Science KS4: Blended Learning Booklet

Stewards Academy

P1 Energy

Name:

Form:

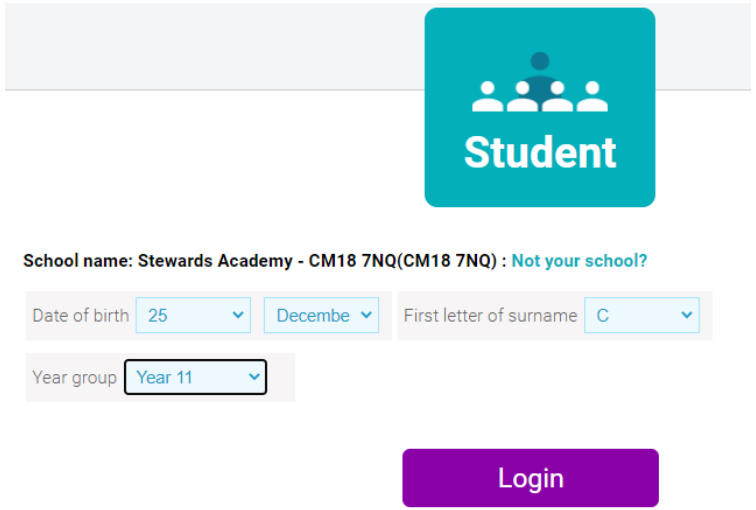
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

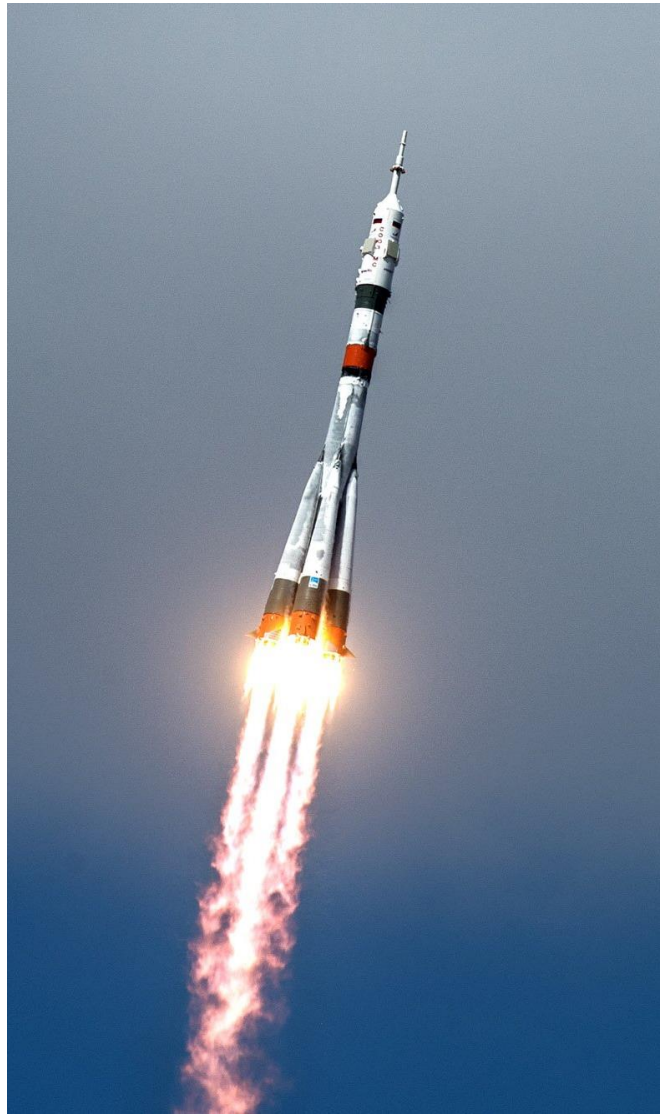
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year





Contents

Contents

(T) Triple Science only

Big Picture – Year 9 Overview

Science

Specific latent heat

Particle motion in gases (T)

End of Year Exam

Nest Year

Specific heat capacity

Changing state

Density

UNIT P3

End of Unit Test

Volumes and concentrations (T)

Percentage yield (T)

Amounts of substance (moles)

Apparent changes in mass

Matter

I will be able calculate the specific heat capacity of water and be able to describe the difference between the specific latent heat of vaporization and the specific latent heat of fusion. **I will** be able to explain the effect heat energy has on gas particles *and how this is related to volume (T).*

I will be able to explain and apply the law of conservation of mass. **I will be** able to explain how we measure amounts of substances and how we can use these values to in calculations. ***I will be** able to determine chemical yields (T)*

Chemical Quantities

Osmosis and active transport

Enzymes and digestion

Plants and minerals

Heart and circulatory system

Gas exchange

End of Unit Test

UNIT C3

Conservation of mass

UNIT B3

I will be able to explain *the principles behind static electricity (T)* and the key concepts in electricity. **I will** investigate and be able to describe the characteristics of electrical components. **I will** be able to explain how electricity is used safely in the home

Electricity

End of Unit Test

Electricity in the home

Investigating resistance

Circuit components

Series and parallel circuits

Static electricity (T)

UNIT P2

Moving materials

I will be able to explain the difference between diffusion and active transport. **I will** be able to explain why some organisms need organ systems and different organisms move things in different ways. **I will** be able to explain how enzymes work.

I will be able to explain what happens when substances change state and why some substances need a lot of energy for a change of state to occur. **I will** be able to describe different types of chemical bond and how they give different substances different properties.

Chemical Bonds

End of Unit Test

Translocation

End of Unit Test

UNIT C2

Chemical bond formation

States of matter

Bond properties

Giant covalent structures

Nano particles (T)

Transpiration

I will be able to explain how plants are adapted to survive and get what they need from the environment. **I will** be able to explain how factors affect photosynthesis . **I will** be able to describe how water moves through a plant and how other substances diffuse in/out of plant cells

Photosynthesis

Diffusion

Increasing food production

Investigating photo-synthesis

UNIT B2

End of Unit Test

Energy Resources

Energy transfer (T)

Specific heat capacity

Work done & Power

I will be able **to** use a model to represent and atom and explain how the model of an atom was developed. **I will** be able to explain how we can use radioactive atoms in carbon dating and why some elements are more reactive than others based on their atomic structure. ***I will be** able to describe properties of transition metals (T)*

I will be learning about the connections between energy and power, and energy and temperature. **I will** be able explain how energy is transferred and describe how different energy resources have an impact on the environment

Energy

Atomic Structure

Atoms, element compounds & mixtures

Sub-atomic structure

The periodic table

Groups 1,9, & 0

Transition metals (T)

End of Unit Test

UNIT P1

Energy

I will be able to describe how scientists have developed their understanding cell structure and function. **I will** be able to explain how a fertilized egg develops into a complex organism. **I will** be able to explain how organisms get their energy from food. ***I will be** able to explain how microorganisms are grown in the lab and how their growth is affected by disinfectants and antibiotics (T).*

Cell Biology

UNIT C1

End of Unit Test

Microbes and antibiotics (T)

Respiration

Stem cells

Cell division and differentiation

Structure and function of cells

UNIT B1

Year 9

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Energy Year: 9 Unit: P1

AIMS

To introduce students to the different types of energy. Describe kinetic energy and different types of potential energy and learn the equations to calculate them. They will learn to calculate work done and use it to solve energy calculations. They will learn about how energy is transferred, stored and dissipated using the equation for power, specific heat capacity, and efficiency. They will look at how as a society get our energy from different resources and how they may affect the environment.

DEVELOPING COURAGE

C Scientists are working hard to understand and treat Cancer

O To learn how to use a light microscope

U How cells work together to form tissues and organs

R To evealuate a new breakthough in medicine (Stem Cell Therapy)

A Cells have specialised structures for a specialised functions

G The ethics of tissue/organ donation

E Understanding how your body works

UP NEXT

Electricity.

- What components are used in circuits
- Calculate current, potential difference and reistance in different circuits
- How electricity is transfered to your home via the national grid

CAREERS

- Rocket Scientist
- Energy Plant Technician
- Insulator Engineer
- Inventor

PREVIOUS LEARNING

Pupils will have some knowledge of cells being the building blocks of all living organisms and that in multicellular organisms cells become specialised. Also that cells require energy from respiration and that single celled organisms can be useful

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. Cells for kids by N Singh,
2. How Stem Cells Are Disrupting Medicine and Transforming Lives by Neil H Riordan,
3. Biochemistry for Dummies..

PERSONAL OBJECTIVES

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Lesson 1: P1.1 – Potential Energy

Connection

Have a look at the topic overview and the P1 zoom in.

Populate what you know and your personal objectives.

Activation

Li: Consider what happens when a spring is stretched, Describe what is meant by gravitational potential energy

https://www.youtube.com/watch?v=DMrnAcnsvKY
https://www.youtube.com/watch?v=G_22yf_gJyg

1. Make a note of the title and the LI
2. Read pages 14-15
3. Write down the equations for gravitational potential energy, weight, and elastic potential energy
4. Draw and label figure 1.4 and 1.5

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Demonstration

Attempt questions 1-9.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.1 – Potential Energy

Connection

1 NA
2 NA
3 NA

Demonstration

1 You would feel that the force needed to stretch the rubber band increases, the more you stretch it.
2 As you turn the key, you stretch the spring more. This means that the energy stored increases.
3 Gravitational potential energy changes when the height changes. Since the aircraft is travelling horizontally, its height stays the same so there is no change in gravitational potential energy.
4 $E_p = m \times \mathrm{g} \times h = 300 \times 10 \times 2 = 6000J$
5 Mass of ball $m = 60g \div 1000 = 0.06kg$
$E_p = m \times \mathrm{g} \times h = 0.06 \times 10 \times 2 = 1.2J$
6 $E_e = \frac{1}{2} \times k \times e^2 = 0.5 \times 300 \times 0.12 = 1.5J$
7 $Extension = 25 - 20 = 5cm = 0.05m$
$E_e = \frac{1}{2} \times k \times e^2 = 0.5 \times 500 \times 0.052 = 0.625J$
8 $E_e = \frac{1}{2} \times k \times e^2$
So: $k = \frac{2E_e}{e^2} = \frac{2 \times 12}{0.16^2} = 937.5 \frac{N}{m}$
9 $E_e = \frac{1}{2} \times k \times e^2$
So $e = \sqrt{\frac{2 \times E_e}{k}} = \sqrt{\frac{2 \times 0.25}{200}} = 0.05m = 5cm$
The total length of the spring = 20cm, which means that the unstretched length = 20 – 5 = 15cm.

Lesson 2: P1.2 – Investigating Kinetic Energy

Connection

Q1. What is the equation for gravitational potential energy and elastic potential energy?

Q2. Define what the extension is

Q3. What are the units of the spring constant

Activation

LI: Describe how the kinetic energy store of an object changes as its speed changes, Calculate kinetic energy, Consider how energy is transferred

https://www.youtube.com/watch?v=NSeL5c65v-g

1. Make a note of the title and the LI
2. Read pages 16-17
3. Write down the equation for kinetic energy
4. Conservation of energy Demo - https://www.youtube.com/watch?v=mhIOylZMg6Q
5. Draw a diagram of a pendulum and label where it has the most kinetic energy and the most potential energy

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.2 – Investigating Kinetic Energy

Connection

1 $E_p = m \times g \times h$

$E_e = \frac{1}{2} \times k \times e^2$

2 The extension is the difference between the original length and the stretched length

3 N/m (newtons per metre)

Demonstration

1 The amount of energy in the kinetic energy store depends on both the mass and the speed. An adult has more mass than a child so they would have more kinetic energy even though the speed is the same.

2 The fuel is the food that the child has eaten.

3a $E_k = \frac{1}{2} \times m \times v^2 = 0.5 \times 50 \times 2^2 = 100J$

3b Her kinetic energy would be four times as much.

4 Kinetic energy stored at 10 m/s = 0.5 × 1200 × 102= 60 000 J
Kinetic energy stored at 30 m/s = 0,5 × 1200 × 302= 540 000 J
So kinetic energy increases by 540 000 – 60 000 = 480 000 J

5 240 km / h = (240 × 1000 m) / 3600 s = 66.7 m/s

6a When the ball is at the highest point.

6b As the ball hits the surface for the first bounce

7 After you let go of the ball and the ball is moving upwards, energy stored in the ball's kinetic energy store is being transferred to energy stored in the gravitational potential energy store.

8 E_p stored by the ball at 20m = m × g × h = 2 × 10 × 20 = 400 J
So E_k ball stores at the ground = 400 J
$\frac{1}{2} \times m \times v^2 = 400$
So $0.5 \times 2 \times v^2 = 400$
$v^2 = 400$
so $v = 400\ m/s$

Lesson 3: P1.3 – Work done and energy transfer

Connection

Q1. What is the equation for kinetic energy?

Q2. Convert 5km/h to m/s

Q3. If the speed of an object is doubled how much does the kinetic energy increase by?

Activation

LI: Understand what is meant by work done, Explain the relationship between work done and force applied. Identify the transfers between energy stores when work is done against friction

https://www.youtube.com/watch?v=GtnXyweBrJg&t=25s

1. Make a note of the title and the LI
2. Read pages 18-19
3. Write down the equation for work done
4. Demo/Practical – Force needed to move a block 30cm over various surfaces

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.3 – Work done and energy transfer

Connection

1 $E_k = \frac{1}{2} \times m \times v^2$

2 $5 \frac{km}{h} = 5 \times \frac{1000m}{3600s} = 1.38\dot{} \frac{m}{s}$

3 If the speed is doubled the kinetic energy increase by a factor of 4.

Demonstration

1 The amount of force and the distance that the force moves.

2 The gravitational force (weight) on the person as the person moves towards the ground.

3 W= F× s= 400 × 1.5 = 600 J

4 She is not doing any work as the force is not moving.

5 W= F× s, so s= W/ F= 300 / 200 = 1.5 m

6 W= F× s, so F= W/ s= 3000 / 12 = 250 N

7a Ek= ½ mv2= 0.5 × 800 × 122= 57 600 J

7b F= W/ s= 57 600 / 8 = 7200 N

8a W= F× s= 500 × 4 = 2000 J

8b 2000 J (assuming all of the energy in her Epstore is transferred to her Ek store)

8c Ek reduces by 2000 J so work done by the trainers = 2000 J.
F× s= 2000 so F× 0.01 = 2000.
F= 2000 / 0.01 = 200 000 N.

Lesson 4: P1.4 – Understanding power

Connection

Q1. What is the equation for work done?

Q2. Does a smooth surface or a rough surface require more work done to move an object?

Q3. A 2kg object is 2m above the ground. Find work done if it was to fall to the ground.

Activation

LI: Define power, Compare the rate of energy transfer by various machines and electrical appliances, Calculate power

https://www.youtube.com/watch?v=oFF134_iokI&pbjreload=101

1. Make a note of the title and the LI
2. Read pages 20-21
3. Write down the definition and equation of power
4. Research the power ratings of various appliances and put them in a table.

Demonstration

https://www.youtube.com/watch?v=kt5Wz16ZukY
Video on how to measure personal power.

Use the videos and the relevant pages of the text book to write a step by step method of how to find your personal power by climbing a set of stairs.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.4 – Understanding Power

Connection

1 $\boldsymbol{W = F \times s}$

2 A rough surface requires more work done to move an object on as it requires more force to move the object.

3 $\boldsymbol{Weight = m \times g}$

$\boldsymbol{Weight = 2 \times 10 = 20N}$

Weight is the force pulling the object downwards.

$\boldsymbol{W = F \times s}$

$\boldsymbol{W = 20 \times 2 = 40J}$

Demonstration

Step 1: Measure the mass of the person with a set of scales.

Step 2: Multiply the persons mass by the gravitational field strength 10 N/kg to get their weight.

Step 3: Measure the height of a single step

Step 4: Multiply the height of one step by the number of steps there are.

Step 5: Time how long it takes the person to climb the set of stairs.

Step 6: Repeat this measurement two more times and find the average.

Step 7: Use the equation $\boldsymbol{W = F \times s}$ to find the work done by the person climbing the stairs.

Step 8: Use the equation $\boldsymbol{Power = \frac{work\ done}{time}}$ to find the power of the person moving up the stairs.

Lesson 5: P1.5 – Specific Heat Capacity

Connection

Q1. What is the equation for power?

Q2. What is the unit of power?

Q3. A kettle transfers 30KJ of electrical energy to water over 3 minutes. What is the power of the kettle?

Activation

LI: Understand how things heat up, Find out about heating water, Find out about specific heat capacity

1. Demo/video – https://www.youtube.com/watch?v=hyPLusD-tyM
2. Make a note of the title and the LI
3. Read pages 22-23
4. List 3x things that the energy needed to change the temperature depends upon.
5. Define "Specific Heat Capacity"
6. Write down the equation for the change in thermal energy

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.5 – Specific heat capacity

Connection

1 $\boldsymbol{Power = \frac{work\ done}{time} = \frac{energy\ transfered}{time}}$

2 The unit of power is the Watt (W)

3 $\boldsymbol{Power = \frac{energy\ transfered}{time} = \frac{30kJ}{3\ minutes}}$

$\boldsymbol{Power = \frac{30000J}{180s} = 166.\dot{6}W}$

Demonstration

1 The material with the bigger increase of temperature does not need as much thermal energy transferred to it to increase its temperature by 1 0C.

2 $\Delta E = m \times c \times \Delta\theta = 1 \times 380 \times 20 = 7600J$

3 $\Delta E = m \times c \times \Delta\theta = 2 \times 450 \times 30 = 27000J$

4 Water has a very high specific heat capacity. This means that the water can transfer lots of thermal energy to the bed as it cools down – making the bed warmer.

5 It is the thermal energy needed to raise the temperature of 1 kg of a substance by 1 0C.

6 $\Delta E = m \times c \times \Delta\theta = 3 \times 450 \times 15 = 20250J$

7 $\Delta\theta = 30 - 10 = 20℃$

$\Delta E = m \times c \times \Delta\theta = 50 \times 800 \times 20 = 800000J$

Concrete is chosen as it has a relatively high specific heat capacity so it can store more thermal energy than most other solids.

8 $\Delta E_{steel} = m \times c \times \Delta\theta = 1 \times 450 \times (80 - \theta) = 36000 - 450\theta$

$\Delta E_{water} = m \times c \times \Delta\theta = 0.5 \times 4200 \times (\theta - 10) = 2100\theta - 21000$

The energy lost by the steel bust be equal to the energy gained by the water.

So $36000 - 450\theta = 2100\theta - 21000$

So $2550\theta = 57000$

$\theta = 22.40$

Lesson 6: P1.6 – Investigating specific heat capacity

Connection

Q1. What is the equation for the change in thermal energy?

Q2. Rearrange the equation to make the specific heat capacity the subject

Q3. Why do we use water to heat our homes?

Activation

LI: Perform an experiment to calculate the specific heat capacity of a metal block

1. Make a note of the title and the LI
2. Video – https://www.youtube.com/watch?v=loeRLKNeUsc
3. Write down a step by step method for how to calculate the specific heat capacity of a metal block

Demonstration

Attempt questions 1-13
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.6 – Investigating specific heat capacity

Connection

1 $\Delta E = m \times c \times \Delta\theta$

2 $c = \frac{\Delta E}{m \times \Delta\theta}$

3 water has a large specific heat capacity meaning that it can hold a large amount of thermal energy for a given temperature.

Demonstration

1 Stir the water and measure the new temperature of the hot water + brass with the thermometer

2 Subtract the new temperature of the hot water + brass from the initial temperature of the hot water (~ 800C)

3 Subtract the temperature of the ice-cold water + brass (0 0C) from the new temperature of the hot water + brass.

4 The temperature would decrease as thermal energy would be transferred to the surroundings.

5 The brass might warm up as you move it. You would assume that the brass changed temperature more than it actually did when you added it to the hot water. This would mean that your measurement of the specific heat capacity would be too small.

6 The temperature of the brass and hot water would steadily decrease as heat energy is being transferred to the surroundings.

7 You need to transfer the brass as quickly as possible and you also need to measure the new temperature of the hot water + brass as quickly as possible (making sure that all of the thermal energy transfer from the hot water to the brass had taken place).

8 In your calculation, you assume that all of the thermal energy transferred to the brass has come from the water rather than the surroundings.

9 $\Delta E = mc\Delta\theta = 0.25 \times 4200 \times (26 - 17) = 9450$ J

10 9450 J

11 The temperature would decrease from 100 0C to 26 0C, so $\Delta\theta = 100 - 26 = 74$ 0C.

12 $c = \Delta E / (m\Delta\theta) = 9450 / (0.6 \times 74) = 213$ J/kg 0 C

13 The brass is likely to cool down as it moves from the boiling water to the cold water. Therefore the temperature change of the brass as it is heating the cold water up is likely to be less than 74 0C. This would result in the calculation in question 12 becoming a larger value.

Lesson 7 P1.7 – Dissipation of energy

Connection

Q1. What is the specific heat capacity of water?

Q2. How much energy is needed to raise the temperature of 1kg of water from room temperature to boiling point?

Q3. Do thermal insulators have a high or low specific heat capacity?

Activation

LI: Explain ways of reducing unwanted energy transfer, Describe what affects the rate of cooling of a building, Understand that energy is dissipated

https://www.youtube.com/watch?v=trJd1MF5nlo

1. Make a note of the title and the LI
2. Read pages 26-27
3. Write down the definition of “lubrication” and “thermal insulation”
4. Draw figure 1.18
5. Demo of conduction, convection and radiation

Demonstration

Conduction: https://www.youtube.com/watch?v=9joLYfayee8
Convection: https://www.youtube.com/watch?v=VxGIiOTuAIs
Radiation: https://www.youtube.com/watch?v=5GoZZKcNZiQ

Create a poster on the three types of energy transfer

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Think of ways that we can reduce energy loss from the home.

Answers: P1.7 – Dissipation of energy

Connection

1 4200 J/kg℃

2 $\Delta E = m \times c \times \Delta\theta =$
$1 \times 4200 \times (100 - 20) = 336000J$

3 Thermal insulators have a high specific heat capacity as they can absorb a lot of thermal energy without increasing their temperature

Demonstration

1 Lubricate the wheels to reduce the effect of friction.

2 Newspaper reduces the amount of thermal energy that is transferred through it in any direction. Therefore, it reduces the thermal energy transferred to a cold ice cream as much as the thermal energy transferred away from the fish and chips.

3 Most thermal energy is lost through the windows. You could draw the curtains / use double glazing as this would reduce the rate that the thermal energy conducts.

4 The eco home needs to be well insulated so that it reduces the amount of thermal energy it loses to a bare minimum. It can do this by having thick walls with cavity wall insulation, thick loft insulation, triple glazed windows.

5 The thermal energy dissipates into the surroundings. This means that it spreads out and becomes diluted. The energy is too thinly spread for us to collect it again to re-use.

6 Energy is transferred to the surroundings and the car itself as thermal energy. Energy is also transferred into sound energy and gravitational potential energy if the car is going uphill.

7 Energy is being transferred to the thermal energy stored in the surroundings. Here the energy is dissipated which means it becomes very spread out and the temperature of the surroundings does not increase by very much (shown by the dark blue colour of the sky). Energy is being transferred more quickly through the windows than through the walls of the buildings because the windows are not as thick and they have a higher thermal conductivity. The ground floors of the buildings are transferring thermal energy more quickly than the higher floors. This is probably due to the ground floors storing more thermal energy as they have been heated more than the upper floors (since people have been there during the day)

Lesson 8: P1.8 – Energy Efficiency

Connection

Q1. What are the three ways that energy can be transferred?

Q2. Why can lubrication reduce the amount of energy loss?

Q3. How does loft insulation reduce energy loss in the home?

Activation

LI: Explain what is meant by energy efficiency, Calculate the efficiency of energy transfers, find out about conservation of energy

https://www.youtube.com/watch?v=QsAgaD7IeuA

1. Make a note of the title and the LI
2. Read pages 28-29
3. Write down the equation for efficiency
4. Show the energy transfers for 3 different appliances and state if the energy transfer is useful or not.

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.8 – Energy Efficiency

Connection

1 Conduction, Convection, Radiation
2 lubrication reduces friction and so reduces the amount of energy lost as thermal energy
3 loft insulation has small air pockets that prevents conduction and convection. And so reduces the amount of energy transferred to the surroundings.

Demonstration

1 It heats up the surroundings. However, the temperature increase of the surroundings is very small as the energy has become very spread out.
2 An electric motor does not get as hot as a petrol or diesel engine as there is no need to convert energy from the fuel into thermal energy. Therefore, much less energy is wasted by transferring energy into the thermal energy stored in the surroundings.
3 Efficiency = useful energy output / total energy input = 80 / 100 = 80 %
4a Efficiency = useful energy output / total energy input = 135 / 500 = 0.27 = 27 %
4b Not all of the coal is burned.
5 Some of the energy is transferred to the thermal energy stored in the kettle and the surroundings rather than the thermal energy stored in the water.
6 Efficiency = useful energy output / total energy input
0.65 = useful energy output / 200
So useful energy output = 0.65 × 200 = 130 J.
7 Energy cannot be created or destroyed, only transferred from one store to another.
8 The metal expands so some of the energy is transferred to the elastic potential energy stored in the metal.
9 Some of the energy is transferred to the thermal energy store of the eardrums; some of it is transferred to the thermal energy stored in the air; some of the sound reflects back off your eardrums; the energy spreads out so not all of the energy transferred by the sound ends up at your eardrums.
10 First calculate the total energy input to the car:
Total energy input = useful energy output (× 100) / efficiency = 100 × 100 / 85 = 117.6 J
Now calculate energy input at the power station using the same formula:
Total energy input = 117.6 × 100 / 35 = 336 J.

Lesson 9: P1.9 – Investigating ways of reducing the unwanted energy transfers in a system

Connection

Q1. What is the equation for efficiency?

Q2. State the energy transfers in a computer and decide which transfers are useful and unuseful.

Q3. If 100J of energy is transferred by powerlines that are 80% efficient, to a lightbulb that is only 5% efficient, what is the total amount of energy used usefully?

Activation

LI: Perform an experiment to show how different materials affect the loss of thermal energy

https://www.youtube.com/watch?v=MUy1o4ogCvw&t=104s

1. Make a note of the title and the LI
2. Read pages 30-31
3. https://www.youtube.com/watch?v=qUPb32O5-Ho
4. Draw a diagram of a house
5. On the diagram label ways that energy loss could be reduced

Demonstration

Attempt questions 1-11
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

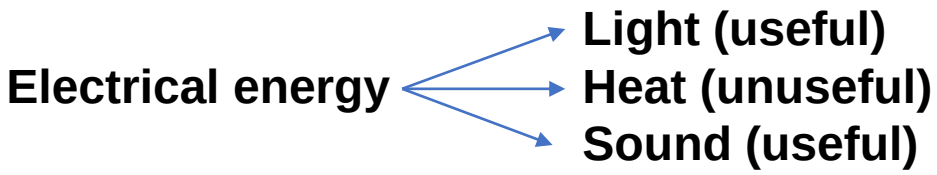
Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.9 – Investigating ways of reducing the unwanted energy transfers in a system

Connection

1 Efficiency = useful energy output / total energy input

2



3 100J x 80% = 80J
80J x 5% = 4J

Activation

1 Tazim is correct to say that only metals are good thermal conductors but other materials are also able to conduct a little. Different materials conduct differently so it is likely that all the materials will have different insulating effects. So Tazim's statement is incorrect.

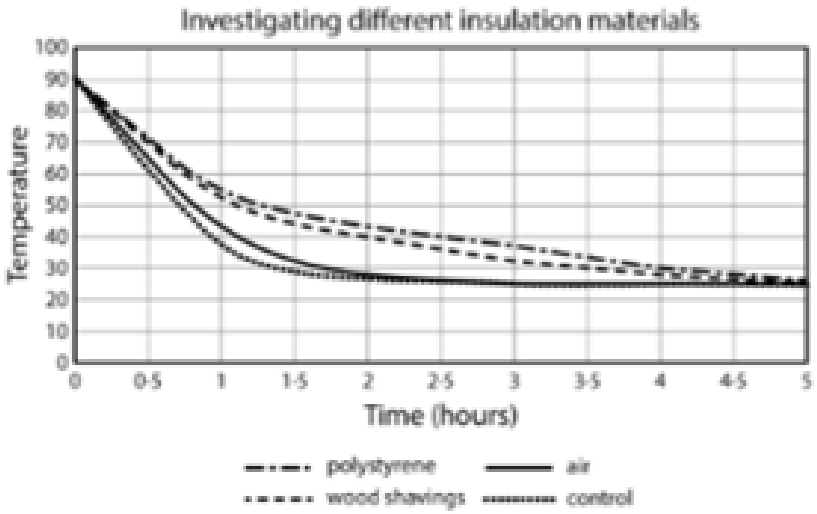
2 The type of insulating material in the box; the amount / thickness of insulating material; the size / surface area of the box; the colour of the surfaces of the box; the material the box is made out of; the temperature of the surroundings; initial temperature of the liquid.

3 e.g. the better that an insulating material traps air then the better insulator it is and the hotter the liquid will be after a certain period of time. So expanded polystyrene would be the best insulator and air would be the worst.

4 Variables that need to be kept the same: size and shape of the box; thickness of insulating material (by making sure the box is completely packed full of the insulating material); the initial temperature of the liquid; the volume of the liquid; the time interval between measuring the initial temperature and the final temperature of the liquid. Variables to change: the insulating material Variables to measure: the initial temperature of the liquid, the temperature of the liquid after a certain amount of time. Method: Pour 300 ml of boiling water into the cooking pot and wait for the temperature to decrease to 90.0 0C. Start a stopwatch to measure the time. Then place the lid on the pot and place the pot in the box as quickly as possible (for the control, take the measurements without putting the pot in the box). Pack in the insulating material as quickly as possible and make sure that sure the box is fully packed. Every minute take the pot out of the box and record the temperature of the water with a thermometer. Put the pot back into the box and repack the insulating material as quickly as possible.

Answers: P1.9 – Investigating ways of reducing the unwanted energy transfers in a system

5.



Demonstration Continued

6 The gradient of the graph – the line with the shallowest slope indicates the best insulator.

7 The liquid becomes almost the same temperature as the surroundings so it only cools very slowly.

8 The rate of cooling is the gradient of the graph.

9 The rate of cooling depends on the difference in temperature between the liquid and the surroundings. During the first hour, the temperature difference was large so the rate of cooling was high; during the fifth hour the temperature difference was small so the rate of cooling was low.

10a No matter how good an insulating material is the pot would end up as cold as the room eventually. It is the time it takes to do this that matters. The experiment showed that the different insulators had different rates of cooling so it was able to test the hypothesis.

10b This is correct. A larger mass of liquid would mean that the liquid takes longer to cool down but the experiment is only meant to investigate how the type of insulating material affects the rate of cooling.

10c The box is trapping the air inside so this is a different situation from when the pot is open to the atmosphere where the air can move around freely. You can see from the graph that the air was able to insulate the pot a little bit better when it was trapped inside the box.

10d Some lines (such as the control) cooled down to their final temperature much sooner than five hours. So if you drew a straight line from 90 0C to 25 0C at the time when the graph reached this temperature then the lines would have different gradients –showing that the materials have different insulating properties.

11a The energy transferred, $\Delta E = mc\Delta\theta$. Since m and c remain the same then the amount of energy transferred depends on the temperature change, $\Delta\theta$.For air: $\Delta\theta = 90.0 - 43.5 = 46.5$ 0CFor polystyrene: $\Delta\theta = 90.0 - 55.0 = 35.0$ 0C.46.5 / 35.0 = 1.33

11b For air: $\Delta\theta = 43.5 - 28.0 = 15.5$ 0CFor polystyrene: $\Delta\theta = 55.0 - 43.5 = 11.5$ 0C15.5 / 11.5 = 1.35

Lesson 10: P1.10 – Using Energy Resources

Connection

Q1. Name one variable that needs to be kept the same in last lesson experiment

Q2. Why do we need to keep some variables the same?

Q3. How was energy being transferred from the water to the surroundings?

Activation

LI: Describe the main energy sources available for use on earth, Distinguish between renewable and non-renewable sources, explain the ways in which the energy resources are used

https://www.youtube.com/watch?v=UZol5vMDhe4

1. Make a note of the title and the LI
2. Read pages 32-33
3. Create a table of renewable and non-renewable energy sources
4. Pick one renewable and one non-renewable energy resource and give two advantages and disadvantages of each

Demonstration

Attempt questions 1-11
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.10 –Using energy resources

Connection

1 The mass of the water, The starting temperature of the water, The amount of insulation.
2 To make it a fair test by limiting the change in temperature to be due to only the type of insulation
3 The energy was transferred by conduction. The energy was passed from the water molecules to the molecules in the glass and air.

Demonstration

1a e.g. a motor, an electric car, a fan
1b e.g. a lift, an escalator, a drone
2 e.g. coal or wood in a fire, gas in a boiler in a central heating system, solar power in a solar cooker
3 Energy from your food, which originally comes from the Sun.
4 It is easy to install wires above the train tracks that can connect up the train to an electricity supply. It would be very difficult and expensive to install wires that aircraft could use while flying. The aircraft have to carry their energy with them.
5 Any two from: wind, wave, hydroelectric, solar, geothermal, tidal, nuclear.
6 Only some countries are surrounded by water where the waves a large and reliable enough to provide useful amounts of energy.
7 When satellites orbit the Earth they spend part of their orbit in sunlight and the other part in the dark. The solar panels will only provide energy when they are in the sunlight. Therefore, they need to charge up a battery which is able to provide energy to the satellite when it is in the dark.
8 We can plant new trees. As long as the trees produce new wood at the same rate that we use it, then the energy resource is always replenished.
9 Nuclear fuel.
10 Bio-fuels are being replenished at the same rate that they are being used. Fossil fuels were formed over millions of years and we are burning them at a considerably faster rate than they are being created. Therefore, they are running out.
11a Energy is the capacity to do work. It is transferred from one energy store to another when an object is doing work. An energy resource stores energy in a form where it can easily be transferred to another energy store and thus do useful work.
11b Energy is always conserved because it always gets transferred from one energy store to another energy store –it never just disappears. An energy resource is not conserved since the energy it stores is transferred to other energy stores. When energy is transferred it usually becomes less useful because some of it is dissipated into the thermal energy stored in the surroundings.

Lesson 11: P1.11 – Global Energy Supplies

Connection

Q1. Name 3x renewable energy resources

Q2. Give one advantage of renewable energy resources and one advantage of non-renewable energy resources.

Q3. Burning fossil fuels produces carbon dioxide, why is this an issue?

Activation

LI: Analyse global trends in energy use, understand what the issues are when using energy resources

https://www.youtube.com/watch?v=N-yALPEpV4w

1. Make a note of the title and the LI
2. Read pages 34-35
3. P1 DART

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.11 – Global energy supplies

Connection

1 solar, wind, geothermal, hydroelectric, tidal,
2
We will not run out of renewable energy resources,
Non-renewable energy resources like oil, coal and gas are very reliable.
3 carbon dioxide in the atmosphere contributes to global warming and climate change.

Demonstration

1 They are non-renewable resources and so will run out.
2 Coal. The worldwide use of coal dramatically increased between 2000 and 2010 and this is when China's energy use grew rapidly.
3 Although fossil fuels will eventually run out and that there are environmental problems, the world's energy needs to come from somewhere. Renewable energy is unable to meet the demand at present.
4 Environmental considerations: This will release carbon dioxide and sulfur dioxide into the atmosphere which will contribute to global warming and acid rain.
Political considerations: People might not vote to elect the council again if they are angry with the plan.
Ethical considerations: It is not morally right to destroy a beautiful part of the country or harm the health of people in the future.
Social considerations: It might give more people jobs but it might adversely affect the health of lots of people.
Economic considerations: It would bring more income to the area but it might cost a lot of money to set it up.
5 The motor does not burn fuel so the only heat it creates is due to friction. Therefore, less energy is wasted.
6 Efficiency = 80% = 0.8. Input power = output power / efficiency = 3/0.8 = 3.75 kW.
7 The power station needs to provide 3.75kW. Therefore, it needs an input power of 3.75 / 0.4 = 9.375 kW. So the overall efficiency = output power / input power = 3 / 9.375 = 0.32 or 32%. This is less efficient than a diesel engine.
8 Make the car more streamlined; make the car lighter; drive the car with less accelerating and breaking; make sure the moving parts are well lubricated; make sure the tyres are in good condition.

Lesson 12: P1.12 – Key Concept: Energy Transfer

Connection

Q1. Give two disadvantages of using fossil fuels

Q2. What is one economic consideration of using nuclear power?

Q3. Why is it difficult to move to "green energy"?

Activation

LI: Understand why energy is a key concept in science, use ideas about stores and transfers to explain what energy does, Understand why accounting for energy transfers is a useful idea.

https://www.youtube.com/watch?v=NC8ItrcR2Ak&t=4s

1. Make a note of the title and the LI
2. Read pages 36-37
3. Draw on graph paper a Sankey diagram for a hair dryer. Where 100J of electrical energy is supplied and converted into, 60J of thermal energy, 20J of kinetic energy and 20J of sound energy.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P1 DIP file

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.12 – Key Concept: Energy Transfer

Connection

1 contributes to global warming, contributes to increased acid rain

2

Nuclear energy costs significantly less to produce than most other energy resources

3 “green energy” is unreliable and not energy dense compared to fossil fuels.

Demonstration

1 All of these are storing energy. The ball is storing kinetic energy, the string is storing elastic potential energy, the hot object is storing thermal energy and the mixture of oxygen and fuel is storing chemical energy.

2a The ball could transfer kinetic energy by colliding with another object. This has limited use but is used in e.g. marble runs, an aid to ten pen bowling, Rube Goldberg machines.

2b The spring could transfer energy from its elastic potential energy store to its kinetic energy store. This is a useful energy transfer in some mechanical clocks and watches or in other clockwork devices.

2c The hot object could transfer energy to the thermal energy stored in the surroundings –for example in a hot water bottle or the heating element in a toaster or kettle.

2d The mixture of oxygen and fuel can transfer energy from its chemical energy store to a thermal energy store. This is used in engines such as rockets.

3

4a Chemical energy store in body decreases; kinetic energy store of bicycle increases (if bicycle is accelerating); gravitational potential energy store of the bicycle increases (if bicycle is going uphill); internal energy of the surroundings increases (since the cyclist needs to do work against air resistance and friction).

4b Chemical energy store in match decreases; thermal energy store of surroundings increases.

5 The amount of energy is represented by the number of bricks. No matter what the child does to the bricks and if one becomes lost –the total number of bricks remains the same.

6 The system must include the surroundings as all of the chemical energy in the coal ends up in the Chemical energy store in body Chemical energy store in battery Internal energy store in bulb Internal energy store in internal energy of the surroundings once the train has stopped.

P1 Revision

Connection

Q1. Give an example of an energy store.

Q2. Give an example of an energy transfer.

Q3. State the law of thermodynamics/ energy conservation.

Activation

LO: Create a topic summary sheet

1. Fold an A3 sheet so it is divided into 8 sections
2. Look back over you lesson and group them into 8 main headings
3. Summarise the key points into each section, use keywords and diagrams and symbols rather than sentences

Demonstration

Test yourself by working with the person sitting next to you by talking though each box on your summary sheet and seeing how many key facts you can remember

Consolidation

Look though the relevant past paper questions for this topic - From the P1 DIP file – see if you can complete any additional questions

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P1.Revision

Connection

1 magnetic/ internal (thermal)/ chemical/ kinetic/ electrostatic/ elastic potential/ gravitational potential/ nuclear.

2 Mechanically - By the action of a force. Electrically - By an electrical current. By radiation - By Light waves or Sound waves. By heating - By conduction, convection or radiation.

3 Energy cannot be created or destroyed only transferred from one store to another

P1 Dart: Nuclear Energy

"America is addicted to oil," George W Bush told us in 2006. W was worried particularly about America, but the problem is really a global one.

But Bush was right about the oil part. Regardless of where you stand on climate change, the world at some point and maybe sooner than we think, is going to run out of oil. According to the Hirsch report, commissioned by the US department of energy, peak oil has already occurred or is about to occur. "Peak oil" is simply when the world is at the peak of extracting oil from the ground, after which we will go into steep decline. If you are optimistic, peak oil isn't coming anytime soon. If like W and the Hirsch report, you are not so optimistic, peak oil has happened or is just about to and we have on the outside about 20 years until we feel the effects.

So what are the alternatives? There are many. Wind – but it has to be windy; solar – but it has to be sunny; hydroelectric – but you have to have water. While many of these energy technologies are good short-to-medium-term solutions and often the perfect local solution, what about the longer term? What about the global energy problem? What about nuclear? Until we develop new technologies, nuclear power is currently the best alternative to oil.

Nuclear power often gets a raw deal, partially for some very good reasons. The waste, for starters. It is difficult to know what to do with nuclear waste. It takes for ever to lose its radioactivity – so long that at the moment the only viable solution is to immobilise and store it. This is not ideal for obvious reasons.

Nuclear accidents also get some rather scary press – Chernobyl, Fukushima and Three Mile Island. Not that these weren't nuclear or industrial accidents, they definitely were, but it is good to be a bit careful about throwing out the baby with the cooling bath water.

In all of these "disasters" some relatively dumb mistakes and painful oversights were made. Such as waiting almost 18 hours to flood Fukushima Daiichi with sea water to cool the reactor. The potential environmental consequences seem fairly large with Chernobyl, though it is hotly debated whether this is solely the result of radiation. In the Three Mile Island meltdown, no one even got hurt, which isn't bad going for an industrial accident. If anything, the Three Mile Island meltdown should make us all feel better about reactor safety in general. Big meltdown, no one died. There is an excellent book that compares the relative environmental and health risks of nuclear reactors with other industries – Terrestrial Energy by William Tucker, who argues that more deaths are caused by our traditional power plants than by nuclear power.

Despite the downsides, the benefits of nuclear power should not be overlooked. It is not oil. Nuclear fuel does not produce CO_2. Nuclear plants are relatively accident-free. There is plenty of radioactive material around currently. Nuclear fuel itself is non-renewable but breeder reactors produce more fuel than they use. The few cons there are, like storage and safety issues, are actually *why* governments need to fund nuclear energy research. Research monies for making safer reactors and better containment would be nice for a start, but government money needs to be found for "blue skies" nuclear research too. Blue-skies funding is what led scientists to find a way to split the atom in the first place. Now it is time to figure out how to safely get rid of radioactive waste. Now is the time to put some serious funding into nuclear energy research, because in 10 years we may not be able to turn the lights on.

https://www.theguardian.com/science/occams-corner/2012/nov/27/the-pros-of-nuclear-power

Challenging

1.

a) Give one example of a nuclear disaster given in the article?

b) What is 'peak oil'?

c) Give one benefit and one risk of nuclear power from the article.

More Challenging

2.

a) Why does the author feel that the Three Mile Island accident should make us feel better about nuclear power? Do you agree?

b) Are there more benefits than risks of nuclear power?

c) Give a three-sentence summary of the authors conclusion.

Mega Challenging

3.

a) Do you feel that the possible benefits of nuclear power justify the authors suggestion for more funding for nuclear power?

b) Explain the effects of what would happen if we changed from an oil-based society to one that relies on nuclear power.

c) The author of the article is a scientist. Do you feel that they are biased or unbiased? Give one piece of evidence from the article to support your claim.

Answers

Challenging

1. a) Chernobyl, Fukushima and Three Mile Island

b) When the world is at the peak of extracting oil from the ground

c) Benefit: doesn't produce CO_2

Risk: storage and safety issues

More Challenging

2. a) No one got hurt at the three-mile island accident.

b) Yes, nuclear power can help fight climate change, is relatively accident free and has an abundant fuel supply. The risk of storage and safety can be reduced with funding.

c) Nuclear accidents should not deter people from using nuclear energy. Nuclear energy is a good alternative to other renewables to help us stop using fossil fuels. More funding needs to be given to nuclear power research.

Mega Challenging

3.a) Yes: The risk is very low and nuclear power can help us fight climate change as an alternative to fossil fuels. The author provides a source telling us that traditional power plants result in more deaths than nuclear power plants. Funding for nuclear research is promoted as blue-sky research which allowed advancements in science such as splitting the atom.

No: The author admits that nuclear disasters are mostly the result of human error and as such the danger presented by nuclear power is too great. The more nuclear power stations the higher the chance of human error.

b) Less CO_2 will be produced, which will help fight global warming and climate change. Most research would be aimed towards finding better technology for storing nuclear waste, safe reactors and better containment. There may be more nuclear accidents but there would be less environmental disasters like oil spills.

c) Biased: They are biased because they are a scientist and they are able to conduct research only if their work is funded, as such they are biased because they have a vested interest in bringing the reader to a positive conclusion about nuclear power. This could be evidenced by them focusing on the positives.

Unbiased: They are unbiased because as a scientist they are an expert in the field of study so would have better knowledge of the science. They are giving a balanced view by mentioning both positives and risks associated with nuclear power. They are not suggesting that nuclear is perfect and they say that more research is needed to make nuclear power safer.

Attainment Band :	P1 Energy (AQA)
	Knowledge and Understanding
Yellow Plus/ Yellow	Apply the equations for gravitational potential energy and elastic potential energy in a variety of contexts, and change the subject of these equations. Use the equation for kinetic energy to solve problems, including changing the subject of the equation. Use the equation for work done to solve problems, including changing the subject of the equation. Calculate temperature changes, masses or specific heat capacities given the other values. Evaluate an experiment to measure the specific heat capacity of a material. Explain how thermal conductivity affects the rate of energy transfer across a material and affects the rate of cooling of a building. Recognise that in a closed system there may be energy transfers that change the way energy is stored, but there is no net change to the total energy. Evaluate and justify the use of various energy resources for different applications.
Blue	Use the equations for gravitational potential energy and elastic potential energy. Know that kinetic energy is related to mass and velocity squared and use the equation to calculate it. Calculate the work done by a force from the size of the force and the distance moved. Describe what is meant by the specific heat capacity of a material and use the equation for specific heat capacity. Plan an experiment to measure the specific heat capacity of a material. Describe how lubrication and insulation can be used to reduce unwanted energy transfer Calculate energy efficiency. Describe how some energy transfers are more useful than others. Describe the advantages and disadvantages of fossil fuel, nuclear and renewable energy resources.
Green	Describe how energy can be stored by raising an object up or by stretching or compressing it. Describe how a moving object has kinetic energy Recognise that when a force moves an object along the line of action of the force, work is being done State that various devices do work and, in doing so, transfer energy. State that some materials require more energy than others to increase a certain mass by a certain temperature rise. Recognise that some energy transfers are unwanted. State that various resources are used as fuels and to generate electricity.
White	Some elements of the above have been achieved