KNOX GRAMMAR SCHOOL

STATE

DA VINCI DECATHLON 2019

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 5 & 6

da Vinci Decathlon® EXCITE ENRICH CHALLENGE An initiative of Knox Grammar School

SCIENCE SOLUTIONS

Q1a-d	Q1e	Sec1 - Q2	Sec 2 - Q3	Sec 3 -Q4	Total	Rank
/5	/15	/3	/17	/15	/55	

Complete the above table with question numbers and marks as required.

SECTION 1: ROCK FORMATION

QUESTION 1: DENSITY OF ROCKS IN THE LANDSCAPE

Density is a measure of how much mass something has per unit of volume. Water has a density of 1 gram per 1 cm^3. The way a rock is formed affects how dense it is. Most rocks are more dense than water and sink, but some rocks are less dense than water and float. You might have seen the rock pumice washed up on the beach or even for sale in the Chemist shop as an aid to smoothing rough skin. If you pick up pumice and look closely, you will notice how light it feels in your hand and see tiny spaces filled with gas. These spaces are called vesicles and we call pumice a vesicular rock.

1) Write the missing values into these density calculations for different rocks and materials.

a) The density of **water**

$$\frac{\text{Mass}}{\text{Volume}} = \frac{74\text{g}}{\boxed{74}\ \text{cm}^3} = 1\ \text{g/cm}^3$$

b) The density of **water**

$$\frac{\text{Mass}}{\text{Volume}} = \frac{1562\text{g}}{\boxed{1.562}\ \text{litres}} = \frac{1562\text{g}}{\boxed{1562}\ \text{cm}^3} = 1\ \text{g/cm}^3$$

c) The density of **granite**

$$\frac{\text{Mass}}{\text{Volume}} = \frac{33\text{g}}{\boxed{12}\ \text{cm}^3} = 2.75\ \text{g/cm}^3$$

d) The density of **pumice**

$$\frac{\text{Mass}}{\text{Volume}} = \frac{\boxed{23}\ \text{g}}{92\ \text{cm}^3} = 0.25\ \text{g/cm}^3$$

e) A geologist went on a fishing trip with her family and came across a big chunk of lustrous rock that looked like gold. She became very excited because if the rock proved to be gold, she would become very rich! The geologist knew that the density of gold is 19.3 and the density of iron pyrite (fools' gold) is 5 so before she shouted, "Eureka!" She decided to measure the density of the rock. Because she was on holidays, she didn't have all her field work tools with her but she was able to find the following objects:

- A large, empty glass gherkin jar
- A plastic bag
- The fish weighing scales from her tackle box
- A 30ml medicine cup from her first aid kit
- A marking pen for marking maps in the glove box of her car
- A bucket of water from the river that they were going to use to hold fish after they caught them

Write a step by step procedure the geologist could use to measure the density of the lustrous rock so she could make sure it was gold and not iron pyrite.

Possible method

- **Weighing the sample using the bag and scale (or another method that would prove successful and accurate)**
- **Filling the jar with enough water to cover the rock and marking the water level on the side of the jar**
- **Adding the rock and marking the higher water level on the outside of the jar**
- **Removing the rock, filling the jar to the original level and then using the medicine glass to measure and add quantities of water until the water level reaches the higher mark**

Alternative method

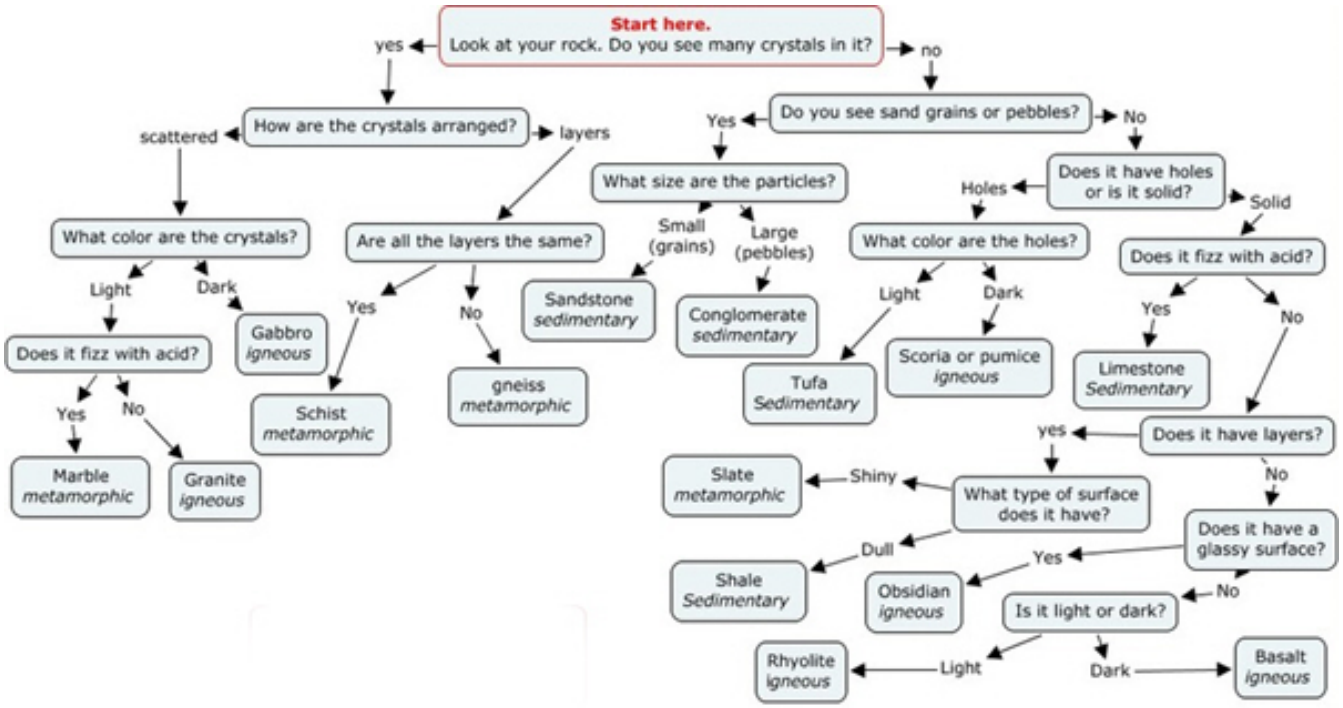
- **Students may also fill the jar completely, place it inside the empty bucket, drop the rock in and collect the water that overflows in the bucket. Then use the medicine glass to measure the water in the bucket.**
- **Divide the mass of the rock in grams by the volume of water it displaces as a measure of cm^3**

Award marks for

- **Clarity** (2)
- **Feasible method, logically explained** (5)
- **Adjectives/adverbs to enhance precision** (1)
- **No additional equipment required other than what is given** (2)
- **Calculations described** (3)
- **Instructions for recording of data detailed** (2)

QUESTION 2: IDENTIFYING ROCKS IN THE LANDSCAPE

2) Scientists often use a ***dichotomous key*** to classify organisms or substances. Use the ***dichotomous key*** below to identify the rocks in the pictures below.



a) This rock is ***does not fizz*** when a few drops of HCl acid placed on it.

The rock is: **Granite**

b) This rock ***does not fizz*** when a few drops of HCl acid is placed on it.

The rock is: **Shale**

c) This rock ***does not fizz*** when a few drops of HCl acid is placed on it.

The rock is: **Conglomerate**

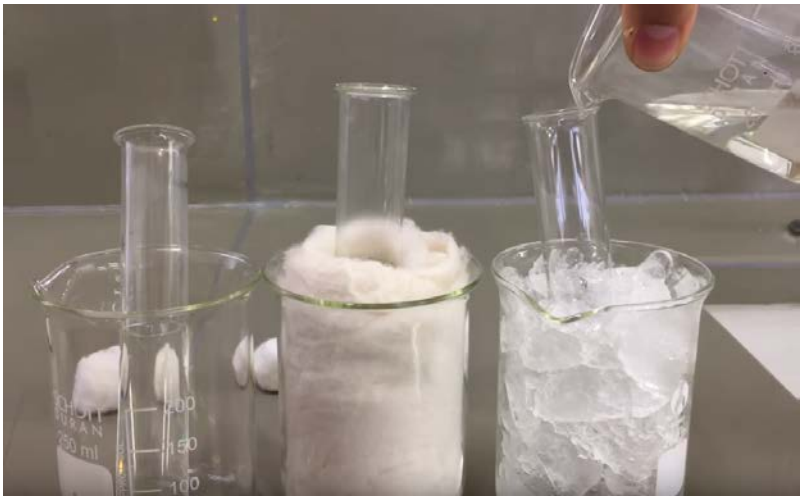
SECTION 2: EXPERIMENTAL DESIGN

QUESTION 3: SCIENTIFIC INVESTIGATION OF CRYSTALLISATION IN ROCKS

A student was hiking through the Australian Alps in Victoria and noticed that some of the rocks had **large crystals** while the shiny particles in other rocks were **really small.** He began to wonder what affects how big the crystals get in rocks. He knew that most of these rocks started out as magma or lava. Just then, a chilly gust of wind made him shiver and it sparked a thought, "Maybe the size of crystals in rocks is affected by how quickly the hot liquid rock cools down." When the student got back to school, his teacher helped him test his theory that it was the rate that the lava cooled down that caused some rocks to have large crystals while the crystals in other rocks were so small you could hardly see them, if at all.

The teacher was eager to help but said it wasn't possible to work with actual lava because it would be too hot but she was able to show him a few chemicals that could be dissolved in large amounts in hot water and then cooled to form crystals. They chose to work with a chemical called Aluminium Potassium Sulphate.

They set up test tubes as shown below.



The procedure they followed was:

1) Create three different cooling conditions:
   - A beaker full of ice for fast cooling
   - A beaker with just air inside for moderate cooling
   - A beaker full of cotton wool for slow cooling

2) Place an empty test tube in each beaker

3) Measure 15g of Aluminium Potassium Sulphate

4) Heat 100mls of water to 60°C
5) Dissolve the Aluminium Potassium Sulphate in the water and stir until clear
6) Pour 30mls of the hot solution into each test tube and wait 8 hours
7) Remove the test tubes from the beakers and observe the size of the largest crystal in each test tube

After eight hours, the crystals in the test tube that had been in the ice bath were small and looked like grains of table salt. The crystals in the test tube that had cooled in a beaker of air were a bit bigger. The test tube that had been wrapped in cotton wool and cooled very slowly contained large crystals the size of peas.

Write up the student's experiment below:

Aim:

To investigate/determine/find out the effect of temperature/rate of cooling on crystal size

Independent variable: **Rate of cooling or conditions inside the beaker**

Dependent variable:**Size of the crystals formed**

Hypothesis:

A prediction of how the dependent variable will be affected by the independent variable, with a reason given for why

Name 4 things that must be kept exactly the same to ensure a "fair test":

Amount of solution poured into test tubes

Starting temperature of the solution

Size and shape of the test tubes

Concentration of the solution

Time between pouring and observing crystals

Substance dissolved in the solution

Risk Assessment (Identify 3 hazards, harms and precautions)

HAZARD OR DANGEROUS SUBSTANCE OR OBJECT	HOW IT COULD HARM A PERSON	PRECAUTIONS. WHAT CAN BE DONE TO STAY SAFE
Glassware	**Could break and cut someone**	**Place glassware away from edge of bench** **Hold glassware in two hands**
Hot water	**May scald student's skin**	**Use mitt or holder when pouring** **Keep hands away from test tube when pouring**

Aluminium Potassium Sulphate	**May get in eyes or irritate skin**	**Wear gloves** **Use a spoon or spatula to add substance** **Keep face away from test tubes by not leaning in**

SECTION 3: PROCESSES SHAPING THE LANDSCAPE

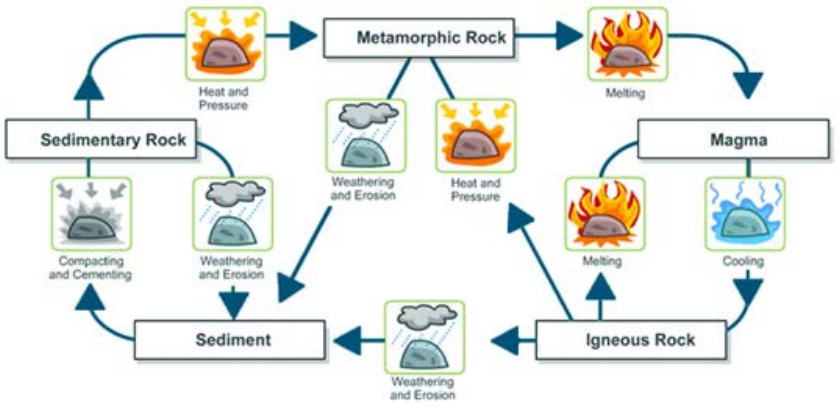
QUESTION 4: THE ROCK CYCLE

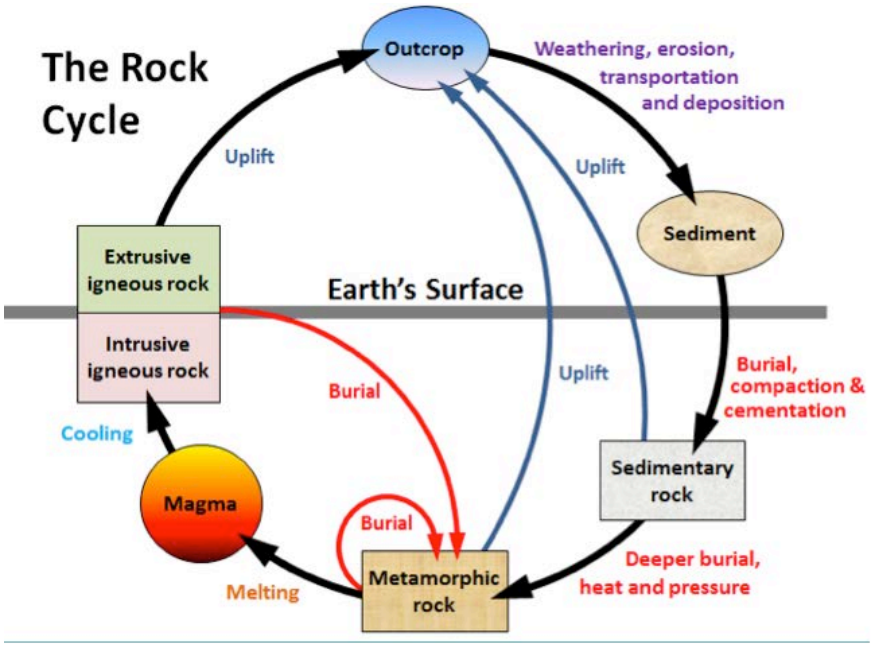
The landscape is continuously being shaped and transformed by processes that make, remove and change rock. Arrange the terms below into a mind map, flowchart or diagram on an A3 sheet to show possible sequences that lead to the construction or destruction of rock. It's unlikely to be in a straight line.

Use arrows and text to explain the why you connected terms.

You will be awarded marks for showing that you can infer the meaning of the terms and make logical connections between the concepts.

The following diagrams show the type of diagram students are expected to create





Award 0.5 marks for each term connected in a way that is consistent with the following definitions and an additional 3 marks for overall effectiveness of the visual representation of information.

Subduction -when an oceanic plate pushes up against a continental plate it sinks down underneath it. Subducted rock melts and eruptions happen nearby
Folding - occurs at plate boundaries to create mountains
Uplift - rock moves upward when it is pushed together
Eruption - volcanic activity is associated with igneous rock. Happens most frequently near subducting plates
Igneous Rock - rock that forms when magma cools
Heating - melts rock or causes a change so it becomes metamorphic
Melting - heating rock causes it to melt
Magma - molten rock under the ground
Lava - molten rock that reaches the surface
Cooling - magma and lava harden
Extrusion - molten rock that cools on the surface - fast cooling and small crystals
Intrusion - molten rock that does not reach the surface but cools slowly under the ground
Crystalisation - As molten rock cools, the minerals form crystals
Metamorphic Rock - sedimentary, igneous or metamorphic rock that changes into another type of rock due to heat or pressure eg limestone becomes marble

Sedimentary Rock - eroded rock forms sediment which is compacted and cemented into rock such as sandstone
Weathering - breaking down of rock physically or chemically
Erosion - removal of the weathered material from the original rock
Ice - breaks rock by forming and expanding in cracks, wedging pieces away
Wind - blows debris against rock to wear it away and transport the weathered rock
Water - moves particles of rock and weathers rock by dissolving it
Transportation - moving eroded rock some distance from the original site, usually by rivers and streams
Deposition - water flows down and the particles fall to the bottom forming sediment
Compaction - pressing particles together
Cementation - sticking particles together (substances such as silica or calcite act like glue)