**Form 2**

**Mandatory Science experiments**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class: \_\_\_\_\_\_\_

**Do not take this booklet home with you**

**It is to be kept in the science lab at all times**

*Remember to use your camera-phone as much as possible to take videos of yourself and your lab partners doing the experiments (it is a great way to revise) and also to paste in any relevant photos.*

**Biology**

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| 2 | Carry out qualitative tests to compare the carbon dioxide levels of inhaled and exhaled air |  |
| 3 | Investigate the presence of micro-organisms in air and soil |  |
| 4 | Study a local habitat, using appropriate instruments and simple keys to show the variety and distribution of named organisms |  |

**Chemistry**

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| 6 | Prepare carbon dioxide and show that it does not support combustion. |  |
| 7 | Conduct a qualitative experiment to detect the presence of dissolved solids in water samples |  |
| 8 | Test water for hardness (soap test) |  |

**Physics**

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| 17 | Investigate flotation for a variety of solids and liquids in water and other liquids, and relate the results of this investigation to their densities |  |

**OB 11: To compare the carbon dioxide levels of inhaled and exhaled air**

**Date:**

**Lab Partners:**

**Diagram**

**Procedure**

1. Pour a little limewater into a test-tube.
2. Blow (exhaled) air into the test tube for one minute.   
   Record the number of breaths taken.
3. Replace with new limewater (use the same amount as you did in step 1) and this time suck (inhale) air through the test tube.  
   Record the number of breaths taken.

**Results**:

Number of breaths required to turn limewater milky when breathing out (exhaling): \_\_\_\_\_\_\_\_\_\_\_

Number of breaths required to turn limewater milky when breathing in (inhaling): \_\_\_\_\_\_\_\_\_\_\_\_

**Conclusion**:

There is \_\_\_\_\_\_\_\_\_\_\_ carbon dioxide in exhaled air than in inhaled air.

**Questions**

1. What precaution(s) did you take to ensure that this was a fair test?
2. Why did the liquid turn *milky*?
3. Why is it a good idea to only use a little limewater rather than a lot?

**OB 65: Investigate the presence of micro-organisms in air and soil**

**Date:**

**Lab Partners:**

**Materials used:**

Petri dishes containing a layer of sterile (uncontaminated) nutrient called agar (the agar acts as a food source).

**Diagram**

**Procedure**

* Add some soil to one of the petri dishes and leave it closed.
* Have another exposed to the air.
* Have another sterile (and leave it covered) as a control.
* Leave all of them for a few days in a warm environment.

**Result**:

After a few days bacteria colonies and some fungus can be seen in all of the petri dishes except for the sterile dish.

Draw a labelled diagram of the petri dishes - include the bacteria and fungi where relevant.

**Questions**

1. Why do we include a control in this experiment?
2. How can you tell which was the bacteria and which was the fungi?
3. What safety precautions should be taken with this investigation?
4. Sometimes when doing this investigation students sprinkle desiccated soil onto another petri dish (desiccated soil is soil which has been dried out and heated to a very high temperature in a special oven). Why do you think this extra step might have been taken?
5. If you leave the sterile dish (which was our control) for long enough then eventually we will probably see bacterial colonies on it also – what does this tell us?

**OB59: Study a local habitat, using appropriate instruments and simple keys to show the variety and distribution of named organisms**

|  |
| --- |
| **Pitfall Trap** |
| **Beating Tray** |
| **Pooter** |
| **Sweep net** |
| **Quadrat** |
| **Line Transect** |

**Date**:

**Lab Partners:**

**Procedure:**

* We first made a map of the habitat we were going to study – in our case we studied the area under a large tree outside our classroom.
* We marked in any distinctive physical features we could think of.
* We recorded physical factors such as soil pH, temp., amount of sunlight etc.
* We then collected as many plants and insects as we could and used a key chart to identify as many as possible.

**We used the following instruments to collect insects**

(see diagrams on the right)

|  |  |
| --- | --- |
| **Instrument** | **How we used it** |
| Pitfall trap |  |
| Beating tray |  |
| Pooter |  |
| Sweep net |  |

**The study of a habitat requires the use of sampling instruments because it is not possible to count every individual plant living there.**

**We used the following instruments to help us estimate the distribution of plants in our habitat:**

|  |  |
| --- | --- |
| Quadrat | Used to estimate the distribution of plants in the habitat. |
| Line transect | Used to show the distribution of a species of plant across an area e.g. from shade to sun in a woodland.  We used a rope with knots at every one metre mark.  We then recorded the name and height of every plant touching each mark. |

**Results**

**Map of the area**

**Habitat Conditions**

|  |  |
| --- | --- |
|  |  |
| Soil temperature |  |
| Soil pH |  |
| Sunlight |  |
| Air temperature |  |

**Insects found**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Instrument used |  |  |  |  |  |  |  |
| Insects found |  |  |  |  |  |  |  |
| Number of insects |  |  |  |  |  |  |  |

**Plant Distribution using a quadrat**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
| Plant found | Number of times a quadrant contained this plant | Number of throws | Expressed as a fraction  (column 2 ÷ by column 3) | Expressed as a percentage  (column 4 ×) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**OC 27: Prepare carbon dioxide and show that it does not support combustion**

**Date:**

**Lab Partners:**

**Preparation of carbon dioxide**

**Calcium carbonate + Hydrochloric acid 🡪 Calcium Chloride + Water + Carbon Dioxide**

(Marble chips)

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**Procedure**

* We set up the equipment as shown (calcium carbonate is the chemical name for marble chips).
* We slowly released the hydrochloric acid into the flask underneath using a syringe.

**Result**:

Air which was in the gas jar gets displaced by carbon dioxide coming from the flat-bottom flask.

**Test for carbon dioxide**

We poured a little limewater into the gas jar and swirled it around.

Result: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**To show that carbon dioxide does not support combustion**

We repeated the experiment but this time we placed a burning match into the jar of carbon dioxide gas.

Result: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Questions**:

1. To see if carbon dioxide supports combustion you don’t need to actually place the burning match *inside* the gas jar – you could just ‘pour’ the gas over the match and it should still go out.

Why would this method work?

1. It is advised when doing this experiment not to have the tube going into the gas jar from the beginning. Instead the first amount of gas coming out should just go into the air because it’s probably not carbon dioxide. Why is this?

**OC30: Conduct a qualitative experiment to detect the presence of dissolved solids in water samples**

**Date:**

**Lab Partners:**

**To detect the presence of dissolved solids in water samples**

**Procedure:**

* We poured tap water into a clean beaker and then boiled the water off using a hotplate.

**Diagram**

**Result**

After all the water was boiled off the dissolved solids remain on the sides of the glass and on the bottom of the beaker as a layer of grime.

**Diagram of beaker afterwards**

**OC30 (continued): Conduct a test water for hardness (soap test)**

**Date:**

**Diagram**

**Lab Partners:**

**Procedure**

Hard water requires a large volume of soap to form a lather, so to check for hard water we simply added some soap flakes to a test tube of the sample of water and checked to see if it formed a lather easily.

**Result**

|  |  |
| --- | --- |
|  | No of spoons of soap powder required to form a lather |
| Sample A |  |
| Sample B |  |

**Questions**

1. Why should the soap flakes be added one at a time?
2. Name an element whose compounds cause hardness in water.
3. How can hardness be removed from water?
4. If you had two samples of water and wanted to know which water was harder you would test in a manner similar to that above.

List three conditions necessary for this method to be a fair test:



1.



2.

3.

**OP 6: Investigate the relationship between the extension of a spring and the applied force**

(the extension of a string is how much it has stretched)

**Date**

**Lab Partners**

**Diagram**

**Procedure**

* We used a newton-meter to stretch a spring (or else hang weights from the spring as shown in the diagram below).
* We recorded the extension of the spring and the force used to cause that extension in the table below.
* We repeated this for lots of different forces.
* We plotted a graph of force used against extension.

**Results**

**Original length of the spring =**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Force** (measured in Newtons) |  |  |  |  |  |  |  |
| **New length**  (measured in cm) |  |  |  |  |  |  |  |
| **Extension** (cm)  (how much it has stretched) |  |  |  |  |  |  |  |

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**Notes:**

1. Many textbooks suggest that the line should go through the origin (0,0) but in practice this is unlikely to happen for your experiment – this is because the relationship usually only holds for *large* extensions.
2. Textbooks usually suggest that all the points will lie on a perfect straight line. In practice this won’t be the case. DO NOT JOIN THE DOTS!

One reason you may not have a perfect straight line is because the equipment may not work perfectly (sometimes the newton-metre ‘jumps’ from one position to another instead of sliding smoothly). Another reason is that you might read the instruments incorrectly.

So what you need to do is look at the dots and tell yourself that somewhere between all those dots lies the line that I would have got if everything was perfect. Now you have to *guess* where that invisible line is and draw it – a good tip is to assume it runs up the middle of all your dots.

1. This may well be the first time that you have come across the phrase ‘directly proportional’ – it means that the force and the extension change at the same rate; if the force on the string doubles so will the extension; if the force triples then the extension will triple also etc.
2. This relationship holds for many different objects, not just springs; you could try bungee cord, elastic bands, hair scrunchys, even knicker elastic (!!).

**Graph used to investigate the relationship between the extension of a spring and the applied force**

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**Result**

The graph should be a straight line.

**Conclusion**

The graph is a straight line which shows that the extension is ***proportional*** tothe applied force.

If the line went through the origin then we could conclude that the extension is **directly** ***proportional*** tothe applied force.

You must still remember this term because it often gets asked in exams (even if it doesn’t appear in textbooks).

**OP 23: To investigate and describe the expansion when heated, and contraction when cooled, of  
(i) solids (ii) liquids and (iii) gases**

1. **To investigate and describe the expansion of *solids* when heated, and contraction when cooled**

**Date:**

**Lab Partners:**

Diagram

**Procedure:**

* We noticed that we were able to pass the ball through the ring when the ball was cold.
* We heated the brass ball using a bunsen burner.

**Result**:

**Questions:**

1. *Why* do solids expand when heated?
2. Is it fair to conclude from this experiment that *all* solids expand when heated?
3. Explain your answer
4. Is it even fair to conclude from this experiment that *this* *solid* (brass) will always expand when heated?
5. Explain your answer
6. What would you have to do to verify that all solids will always expand when heated?
7. Allow the ball to cool again under a water tap and now try to pass it through the ring again – what happened?
8. What, if anything do you think this tells us anything about science?
9. **To investigate and describe the expansion of *liquids* when heated, and contraction when cooled**

**Date:**

Diagram

**Lab Partners:**

**Procedure**

* We connected a glass tube to the top of a test tube of water (we used food colouring to make the water more visible).
* We used a bunsen burner to heat the test tube of water.

**Result**:

**Questions**

1. Why was dye added to the water?
2. Why did the water rise up through the tube?
3. What caused the water to expand?
4. How does the heat transfer from the outside of the round-bottom flask to the liquid inside?
5. What does this investigation tell us about the expansion of liquids when heated, and contraction when cooled?
6. Is it fair to conclude from this experiment that *all* liquids expand when heated?
7. Explain your answer
8. Is it even fair to conclude from this experiment that *this* *liquid* (water) will always expand when heated?
9. Explain your answer
10. What would you have to do to verify that all liquids will always expand when heated?
11. What, if anything do you think this tells us anything about science?
12. **To investigate and describe the expansion of *gases* when heated and contraction when cooled**

**Date:**

Diagram

**Lab Partners:**

**Procedure**

We gently heated the flask of air using a hair-dryer.

**Result**:

**Procedure**

We then put a little food colouring into the beaker of water and turned the hair-dryer onto a ‘cool’ setting.

**Result**

**Questions**

1. *Why* did the air expand?
2. *Why* did bubbles appear when the flask was heated?
3. How does the heat transfer from the outside of the round-bottom flask to the air inside?
4. What does this investigation tell us about the expansion of gas when heated, and contraction when cooled?
5. Is it fair to conclude from this experiment that *all* gas expands when heated?
6. Explain your answer
7. Is it even fair to conclude from this experiment that *this* *gas* (air) will always expand when heated?
8. Explain your answer
9. What would you have to do to verify that all gases will always expand when heated?
10. What, if anything do you think this tells us anything about science?
11. Why was food colouring added?
12. Why might the flask crack if it was heated with a Bunsen burner instead of a hair-dryer; yes the Bunsen burner would heat it more quickly but why would that make the glass crack?
13. What does this investigation tell us about the expansion of gases when heated, and contraction when cooled?

**OP 31:**

**Transfer of heat energy by *conduction*: To compare the ability of different metals to conduct heat**

**Date:**

**Lab Partners:**

**Diagram**

**Procedure**

* We used the apparatus shown which consists of a piece of timber with four different strips of metal.
* We placed some candle wax at the end of each metal strip and placed a match standing up in the wax at the end.
* We lit the Bunsen (or candle) under the middle and noted the order in which the matches fall.

**Result** (you don’t need to remember the names of the metals):

**Questions**:

1. Give one precaution you needed to take to ensure that this was a fair test

**OP 31: Transfer of heat energy by *conduction*: To show that water is a poor conductor of heat**

**Date:**

**Lab Partners:**

**Procedure**

**Diagram**

1. We filled a boiling tube with water, then we dropped in an ice-cube and used a piece of metal to hold down the ice.
2. Holding the boiling tube at an angle with a tongs, we heated it at the top using the Bunsen burner for a short period of time.

**Result**:

**Conclusion**:

The fact that the water at the top was boiling while the ice-cube at the bottom still didn’t melt meant that the heat didn’t travel from the top to the bottom, so water must be a bad conductor of heat.

**Question**:

1. Why not let the ice float to the top of the water and then just heat the bottom?  
   Would the result be the same?

Why not?

1. Why was the boiling tube held at an angle?

**Transfer of heat energy by *convection*: Convection currents in air**

**Date:**

**Lab Partners:**

**Diagram**

**Procedure**

* We cut some tissue paper into narrow strips, tied them together at one end and hung them from a retort stand as shown over a hot-plate.

**Result**

**Questions**

1. How do you know that the hot-plate was the reason that the pieces of tissues began to move?
2. How did the heat get from the hot-plate to the pieces of tissue?

**Transfer of heat energy by *convection*: Convection currents in water**

**Date:**

**Lab Partners:**

**Diagram**

**Procedure**

1. Use the apparatus shown and drop in some copper sulphate or potassium permanganate.
2. Place the Bunsen under one of the corners and note the movement of the water around the apparatus.

**Result**:

What happened?

**Questions:**

1. Why was copper sulphate (or potassium permanganate) needed?
2. Why did the water begin to move the way it did and not the other way?

**Transfer of heat energy by *radiation*: Dark materials are better radiators of heat than shiny materials**

**Diagram**

**Date:**

**Lab Partners:**

**Procedure**

* We placed an equal amount of hot water in two similar metal containers - one bright and the other dark.
* We let both containers cool down.
* Using a thermometer and stop-watch we recorded the temperatures of both containers and the times and filled it into the table below.

**Result**:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time (in minutes) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Temp or dark can |  |  |  |  |  |  |  |  |  |  |
| Temp of silver can |  |  |  |  |  |  |  |  |  |  |

**Conclusion**

The dark container cooled more quickly, therefore dark materials are better radiators of heat than bright materials and therefore they cool down more quickly.

**Questions**

1. List two precautions you had to take to make sure that this was a fair test.
2. Can you think of any application of this fact (an application is a man-made device based on this principle)?

Can you think of any other questions to ask about this experiment?

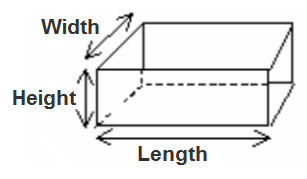
**OP 3 Investigate flotation for a variety of solids and liquids in water and other liquids, and relate the results of this investigation to their densities.**



In each case to calculate the density we simply use the formula:

**To measure the density of a regularly-shaped block**

*To find the mass* - weigh it on an electronic balance.

Mass = \_\_\_\_\_\_\_\_\_ g

*To find the volume*:

Length = \_\_\_\_\_\_\_\_\_\_\_\_ cm

Width = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Breadth = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Volume = \_\_\_\_\_ × \_\_\_\_\_\_ × \_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_ cm3

**Result**

Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/cm3

**To measure the density of an irregularly-shaped small stone**

*To find the mass* - weigh it on an electronic balance.

Mass = \_\_\_\_\_\_\_\_\_ g

*To find the volume*:

* Pour water into a cylinder and note the volume.

Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

* Drop the stone into the graduated cylinder water and note the new volume.

New volume = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

* To get the volume of the stone simply subtract the two readings.

**Result**

Volume = \_\_\_ – \_\_\_ = cm3.

Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/cm3

**To measure the density of an irregularly-shaped large stone**

*To find the mass*

Weigh it on an electronic balance.

Mass = \_\_\_\_\_\_\_\_\_ g

*To find the volume:*

Fill an overflow can up to the top and place an empty graduated cylinder under the spout.

Carefully drop the stone in (using a string so there is no splash).

Note the level of water in the overflow can.

Volume = \_\_\_\_\_\_\_ = cm3.

**Result**

Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/cm3

**To measure the density of a liquid**

*To find the mass:*

Weigh an empty graduated cylinder, and then weigh the graduated cylinder after pouring water into it.

Then subtract the two readings.

Mass of empty cylinder: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

Mass of cylinder with water: \_\_\_\_\_\_\_\_\_\_\_\_ g

Mass of water: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

*To find the volume* simply note the level of water in the graduated cylinder.

Volume = \_\_\_\_\_\_\_ = cm3.

**Result**

Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/cm3