Exemplar Materials: Unit 8 Investigating the Scientist's Work

Name of Student:……..

Aim of Investigation:

Task Set	Mark	Comments	Resubmission	Mark
Planning AO1a 5 marks	1	Lack of full plan		
Research AO1b 5 marks	2	Range of research Need suitable validation for MB2 Although some constraints		
Implementation AO3a 6marks	2	Teacher assessed More detail regarding risk assessments.		
AO3b 5marks	2	No clear record of plan being monitored – problems listed – changes given.		
Scientific Report AO3c 7marks	2	Limited scientific understanding		
Data Interpretation AO3d 4marks	1	Data interpreted		
Evaluation AO3c 4marks	2	Not critical		
Presentation of Data AO2 a 5 marks	2			

Task Set	Mark	Comments	Resubmission	Mark
Processing AO2b 5 marks	2	Suitable processing some interpretation		
Calculations AO2c 5 marks	-	Not completed		
			Final Mark	16

Comments

Work presented at mark band 1-2.

The assignment scores 16 marks out of possible 50.

This piece of work is a sound basic attempt at a vocationally-related subject, and good use has been made of industrial links. However it lacks scientific background or rigour.

A higher mark might have been achieved if repeated readings, calculations based on results and a more considered evaluation have been included. Also it lacked a full plan with monitoring.

Final Agreed Total Mark: 16

Student Signature:…….. Tutor Signature:…….....

NB: This portfolio is intended as an example of a typical students' work rather than a perfect model. As such it contains errors in punctuation, spelling, grammar as well as occasional incorrect use of words.

EXEMPLAR PORTFOLIO WORK – ASSIGNMENT 8 **Investigating the Scientist's work**	**Commentary on Mark Allocation**
<u>An Investigation into Insulating Materials</u> Plan The aim of my experiment is to see how different types of insulation affect the control of heat loss and to find the best insulator. Experiment 1:- Using the materials Foam, Bubble Wrap, Cloth and a beaker with no insulation as a standard for my experiment I will get a general idea of which insulation is the most effective. Apparatus: To complete my experiment with the most reliable data I can get I will need the following: • 4* 250ml Beakers • 4* Thermometers • 4* Stop Clocks • 4* Pieces of Wood • A piece of Foam • Apiece of Cloth • A piece of Bubble Wrap • Kettle Prediction:- Before I carry out my experiment I would like to make a prediction as to how I think the experiment will turn out. Looking at my three pieces of insulation I believe the experiment will turn out like this Foam being The best Insulator → Bubble Wrap → Cloth being the worst Insulator After this experiment I am looking to extend the practical. I have been in contact with British Gypsum and they have offered to send me a wide range of samples of commercial insulation plaster board which I am going to be testing to find out which is the best and why. I am also going to be looking at the cost of the insulation board where I can find out if the best board is the most expensive the from British Gypsum.	**AO1a Plan:** Plan does not show a holistic workable plan – it only shows aims and experimental details, shows very limited knowledge of experimental techniques – no scientific principles shown here - prediction not relevant as not supported with scientific knowledge (but see later experiment 2). **Mark Band 1** **1 mark** Shows direct vocational involvement.

http//www.healthgoods.com/Education/Healthy_Home_Information/Insulation/introduction_insulation.htm

Why Should You Insulate?
The Crucial Role of Thermal Insulation
Insulation priorities
How Does Insulation Work for You?
Basic Forms of Thermal Insulation

httpi/www.ncpublicpower.com/insulation.htm

Putting it in place
Types of insulation

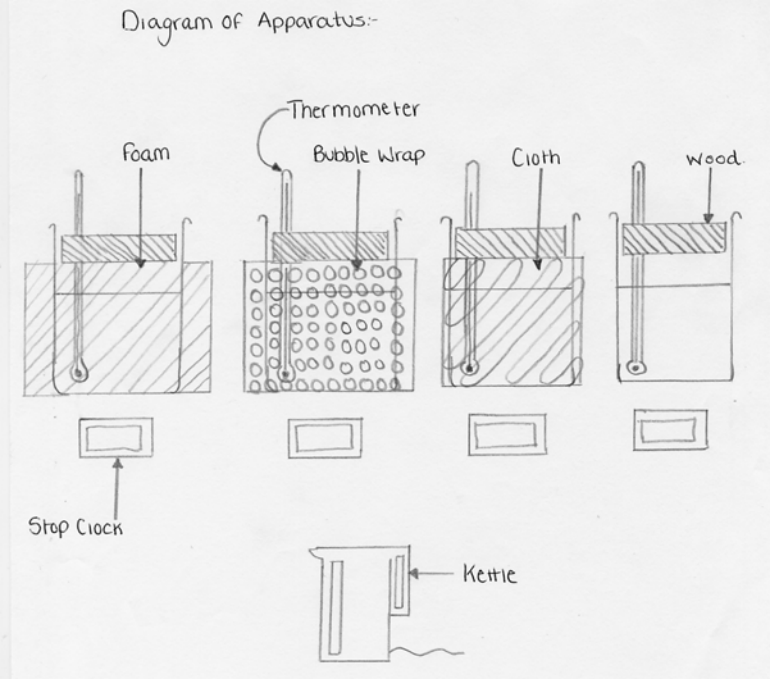
The student also included British Gypsum literature here.

AO1b Research: Evidence of selected research about suitable experimental work and health and safety, **little evidence of** identifying information on deadlines you will need to be aware of but **sufficient** to meet **(Mark Band 1 - 2 marks scored)**

Insufficient relevant evidence for MB2

<u>Method:</u>

I am going to introduce 200ml of boiling water into four beakers one insulated by foam, another by bubble wrap another by cloth and a final beaker with no insulation as this will be my standard. I will then time the experiment and take a temperature for all four beakers every minute and record them into at table.



Time (min)	Foam (Temp C)	Bubble wrap (Temp C)	Cloth (Temp C)	No Insulation (Temp C)
Room Temp	27	27	25	27
1	74	77	78	81
2	74	76	77	80
3	73	76	76	79
4	73	75	75	77
5	73	73	75	76
6	72	74	73	75
7	72	73	72	74
8	72	71	72	74
9	71	71	71	73
10	71	71	71	72
11	70	70	70	71
12	70	69	70	71
13	70	69	69	70
14	69	68	69	69
15	69	68	68	68
16	69	67	67	67
17	69	66	67	66
18	68	66	66	65
19	68	65	66	64
20	67	65	64	63

Thickness of the Foam:- 1.2cm
Thickness of the Bubble Wrap:- 0.4cm
Thickness of the Cloth:- 0.1cm

Due to not having enough time I was unable to repeat each experiment I will carry out any repeats if necessary after looking at the results from my experiments.

Student used relevant risk assessments when he completed this practical and worked safely.

Teacher + date assessed

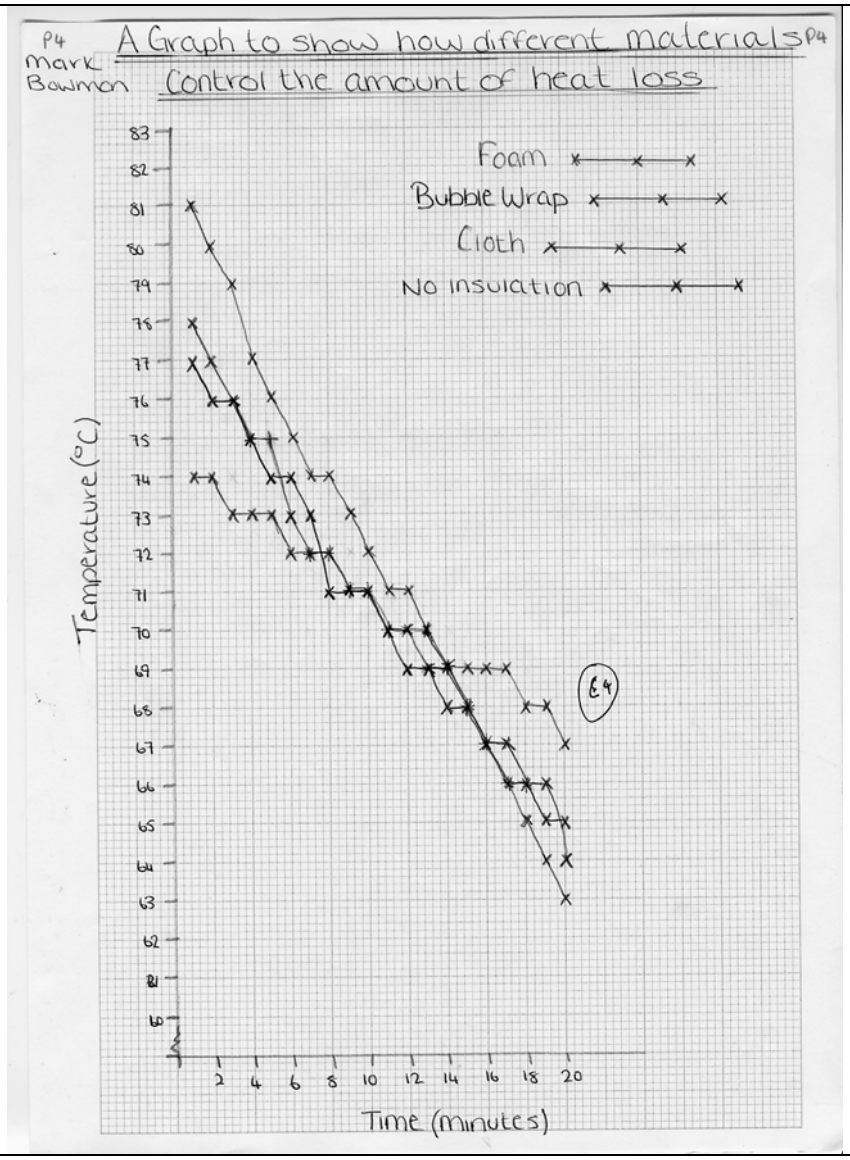
AO2a
Results part 1:

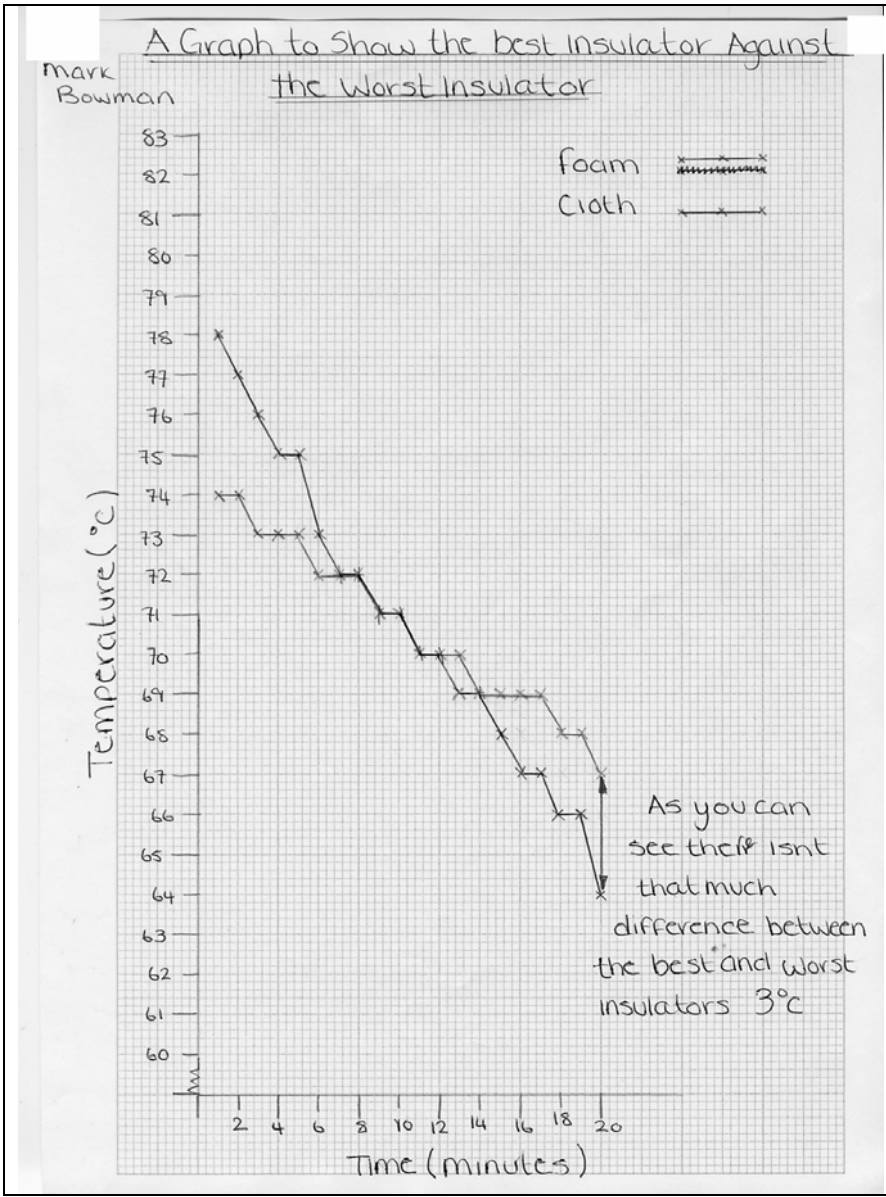
Results of the investigation recorded and presented in a suitable format. See also graphs following **(Mark Band 2 - 2 marks scored) (+ later work)**

AO3a
Procedures + later work – 2 marks
(teacher assessment is sufficient however risk assessments used should be included).

AO3b
Work has obviously been completed – record needed that plan followed:
(Mark Band 1 – 2 mark scored)

See later evidence of modifications.





AO2 b
Processing:
Limited processing and interpretation of the data collected with a suitable link to the vocational context set;
(Mark Band 1 - 2 marks scored)
not suitable processing and interpretation of the data collected, relating to the objectives of the investigation. Hence does not achieve mark band 2.

AO2 c
Calculations – No evidence
no marks, strand 3

Graphical Explanation	
As you can see from the graphs the best insulation was the foam as there was minimum heat loss in comparison with the other three insulators. Following the foam was the bubble wrap closely followed by the cloth. The reason for the foam proving to be the best insulator is that, the foam contains pockets which become trapped with air. As the air boiling water gives of steam by convection these air pockets begin to heat up forming a layer of hot air around and inside the foam. Due to air being a poor conductor of heat this keeps the water warm and slows down the cooling process. As the bubble wrap had some air pockets covering the surface of the insulating material this to slow down the cooling process. Looking at the second graph showing the best insulation against the worst insulation you can see there isn't much difference only three degrees between them. However the water contained in the beaker surrounded by the cloth insulation starts of at a much high temperature than the foam. I recognise this as a problem as if the insulators were to start at the same temperature I would have seen a more clear and definite difference. Although it is interesting to see that the line drawn for the data of the cloth insulator shows a rapid heat loss as the line plummets dramatically compared to the line representing the foam shows a steady decrease.	**AO2 a Results, part 2:** Description and explanation of the results not clear especially – *"As the air boiling water gives of steam by convection these air pockets begin to heat up forming a layer of hot air around and inside the foam."* **2marks allocated description of results throughout work.** **AO3d Interpretation Mark Band 1 achieved, 1 mark scored. No evidence of assessment of reliability Mark Band 2 not achieved.**

An Investigation into the Control of heat loss using Commercial Insulation Boards Provided by British Gypsum

Aim:-
The aim of my second experiment is to see how different commercial insulation boards control the amount of heat loss and to find the best insulator D, Ray for housing.

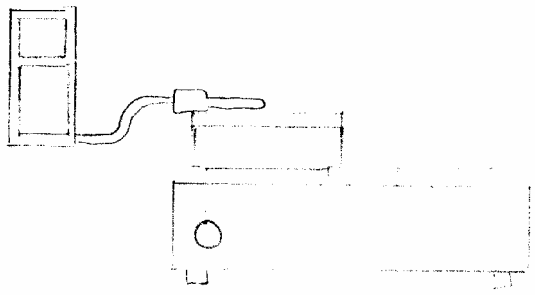
Extended Practical-
Using the different insulation boards Thermaline Platinum, Super, Plus, Basic, Reveal and TriLine supplied by British Gypsum I am going to place these on a heating plate and attach a data logger to the top of the board which will record the temperature of the outer surface of the board every minute I will then be able to see which is the better board by seeing which board surface stays the coolest as the insulators should block some of the heat.

Apparatus:-
To complete the experiment desired I will need the following equipment:-

- The six pieces of insulation board mentioned above
- A Hot Plate
- A Data Logger

Method:-
First I will draw up a table of results form my six pieces of insulation board, Then I will set my data logger to record the temperature of the board every minute for the next 20 minutes, I will then transfer the results onto my results table and then repeat the process for the other five insulation boards. However I will be knocking of the hot plate for *5* minutes letting it cool down so my data will be more reliable.

Diagram of Apparatus:-



Student used relevant risk assessments when he completed this practical and worked safely.

Teacher +date assessed

This should have been all grouped together in a holistic plan.

Evidence of range techniques – aiming towards MB2.

Prediction of the performance of British Gypsum insulation Board

Before I carry out my investigation into the performance of the insulation board supplied by British Gypsum I would like to make a prediction as to how I think the different boards will do under the conditions. This is how I think the experiment will turn out:-
I believe the Thermaline Super to be the best insulator and the worst to be the Thermaline Basic. My prediction is based on the book I received form British Gypsum as reading up on the boards I discovered the Thermaline Super has the highest Thermal Resistance (R) than the other boards at 1.16 when the board is measured to be 30mm and the Theramline Basic has the lowest thermal resistance than the other boards at 0.55 at the same thickness of 30mm.i will be interested to see if my prediction is correct.

Problems which may arise during the Experiment

Some problems which I have foreseen that could happen during my experiment are

- That the hot plate could still be warm from the previous insulation board tested. So I have had to modify my plan slightly from leaving the hot plate to cool for 10 minutes not *5* so that the hot plate has more time to completely cool meaning there is less room for error and giving my data more reliability.
- Another problem which may occur is the accuracy of recording the results, so I am going to use a data logger instead of a thermometer like in the first experiment, for a more reliable form of recording.
- Saying that the data logger is a more reliable form of recording this piece of apparatus isn't totally reliable as it may crash or cut out in the middle of testing a piece of insulation board. To overcome this problem I am going to conduct the experiment using two data loggers so if one does cut out I have the other data logger as insurance. Using two data loggers also provides me with two sets of data so I can compare the results, if there are any differences one data logger may be corrupt. So using two data loggers can provide help in many ways.

Table of Results for the Commercial Insulation Board

Time (min)	Thermaline Platinum	Thermaline Super	Thermaline Plus	Thermaline Basic	Thermaline Reveal	Triline
1	25.8	25.7	23	23.6	26.4	25.9
2	26.7	25.8	23.4	24.6	26.5	25.9
3	28.9	26	24.1	27.6	27.4	27.4
4	31.2	26.1	25.1	31.4	29.2	33
5	33.2	26.3	26.3	35.4	31.2	38.5
6	34.9	26.4	27.8	37.1	33.4	41
7	37.2	26.5	28.9	39.3	35.3	42.6
8	39.2	26.6	29.9	41.4	37.3	42.8
9	40.4	26.8	30.6	42.8	38.8	41.6
10	41	27	31.1	43.2	39.8	39.9
11	41.4	27.3	31.3	43.5	40.9	39.8
12	42.3	27.5	31.5	43.5	41.6	39.1
13	42.7	27.8	31.9	43.5	41.9	38.6
14	42.7	28	32.1	43.3	42.5	37.5
15	42.7	28.3	32.3	43.5	42.6	36.8
16	43	28.7	32.5	43.9	42.4	37.8
17	43.2	28.8	32.6	43.8	42.6	37.5
18	43	29	32.6	43.7	42.5	36.7
19	42.6	29.3	32.8	43.2	42.3	36.4
20	42.8	29.5	32.8	43.1	42.3	36.4

Thickness of material:-

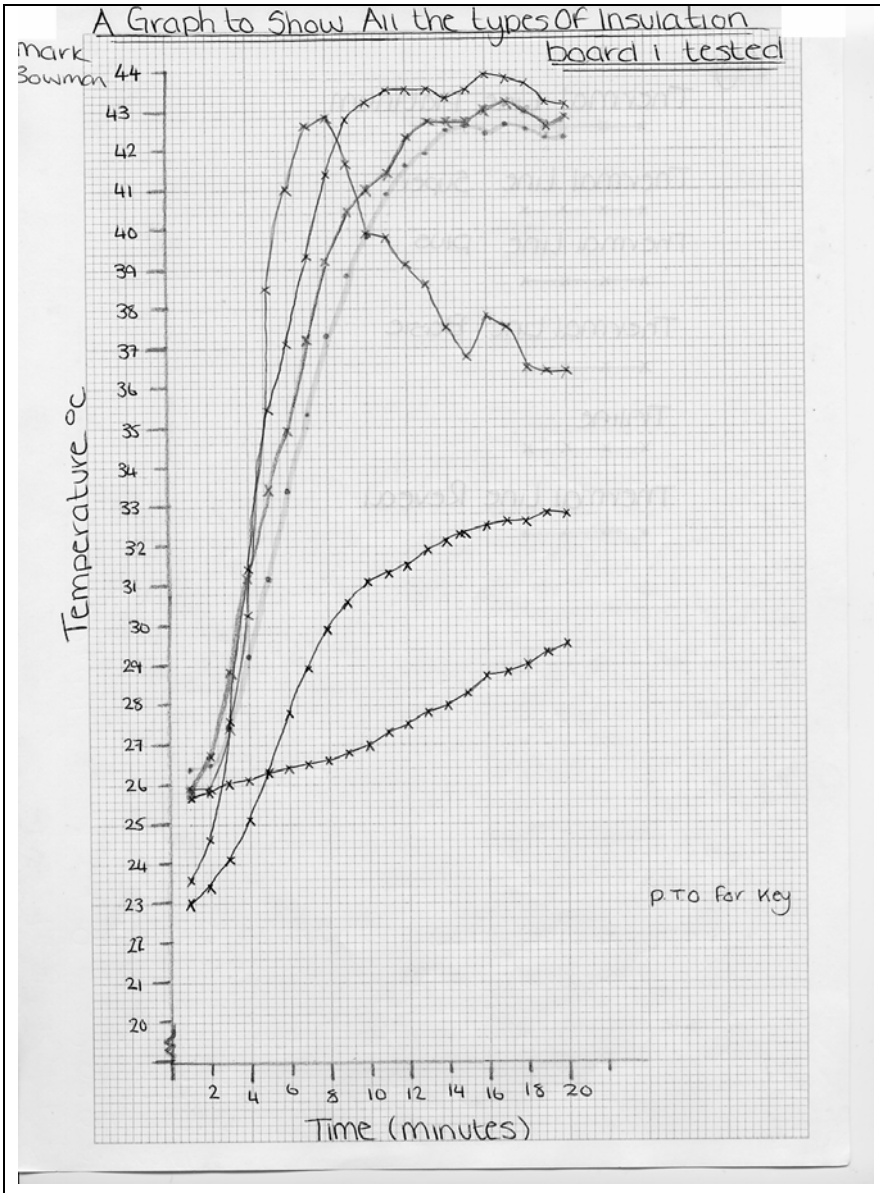
Each piece of insulation board has a 1 cm wall board attached

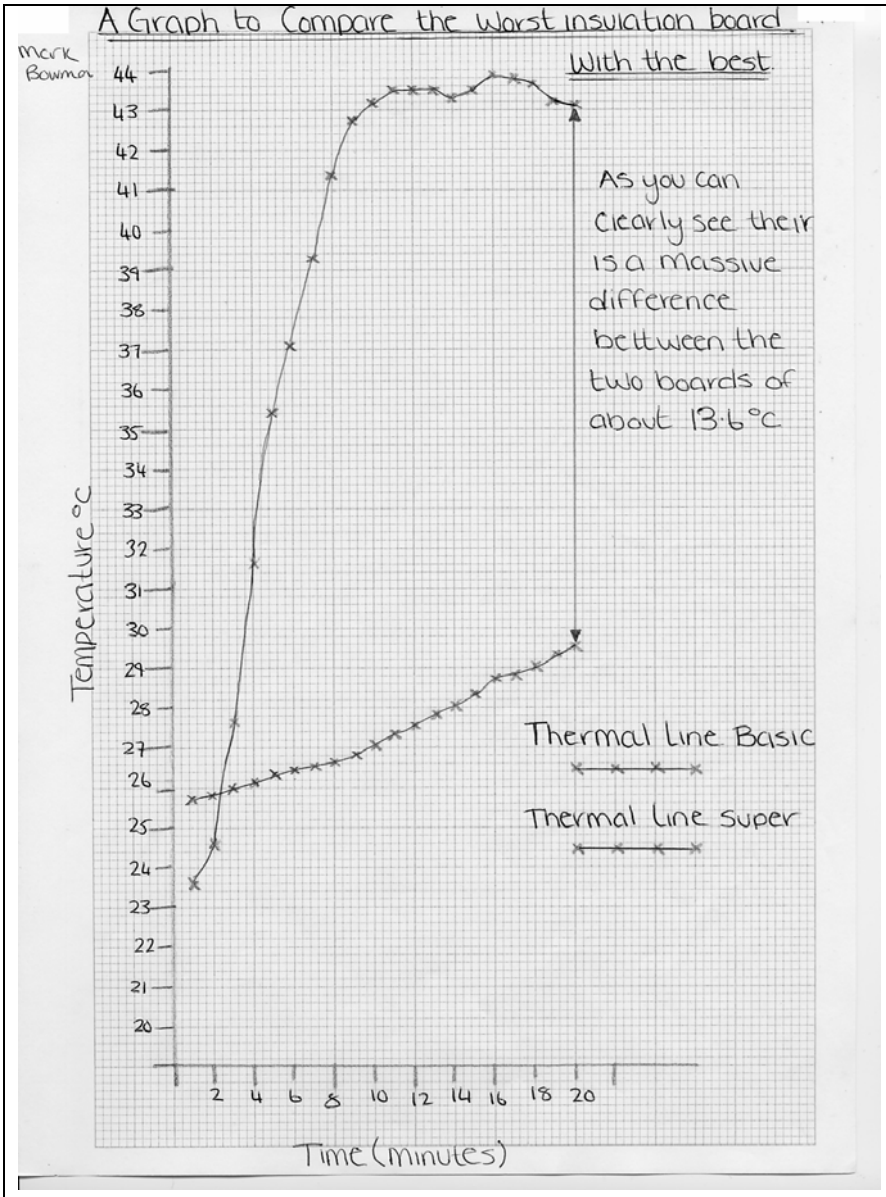
- Thermaline Platinum:- 1.2 cm
- Thermaline Super:- 5 cm
- Thermaline Plus:- 2.5 cm
- Thermaline Basic:- 1.8 cm
- Thermaline Reveal:- 2.2 cm
- Triline:- 1.6 cm

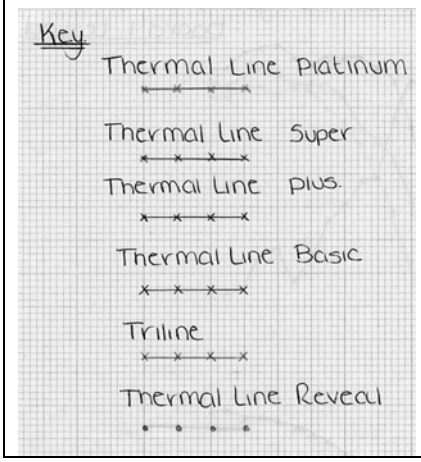
Temperature of the Hot Plate throughout the Experiment

Time (minutes)	Temperature (C)
1	30
2	70
3	89
4	95
5	94
6	92
7	96
8	96
9	94
10	92
11	94
12	94
13	94
14	92
15	94
16	94
17	92
18	92
19	94
20	94

As you can see the temperature of the hot plate rises very quickly to a temperature of 98 C but then drops to 94 C and stabilises between 94 and 92 C So the temperature is almost kept constant. This would suggest that the hot plate is thermostatically controlled and would be the same through out the testing of the insulation boards. Proving my results to be more accurate.

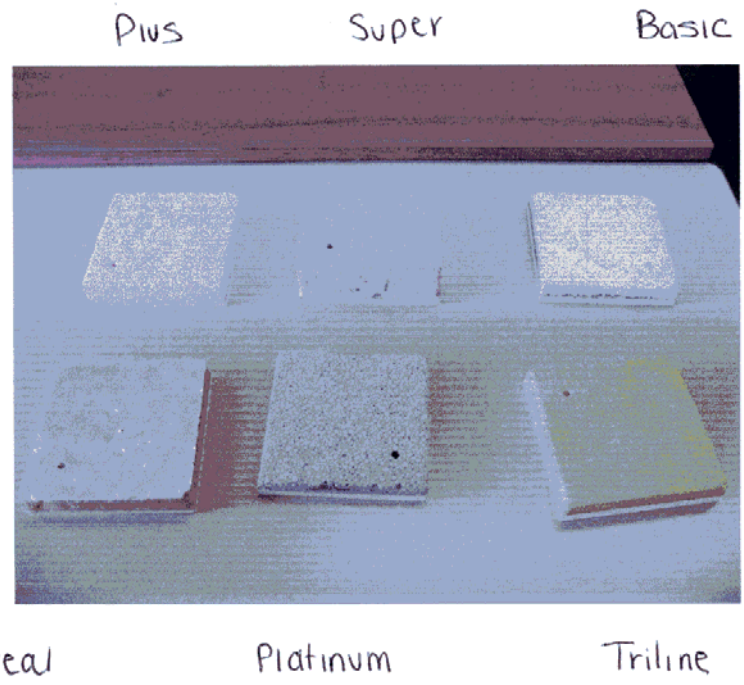

A Graph to Show All the Types Of Insulation board i tested
Mark Bowman
Temperature °C
Time (minutes)
p.T.O. for Key





Graphical Analysis for the British Gypsum Insulation Board Tested As you can see from the graph the best insulator by far was the Thermaline Super as the top surface of the insulation board was kept the coolest in comparison with other five different insulation boards, followed closely by the Thermaline plus then the Triline, Reveal, Platinum and finally the Basic. One reason the super insulator came out on top is that it is the thickest insulator of all the boards meaning that the heat would take longer to cross the insulation board through conduction or convection with the assistance of air pocket. This theory is entirely plausible as it is interesting to see the thermaline plus which has the next largest thickness is in fact the second best insulator I found during my experiment. Looking at the second graph showing the best insulation against the worst there is a massive difference of 13.6 C comparing to my first experiment where there were only a small difference of 3 C looking at the line drawn for the thermaline basic has a terrible start as soon as the hot plate begins to heat up the insulators surface begins to heat up the insulators surface begins to become increasingly hot. Compared with the thermaline super the insulation board steadily creeps up increasing in temperature starting from *25.7* C increasing to *29.5* C only increasing 3.8 C in surface temperature making it an extremely good insulator. It's interesting to see that the insulation board which turned out to be the worst was made from the same material as the insulator I used in the first experiment where it trued out to be the best. This gives us some indication that development and technology are always producing something exceedingly better.	**AO3c Report** **Mark Band 2, 3 marks achieved.** Some evidence of understanding of scientific concepts. Logical – but more guidance and direction needed towards the assessment criteria.

Photo Showing the insulation boards I have tested.



The student included British Gypsum "Value your choice" data here.

Value for Choice!

Looking at British Gypsums own value for choice Gyproc Thermaline "Ready Reconer" it doesn't mirror the results which I found carrying put my experiment. I found that thermaline super to be a far more superior insulating board than the platinum insulator which has been chosen as their best insulator for value for money, I think this is because the thermaline super insulator does its job extremely well but is very expensive as a result. Compared with the thermaline platinum which does its job competently well for considerably less money.

The Science and means behind the Board

The purposes of installing insulation is to reduce the flow of heat which leaves the house in winter and try to prevent heat entering the house in summer, As heat naturally flows from a hotter region to a colder region which is known as convection, with aspects of conduction and radiation. This is because molecules from a hotter region have more kinetic energy and when this is met with a colder region the two molecules collide and some kinetic energy is lost this is known as the collision theory. Thermal insulation acts to slow down the flow of energy from hot to cold. The three main processes by which the energy is transferred are Conduction, Convection and Radiation the insulation works by disrupts all three.

1. Conduction, thermal energy is “conducted” through a material by the colliding of adjacent atoms and also by the movement of free electrons.

Thin fibres of electrically insulating material make good thermal insulators. Because thy make it difficult for the atomic colliding to transfer heat as they disrupt the flow of heat so there are very few electrons to conduct the heat.

2. Convection happens in hot liquids and gases whereby particles heat up and collide forcing each other apart so the fluid becomes less dense. This causes gases to rise where they cool and lose their heat leading them to become denser once again meaning they begin to fall.

Finally divide materials slow air flow and stop air from carrying heat via convection. Empty space or Vacuum, also stops convection because there is no air within the insulation to heat up and convect.

3. Radiation, otherwise known as electromagnetic radiation. Surfaces are always emitting and receiving electromagnetic waves which we know as infra red, visible or ultra violet light radiation tends to transfer heat from hot surfaces to colder surfaces.

Insulators diffract and block these waves by reflecting them which is done by shiny surfaces or opaque insulation tends to slow heat flow via radiation.

Evaluation

If I were to do this experiment again I would ask British Gypsum if they could supply me with a wider variation of insulation boards so I would have a wider scope of and well defined set of data. I would also like to like to do the experiment again but with different thicknesses of the same insulation boards to see if the thickness really makes a difference in the performance of the insulation.

I would also like to carry out more tests on the boards under different conditions such as is the board smoke resistant of flame retarded. If Id had the opportunity to perform these types of experiments I would have liked to have found if there were any correlation between the different conditions for example If the board is a good insulator would the board process a good smoke resistant quality or vice versa.

Although I found myself making modifications to the experiments through forseen circumstances I found these to make my experiments more reliable and in turn making my results more reliable therefore I believe me experiments to be a success.

Conclusion

As you can see from my graphs that the best insulator is the thermaline super (which is made from Phenolic foam) by a massive temperature difference of 13·6 °C Compared with the worst insulator which was the thermaline basic. ~~this proves that~~ meaning that the R-Value of the thermaline super is a lot higher than the thermaline basic. This proves that my prediction is correct. I believe this is because the thermaline super is a thik insulation board with no air pockets for conduction and convection to take place so little heat energy can escape through the walls of the house. Compared to the thermaline basic which is made from polystyrene which contains air pockets which when heat up create a layer of hot air which slows down the rate of conduction but not entirely as a large percentage of the heat escapes from the house, Compared to the thermaline super.

AO3e
Evaluation produced. Mark Band 2 achieved – 3 marks scored.
Not critical Mark Band 3 not achieved.