

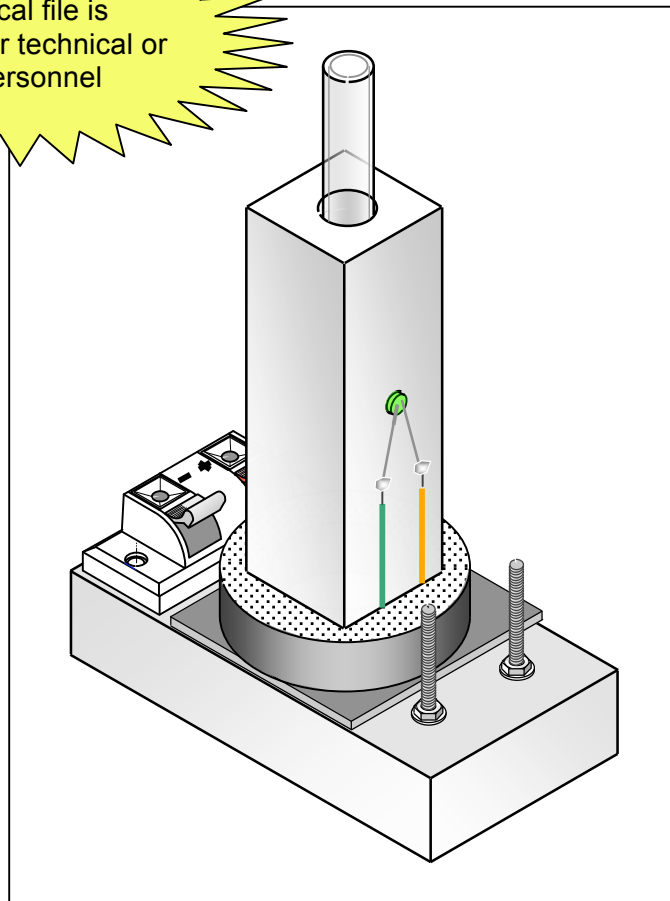


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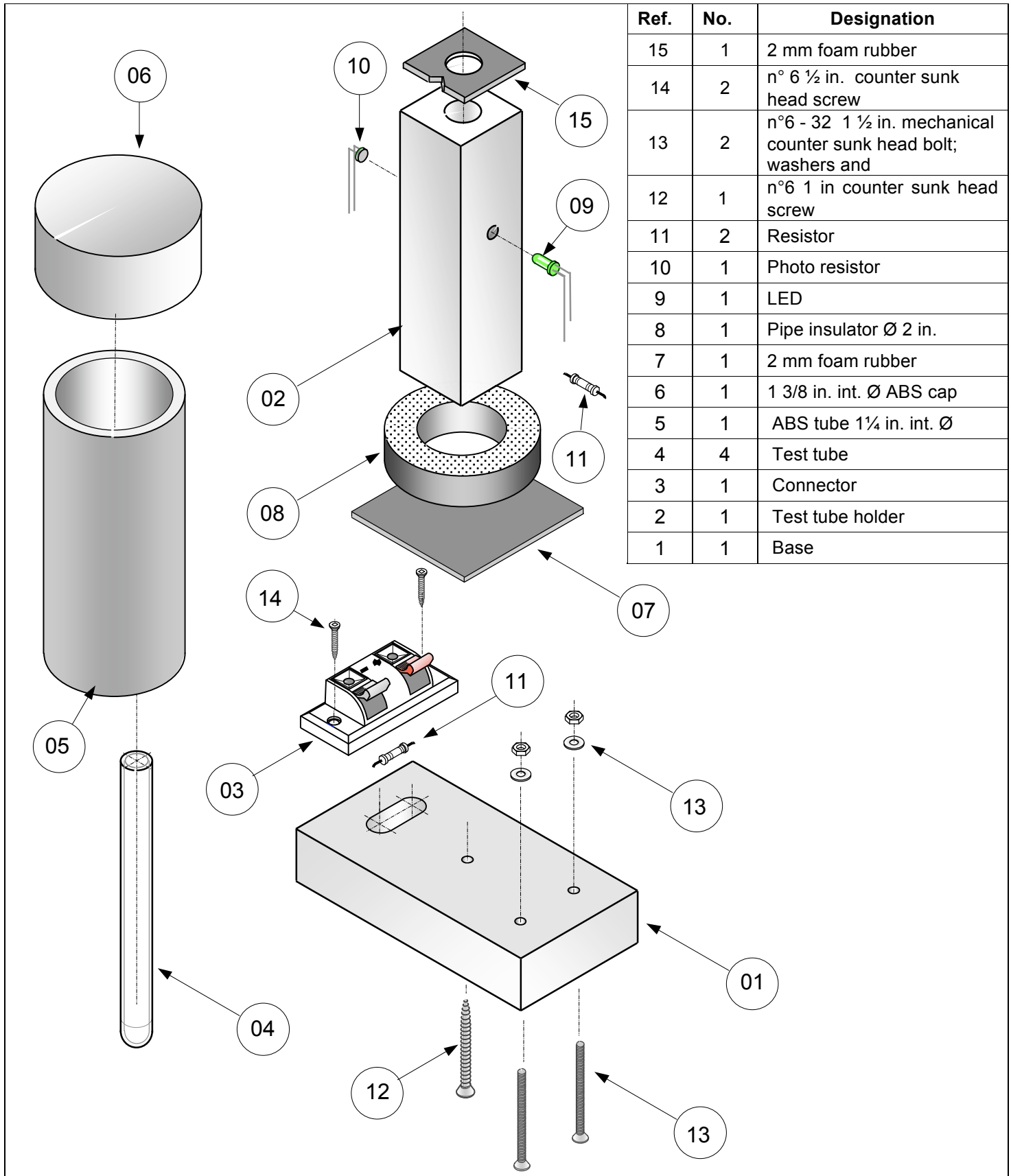
Working document

TECHNICAL FILE OF THE COLORIMETER

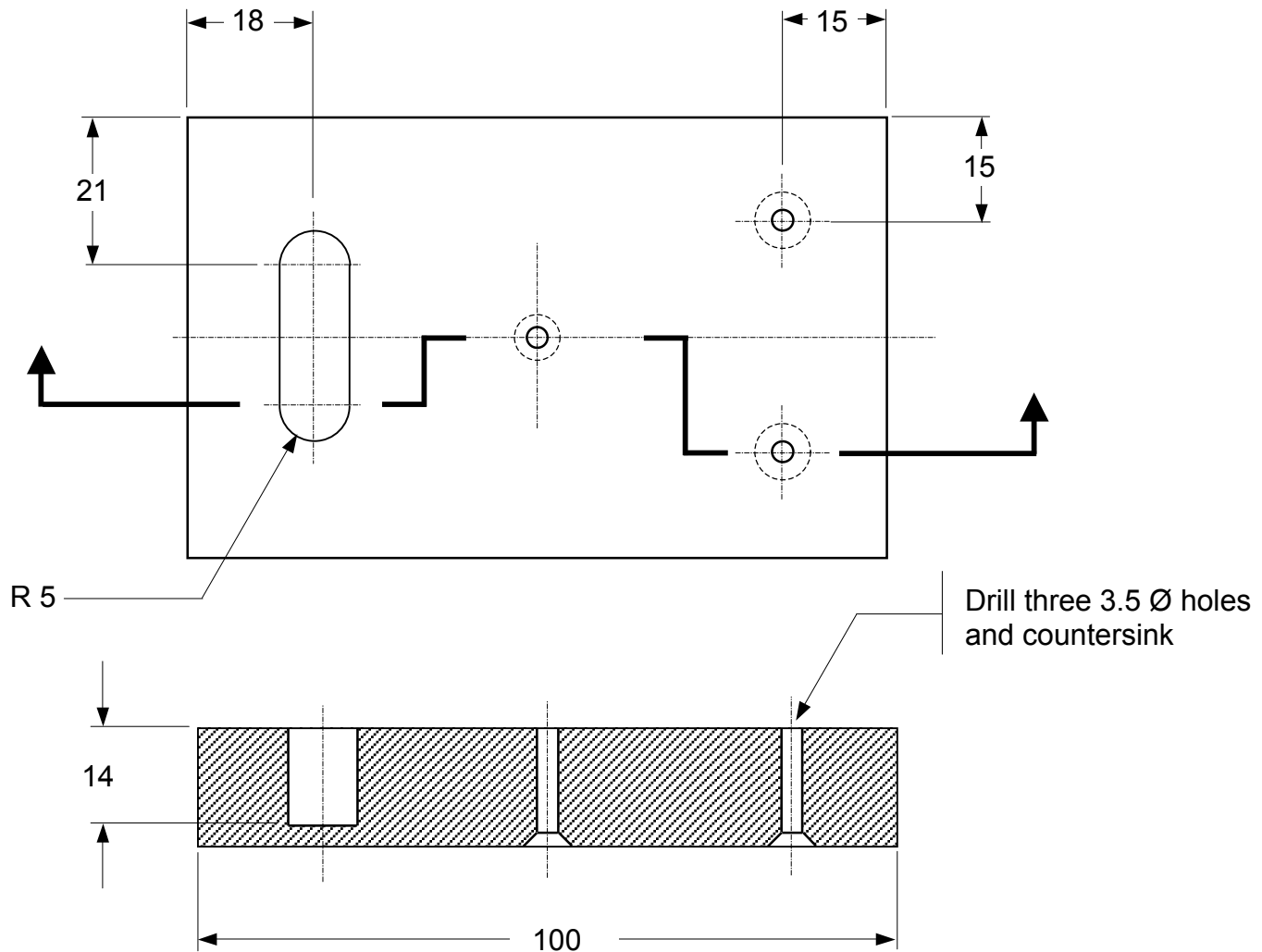
This technical file is
intended for technical or
teaching personnel



« FIND THE SOLUTION! » LES



Ref.	No.	Designation
15	1	2 mm foam rubber
14	2	n° 6 ½ in. counter sunk head screw
13	2	n°6 - 32 1 ½ in. mechanical counter sunk head bolt; washers and
12	1	n°6 1 in counter sunk head screw
11	2	Resistor
10	1	Photo resistor
9	1	LED
8	1	Pipe insulator Ø 2 in.
7	1	2 mm foam rubber
6	1	1 3/8 in. int. Ø ABS cap
5	1	ABS tube 1¼ in. int. Ø
4	4	Test tube
3	1	Connector
2	1	Test tube holder
1	1	Base



LONGITUDINAL CUT VIEW OF THE BASE



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TITLE: **Detail drawings of the base**

NAME: **Colorimeter**

DATE: **02 February 2010**

SCALE: **1 = 1**

DRAWING: **N° 2**

FABRICATION RANGE

ELEMENT: **BASE OF THE COLORIMETER**

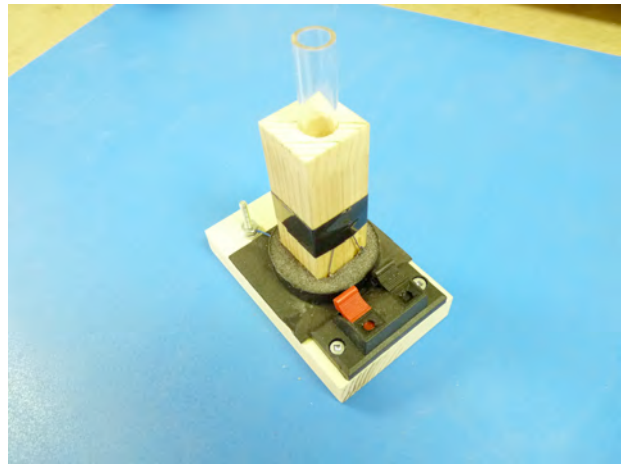
SET: **FIND THE SOLUTION!**

RANGE: 1




SHEET: 1 of 3






NUMBER: 1



MATERIALS: **Various**



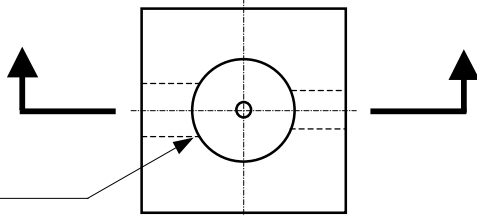
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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10	FABRICATION OF THE BASE		
11	In a pine board 63mm wide, measure a 100 mm length.		<ul style="list-style-type: none"> - Pencil - Ruler - Carpenter's square
12	Using a mitre box or a band saw, cut this piece.		<ul style="list-style-type: none"> - Hand saw - Mitre box or - Band saw
13	Sand the ends of the part.		<ul style="list-style-type: none"> - Sand paper

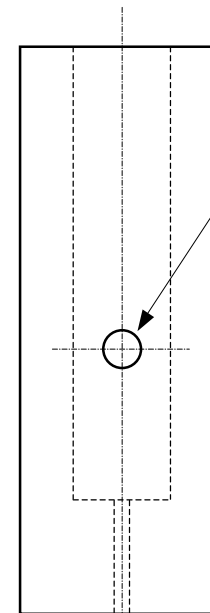
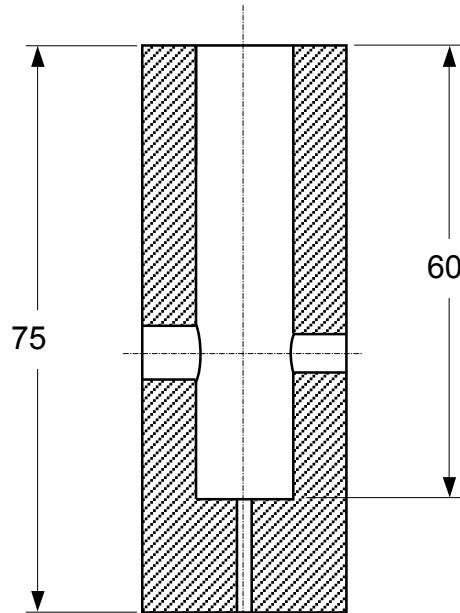
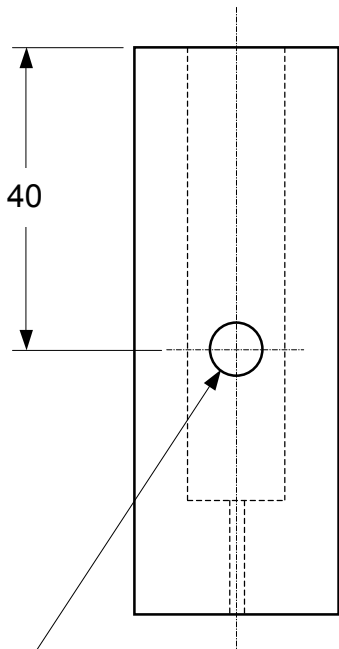
FABRICATION RANGE OF THE BASE OF THE COLORIMETER			SHEET: 2 of 3
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
14	<p>Using the detail drawings of the base mark the position of all the holes.</p> <p>Punch these holes.</p>		<ul style="list-style-type: none"> - N° 2 Detail drawings - Ruler - Pencil - Punch - Hammer
15	Drill the three holes with a 3.5mm (9/64 in.) diameter.		<ul style="list-style-type: none"> - Drill - 3.5 mm (9/64 in.) Ø bit
16	Turn the part over and countersink the holes.		<ul style="list-style-type: none"> - Countersink - Drill
17	<p>Set the depth of the two 10mm. (25/64 in.) diameter holes.</p> <p>See the detail drawings of the base</p>		<ul style="list-style-type: none"> - N° 2 Detail drawings - Depth guide - Press drill - 10 mm (25/64 in.) Ø bit
18	Drill the two 10 mm (25/64 in.) diameter holes.		<ul style="list-style-type: none"> - Drill - 10 mm (25/64 in.) Ø bit

FABRICATION RANGE OF THE BASE OF THE COLORIMETER			SHEET: 3 of 3
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
19	Drill a third hole between the two others.		<ul style="list-style-type: none"> - Drill - 10 mm (25/64 in.) Ø bit
20	Using the bit, form an oblong hole by gently moving the part.		<ul style="list-style-type: none"> - Drill - 10 mm (25/64 in.)

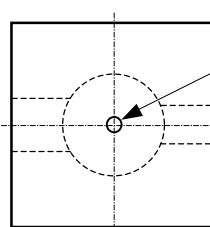
Drill $\varnothing 13 \times 60$



Drill $4.5 \varnothing$



Drill $9/32 \varnothing$ or
depending on the \varnothing of
the photo resistor



Drill $2 \varnothing$



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TITLE: **Detail drawings of the test tube holder**

NAME: **Colorimeter**

DATE: **02 February 2010**

SCALE: **1 = 1**

DRAWING: **N° 3**

FABRICATION RANGE

**ELEMENT: TEST TUBE HOLDER FOR THE
COLORIMETER**

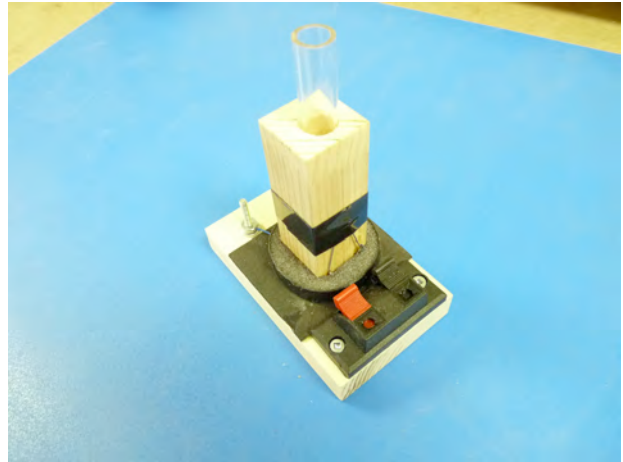
SET: FIND THE SOLUTION!

RANGE: 2

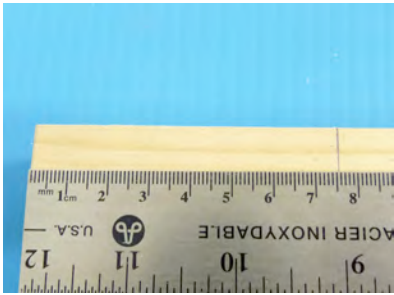

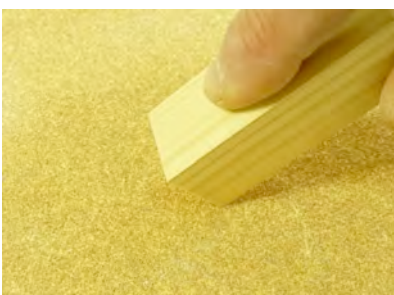
SHEET: 1 of 3

NUMBER: 1

MATERIALS: Various



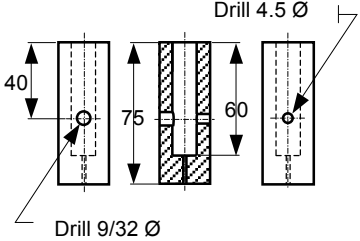
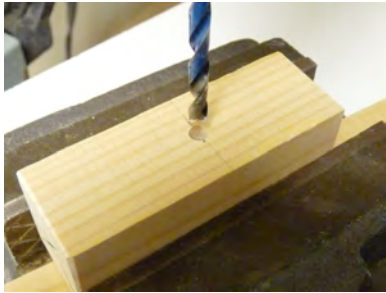
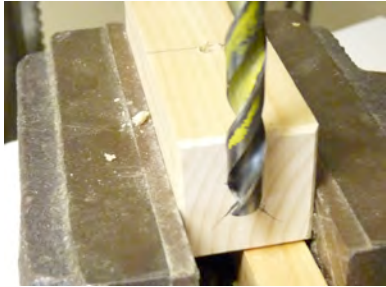

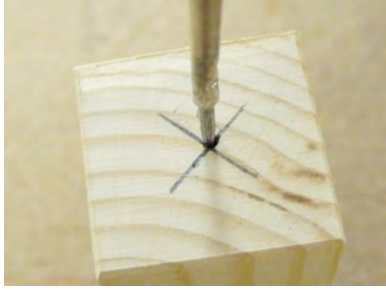
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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10	TEST TUBE HOLDER		
11	In a 27 mm x 27 mm (1 in. x 1 in.) square pine moulding, mark a 75mm length.		<ul style="list-style-type: none"> - Pencil - Ruler - Carpenter's square
12	Using a mitre box or a band saw, cut the part.		<ul style="list-style-type: none"> - Hand saw - Mitre box or - Band saw
13	Sand the ends of the part.		<ul style="list-style-type: none"> - Sand paper

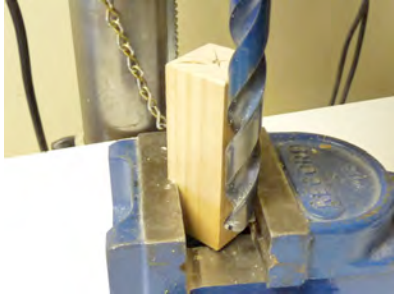


**FABRICATION RANGE OF THE TEST TUBE HOLDER FOR THE
COLORIMETER**

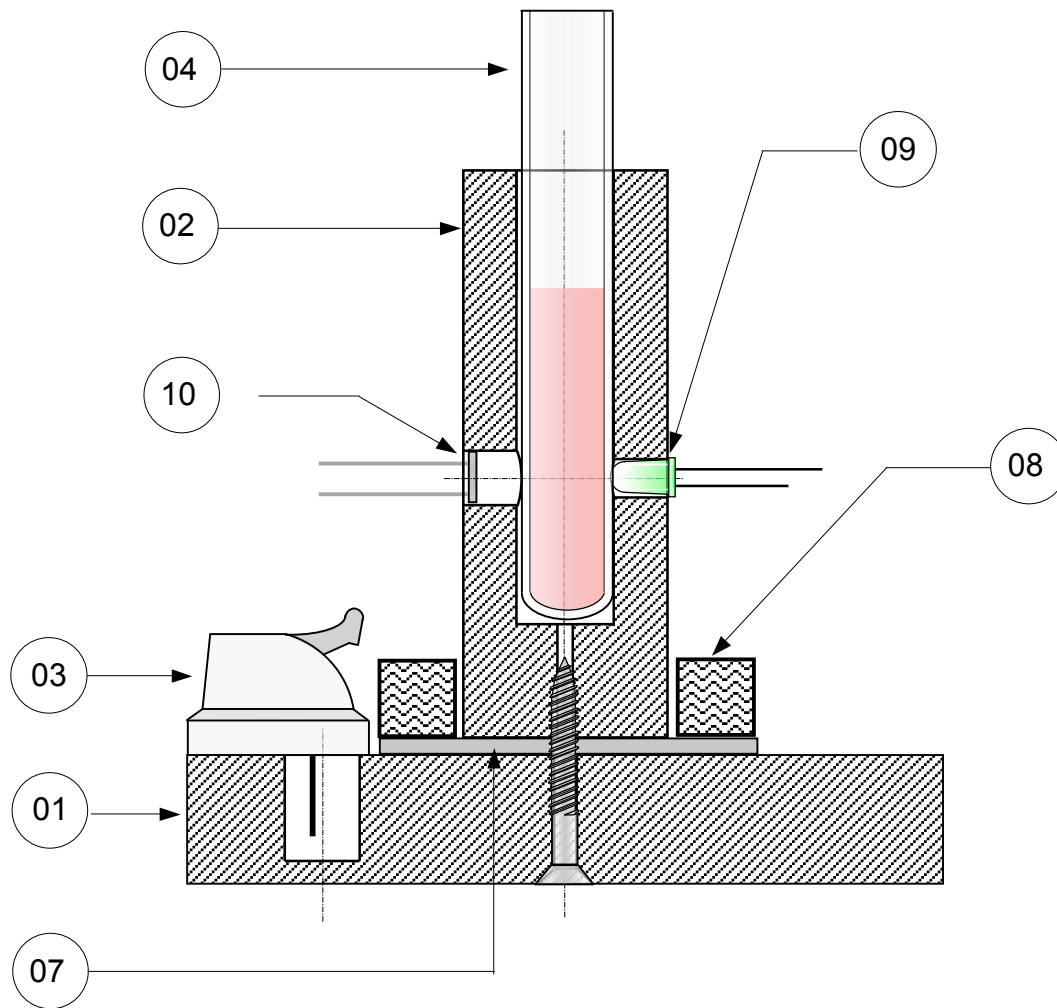
SHEET: 2 of 3

N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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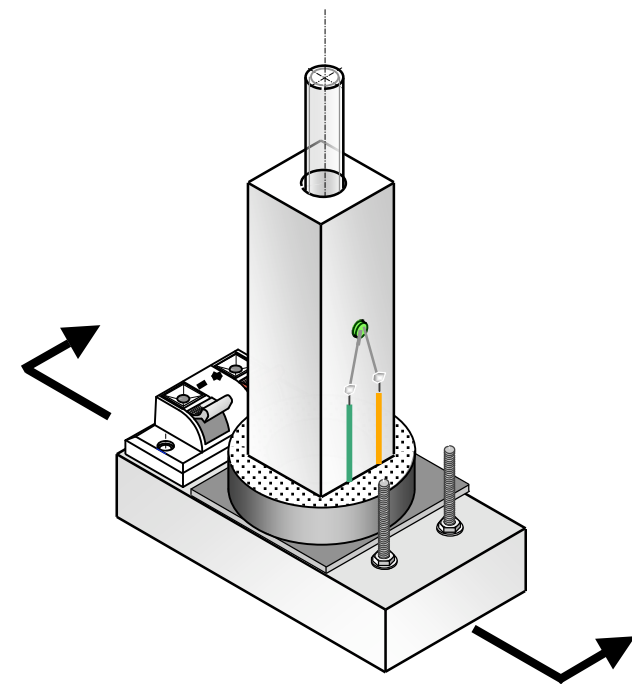
14	<p>Respecting the detail drawings of the test tube holder, mark the position of the holes for the LED and the photo resistor.</p> <p>See N°3 detail drawings</p>		<ul style="list-style-type: none"> - N°3 detail drawings - Pencil - Ruler - Carpenter's square
15	<p>Punch and drill the hole for the LED through and through with a 4.5mm diameter.</p>		<ul style="list-style-type: none"> - Punch - Hammer - Press drill - 4.5 mm Ø bit - Drill vise
16	<p>Turn the part over in the vise and set the drill depth at half the depth of the block.</p>		<ul style="list-style-type: none"> - Depth guide
17	<p>Widen the hole for the photo resistor to a diameter of 7mm (9/32 in.).</p>		<ul style="list-style-type: none"> - Press drill - 7 mm (9/32 in.) Ø bit - Drill vise
18	<p>Mark and punch the center of the hole that will hold the test tube.</p>		<ul style="list-style-type: none"> - Pencil - Ruler - Punch - Hammer

FABRICATION RANGE OF THE TEST TUBE HOLDER FOR THE COLORIMETER		SHEET: 3 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS

19	<p>Affix the part in the drill vise.</p> <p>Set the depth at 60 mm. See N°3 detail drawings</p>		<ul style="list-style-type: none"> - N°3 detail drawings - Press drill - drill vise - Depth guide
20	<p>Drill a 13 mm diameter hole.</p> <p>NOTE: It is preferable to use a lip and spur bit.</p>		<ul style="list-style-type: none"> - Foret Ø 13 mm. - Perceuse à colonne - Étau de perceuse
21	<p>Turn the part around in the vise and drill the 2 mm (5/64 in.) diameter hole that will allow the part to be affixed to the base.</p>		<ul style="list-style-type: none"> - 2 mm (5/64 in.) Ø bit - Drill - Drill vise



Ref.	No.	Designation
10	1	Photo resistor
9	1	LED
8	1	2 in. Ø pipe insulator
7	1	2 mm Foam rubber
4	4	Test tube
3	1	Connector
2	1	Test tube holder
1	1	Base



LONGITUDINAL CUT VIEW FO THE COLORIMETER

ASSEMBLY RANGE

ELEMENT: **COLORIMETER**

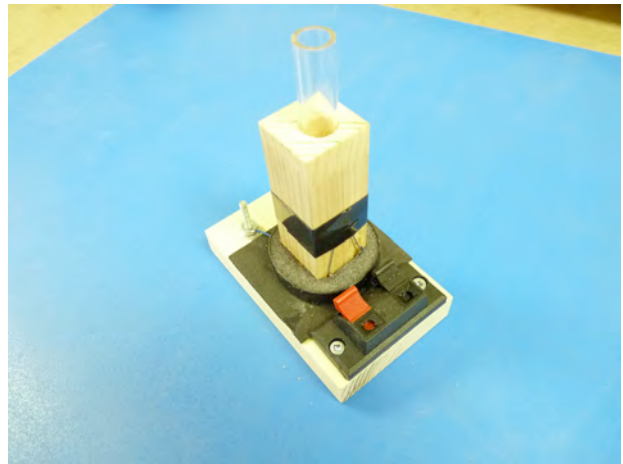
SET: **FIND THE SOLUTION!**

RANGE: **3**



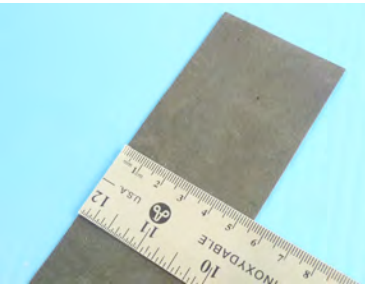
SHEET: **1 of 5**

NUMBER: **1**

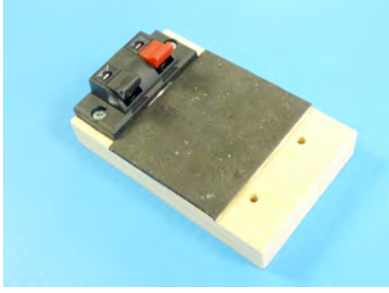
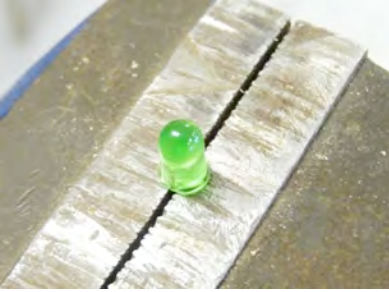

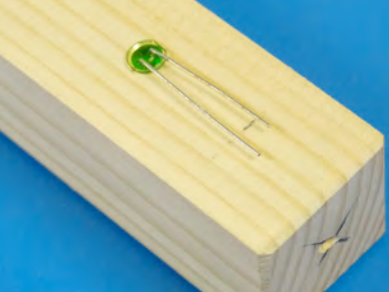

MATERIALS: **Various**

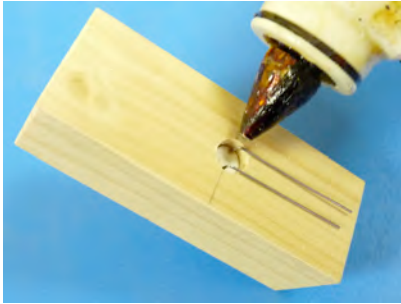
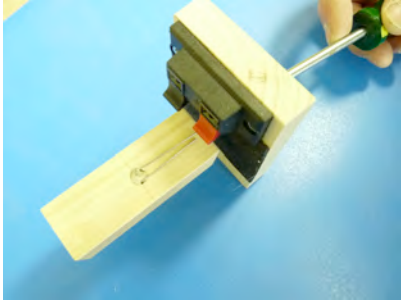
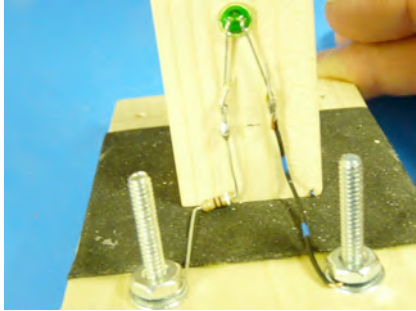
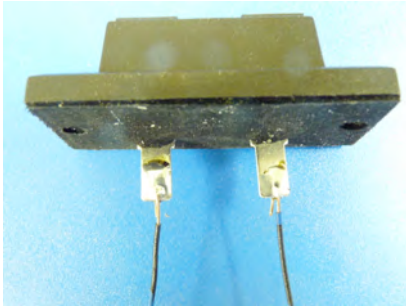
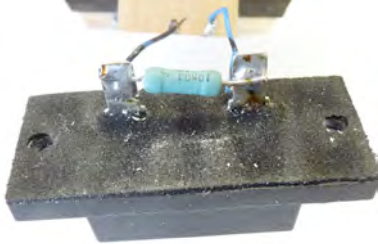


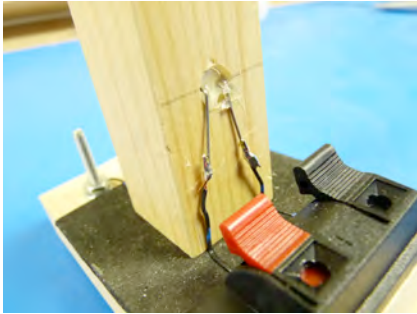
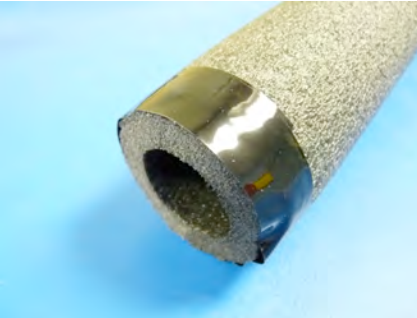
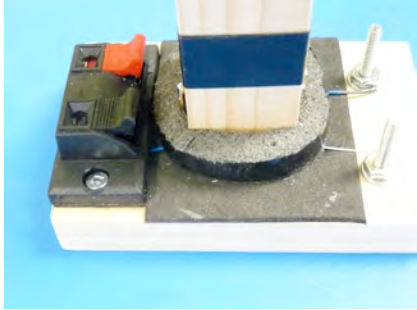
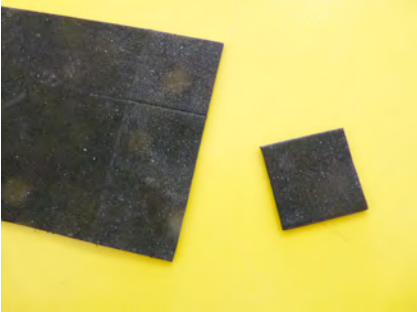
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOL
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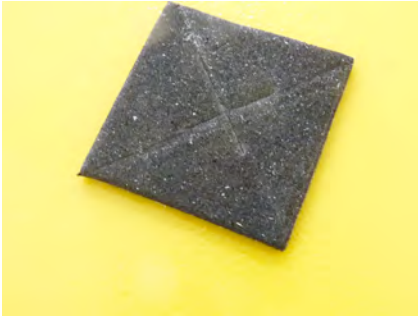
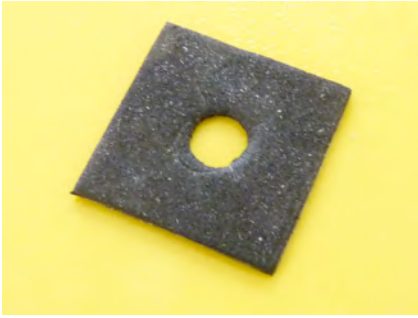
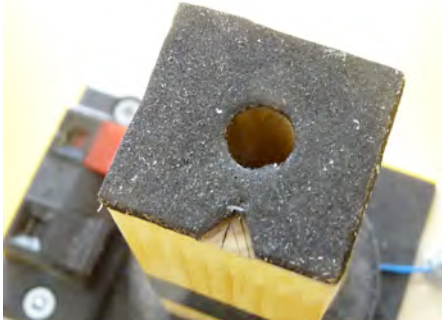

10	MOUNTING THE FOAM RUBBER		
11	Install the connector as shown.		<ul style="list-style-type: none"> - Connector
12	<p>Temporarily screw the connector to the base using two N°6 ½ in. counter sink head screws.</p> <p>NOTE: This will allow us to position the foam rubber.</p>		<ul style="list-style-type: none"> - Screwdriver - N°6 ½ in. screws
13	In a strip of foam rubber 63 mm wide, cut a 55mm piece.		<ul style="list-style-type: none"> - Pencil - Ruler - Retractable blade knife

ASSEMBLY RANGE FOR THE COLORIMETER			SHEET: 2 of 5
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOL

14	Using wood glue, affix the foam rubber on the base as shown.		– Wood glue
20	ASSEMBLY OF THE COMPONENTS		
21	Place the LED in a vise.		– Bench vise
22	<p>Ensure that the longer leg is on the left in the block.</p> <p>Take the test tube holder, into which a test tube has been inserted.</p> <p>Press it gently onto the LED, until it penetrates the hole.</p>		<ul style="list-style-type: none"> – Bench vise – 12 x 75 mm test tube
23	Fold back the two legs onto the wooden block.		
24	Fold back the legs of the photo resistor to 90°.		– Needle nosed pliers

ASSEMBLY RANGE FOR THE COLORIMETER			SHEET: 3 of 5
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOL
25	<p>Insert the photo resistor into its hole.</p> <p>Fill this hole with hot glue. This will allow you to fix the photo resistor in place.</p>		<ul style="list-style-type: none"> - Hot glue gun
26	<p>Screw the test tube holder onto the base using a N°6 - 1 in. counter sink screw.</p>		<ul style="list-style-type: none"> - Screwdriver - N°6 - 1 in. screw
27	<p>Bolt the two bolts that will serve as terminals onto the base. (Drawing no.1 Ref. 13)</p> <p>Solder the longer leg of the LED to the resistor (to protect the LED) and connect it to one of the terminals bolted onto the base. Solder the other leg to an electrical wire that will be connected to the other terminal.</p> <p>Temporarily unscrew the connector in order to solder the two electric wires to the two terminals, then screw it back to the base.</p>	 	<ul style="list-style-type: none"> - Drawing no.1 - N° 6 – 32 - 1½ in. bolt - Nut - Washer - Soldering iron - 510 Ω resistor <ul style="list-style-type: none"> - Screwdriver - Soldering iron
28	<p>Solder a 10 k Ω resistor which will neutralize parasites. Screw the connector back to the base.</p>		<ul style="list-style-type: none"> - Soldering iron - Screwdriver - 10 k Ω resistor

ASSEMBLY RANGE FOR THE COLORIMETER			SHEET: 4 of 5
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOL
29	Solder the two other extremities to the legs of the photo resistor and replace the connector in place on the base.		<ul style="list-style-type: none"> - Soldering iron - Screwdriver
30	Roll electrical tape around a piece of 2 in. pipe insulation and cut a ring 10 mm. thick.		<ul style="list-style-type: none"> - Ruler - Band saw - Electrical tape
31	<p>Roll electrical tape around the test tube holder in order to protect both the LED and the photo resistor.</p> <p>Insert the foam washer onto the test tube holder, sliding it gently toward the bottom until it touches the foam rubber.</p> <p>The purpose of this washer is to prevent any light from getting into the darkroom.</p>		<ul style="list-style-type: none"> - Electrical tape
32	In a strip of foam rubber, cut a 25mm X 25mm square.		<ul style="list-style-type: none"> - Pencil - Ruler - Utility knife

ASSEMBLY RANGE FOR THE COLORIMETER			SHEET: 5 of 5
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOL
33	Find the center of the square.		<ul style="list-style-type: none"> - Pencil - Ruler
34	Using an 8mm diameter punch, make a hole.		<ul style="list-style-type: none"> - 8 mm punch - Hammer or - Drill - 8 mm Ø bit
35	<p>Glue the foam rubber square onto the test tube holder, centering the holes.</p> <p>Make a notch, which will allow you to position the test tube the same way every time.</p>		<ul style="list-style-type: none"> - Pencil - Ruler - Retractable blade knife - Carpenter's glue
40	DARKROOM		
41	<p>In a 2 in. (ext. Ø) ABS pipe, cut a 100mm length.</p> <p>Insert a cap on one extremity. This cap may or may not be glued.</p>		<ul style="list-style-type: none"> - Pencil - Ruler - Band saw

Colorimeter (February 2010)

Part number	Part name	Material	Size in store	Cost for the size in store	Length, surface or number used	Cost per part	Supplier
1	Base	Pine	3/4" x 3" x 96"	7,12	4"	0,30	Hardware store
2	Test tube holder	Pine	3/4" x 3/4" x 96"	7,19	3"	0,22	Hardware store
3	Connecor	Plastic	7/8" x 2" x 5/4"	0,39	1	0,39	Electronics store
4	Test tube	Glass 12 x 75mm	250	15,00	1	0,53	Laboratory equipment supplier
5	1¼ in. int. Ø ABS pipe	ABS	1 1/2" x 36"	2,99	4"	0,33	Hardware store
6	1 3/8 in. int. Ø ABS cap	ABS	1.5"	2,34	1	2,34	Hardware store
7	2 mm foam fubber	Foam rubber	1/16" x 9" x 12"	2 for \$1	50 x 50 mm	0,02	Dollar store
8	2 in. Ø pipe insulation	Pipe insulation	2" ø x 36"	1,19	0.5"	0,02	Hardware store
9	LED	Plastic	5 mm ø	10 for \$1.50	1	0,15	Electronics store
10	Photo electric cell	Metal	7 mm ø	0,49	1	0,49	Electronics store
11	Resistor	Metal and graphite	100 for \$2,75	100 for \$2.75	1	0,03	Electronics store
12	n° 6 1½ in. counter sink head screw	Metal	100 per box	5,19	1	0,05	Hardware store
13	6-32 - 1 ½" long mechanical counter sink head screw	Metal	100 per box	4,76	2	0,1	Hardware store
13	6-32 nuts	Metal	100 per box	5,49	2	0,11	Hardware store
13	Washers	Metal	100 per box	3,79	2	0,08	Hardware store
14	n° 6 ½ in. counter sink head screw	Metal	100 per box	3,57	2	0,07	Hardware store
15	Foam rubber	Foam rubber	1/16" x 9" x 12"	2 for \$1	2.5 x 2.5 mm	0,005	Dollar store
Total cost for project						5,24	
To minimise the cost							
The cap could be replaced by a black foam washer glued with hot glue and sanded with the electric sander.							
