **3.18 ± 0.05 cm**

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Using a Vernier Caliper

PRACTICE (1 continued ...)

1. What is the reading (including the error) of the following metric vernier calipers?

(c) **0.87 ± 0.05 cm**

(d) **2.63 ± 0.05 cm**

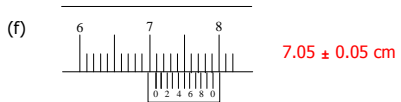
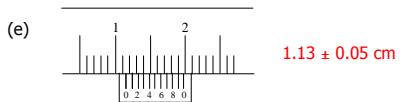
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Using a Vernier Caliper

PRACTICE (1 continued ...)

1. What is the reading (including the error) of the following metric vernier calipers?



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