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| **Energy Transfer by Heating (Chapter 2) Exam Questions** |
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| Name: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
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| Time: | **115 minutes** |
| Marks: | **115 marks** |
| Comments: |  |
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**Q1.**          People do a number of things to reduce the energy loss from their homes.

          (a)     Describe **one** thing they may do to cut down the energy loss through:

(i)      the roof;

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**(1)**

(ii)     the outside walls;

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**(1)**

(iii)     the glass in the windows;

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**(1)**

(iv)    gaps around the front and back doors.

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**(1)**

(b)     A house is more difficult to keep warm in cold weather. What other type of weather makes it difficult to keep a house warm?

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**(1)**

**(Total 5 marks)**

**Q2.**          (a)     The graph shows the temperature inside a flat between 5 pm and 9 pm. The central heating was on at 5 pm.



(i)      What time did the central heating switch off?

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**(1)**

(ii)     Closing the curtains reduces heat loss from the flat.

         What time do you think the curtains were closed?

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Give a reason for your answer.

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**(2)**

(b)     Less heat is lost through double-glazed windows than through single-glazed windows.



          Complete the following sentences by choosing the correct words from the box. Each word may be used once or not at all.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **conduction** | **conductor** | **convection** | **evaporation** | **insulator** | **radiation** |

Air is a good ........................................... . When trapped between two sheets of glass it

reduces heat loss by .......................................... and ....................................................

**(3)**

(c)     The table gives information about three types of house insulation.

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of insulation** | **Cost toinstall** | **Money save eachyear on heating bills** | **Payback time** |
| Double glazing | £4000 | £200 | 20 years |
| Loft insulation | £300 | £100 | 3 years |
| Cavity wall insulation | £600 | £150 |   |

(i)      Use the information in the table to calculate the payback time for cavity wall insulation.

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**(1)**

(ii)     Explain why people often install loft insulation before installing double glazing or cavity wall insulation.

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**(2)**

**(Total 9 marks)**

**Q3.**          The picture shows one type of solar water heater. Water from the tank is slowly pumped through copper pipes inside the solar panel where the water is heated by energy from the Sun.



(a)     Explain why the copper pipes inside the solar panel are painted black.

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**(2)**

(b)     Each day the average European family uses 100 kg of hot water.
To kill bacteria, the water going into the tank at 20 °C must be heated to 60 °C.

Calculate the energy needed to increase the temperature of 100 kg of water by 40 °C.

Specific heat capacity of water = 4200 J/kg °C.

Write down the equation you use, and then show clearly how you work out your answer.

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Energy transferred = .................................... J

**(2)**

(c)     The bar chart shows how the amount of solar energy transferred to the water heater varies throughout the year.

     

How many months each year will there **not** be enough solar energy to provide the hot water used by an average European family?

.................................................. months

**(1)**

(d)     *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate*.

The water in the tank could be heated by using an electric immersion heater.

Outline the advantages and disadvantages of using solar energy to heat the water rather than using an electric immersion heater.

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**(6)**

**(Total 11 marks)**

**Q4.**          The drawing shows parts of a house where it is possible to reduce the amount of energy lost.



(a)     Give **one** way in which the amount of energy lost can be reduced from each of the following parts of the house.

          **1**, **2** and **4** ....................................................................................................................

**5** ..................................................................................................................................

**7** ..................................................................................................................................

**(3)**

(b)     Energy consumption can be reduced by using a more efficient boiler or more efficient light bulbs.

          What is meant by a *more efficient* light bulb?

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**(1)**

**(Total 4 marks)**

**Q5.**          (a)     The diagram shows the ways in which heat energy can be transferred from an old house.



(i)      Calculate the percentage of energy transferred by draughts.

% energy transferred by draughts = ......................................

**(1)**

(ii)     Complete the following sentence using **one** of the words from the box.

|  |
| --- |
| **conduction                     convection                      radiation** |

Draughts transfer heat energy by ......................................................................

**(1)**

(iii)     State **one** way of reducing the heat transfer by draughts.

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**(1)**

(b)     The diagram shows a section through the walls of a house built in 1930.



          Explain how the air cavity between the two walls reduces the heat transfer from the house.

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**(2)**

(c)     The table shows the installation costs and yearly savings on energy bills for different methods of insulating a house.

|  |  |  |
| --- | --- | --- |
| **Method of insulation** | **Installation cost in £** | **Yearly saving on energy bills in £** |
| Double glazing | 4000 | 65 |
| Loft insulation | 240 | 60 |
| Cavity wall insulation | 600 | 80 |

(i)      Give **one** reason why loft insulation is often fitted to an old house before double glazing or cavity wall insulation.

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**(1)**

(ii)     The time it takes for the saving on energy bills to equal the cost of installing the insulation is called the pay-back time.

         Calculate the pay-back time for loft insulation.

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Pay-back time = .................................................... years

**(1)**

**(Total 7 marks)**

**Q6.**A student used the apparatus in **Figure 1** to compare the energy needed to heat blocks of different materials.

Each block had the same mass.

Each block had holes for the thermometer and the immersion heater.

Each block had a starting temperature of 20 °C.

**Figure 1**

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The student measured the time taken to increase the temperature of each material by 5 °C.

(a)     (i)      State **two** variables the student controlled.

1 ............................................................................................................

2 ............................................................................................................

**(2)**

**Figure 2** shows the student’s results.

**Figure 2**

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                          Material

(ii)     Why was a bar chart drawn rather than a line graph?

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**(1)**

(iii)    Which material was supplied with the most energy?

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Give the reason for your answer.

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**(2)**

(iv)    The iron block had a mass of 2 kg.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 5 °C.

Use the correct equation from the Physics Equations Sheet.

The specific heat capacity of iron is 450 J / kg °C.

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Energy transferred = ............................................................ J

**(2)**

(b)     The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 3**.

**Figure 3**

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                            Time the immersion heater is switched on for in minutes

(i)      One of the student’s results is anomalous.

Draw a ring around the anomalous result.

**(1)**

(ii)     Draw the line of best fit for the points plotted in **Figure 3**.

**(1)**

(iii)    What was the temperature of the room?

Temperature = .............................. °C

**(1)**

(iv)    What was the interval of the time values used by the student?

Interval = .............................. minutes

**(1)**

**(Total 11 marks)**

**Q7.**A ‘can-chiller’ is used to make a can of drink colder.

**Figure 1** shows a can-chiller.



(a)     The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J / kg °C.

Calculate the energy transferred from the liquid as it cools.

Use the correct equation from the Physics Equations Sheet.

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Energy = ................................................. J

**(2)**

(b)     Complete the following sentence.

The specific heat capacity of a substance is the amount of energy required to

change the ............................................................. of one kilogram of the

substance by one degree Celsius.

**(1)**

(c)     To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

State the name of a measuring instrument used to measure mass.

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**(1)**

(d)     The back of the can-chiller has cooling fins, as shown in **Figure 2**.



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

The cooling fins are a ................................... colour because that makes them

good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller

to gain energy quickly and rise, transferring energy by ................................... .

**(2)**

(e)     (i)      The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

Energy can be transferred usefully, stored or dissipated, but cannot be

................................. or destroyed.

**(1)**

(ii)     The temperature of the can of drink decreases while it is in the can-chiller.

What happens to the temperature of the air around the cooling fins?

...............................................................................................................

**(1)**

**(Total 8 marks)**

**Q8.**                 The diagram shows a metal pan being used to heat water.



Energy from the gas flame is transferred through the metal pan by conduction.

Explain the process of conduction through metals.

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**(4)**

**(Total 4 marks)**

**Q9.**          The diagram shows the equipment a student used to investigate how the colour of a surface affects how fast it emits (gives out) heat.



An equal volume of boiling water was poured into each metal can. The student then recorded the temperature of the water in each can every minute for ten minutes.

(a)     (i)      Which of the following was a control variable in this investigation?

Put a tick () in the box next to your answer.

|  |  |
| --- | --- |
| The volume of boiling water. |  |

|  |  |
| --- | --- |
| The decrease in temperature of the water. |  |

|  |  |
| --- | --- |
| The outside colour of the metal can. |  |

**(1)**

(ii)     Give **one** advantage of using a temperature sensor and datalogger rather than a thermometer to measure the temperature of the water.

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**(1)**

(b)     The student’s results for both cans are plotted on the graph.



Which line, **A** or **B**, shows how the temperature of the water inside the black-coloured metal can changed?

Draw a ring around your answer.        **A**        **B**

Explain the reason for your answer.

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**(2)**

(c)     Some gardeners make soil darker by digging black soot into the soil. Other gardeners use straw to protect plants from the cold.

(i)      Complete the following sentence by drawing a ring around the correct line in the box.

On a warm day, the temperature of darker coloured soil will increase

|  |  |
| --- | --- |
| slower than |   |
| as fast as | the temperature of lighter coloured soil. |
| faster than |   |

**(1)**

(ii)     Give a reason for your answer to part (c)(i).

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**(1)**

(iii)    The statement in the box is **false**.

|  |  |
| --- | --- |
| Straw keeps plants warm by trapping air. | This is because air is a good conductor. |

Change **one** word in the statement to make the statement **true**.

Write down your **new** statement. The answer has been started for you.

This is because air is a ............................................................................

**(1)**

**(Total 7 marks)**

**Q10.**          (a)     The diagram shows the position of a radiator inside a room. The radiator is made from metal and is painted white.



(i)      Heat is transferred from the hot water inside the metal radiator to the air touching the outside surface of the radiator.

What name is given to this method of heat transfer?

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**(1)**

(ii)     Explain, in terms of the particles in the metal, how heat is transferred through the radiator.

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**(2)**

(iii)    What name is given to the main method by which heat is transferred from the radiator to the people on the other side of the room?

                                                   ............................................................

**(1)**

(b)     A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C.
After 20 minutes the temperature of the water inside each container was measured.

|  |  |  |  |
| --- | --- | --- | --- |
|     **A** |       **B** |    **C** |    **D** |

The results from the investigation are given in the table.

|  |  |  |  |
| --- | --- | --- | --- |
| **Container** | **Colour** | **Temperature after20 minutes in °C** | **Temperature fallin °C** |
| **A** | White | 86 | 14 |
| **B** | Black | 86 | 14 |
| **C** | White | 73 | 27 |
| **D** | Black | 60 | 40 |

(i)      The student uses the results in the table to see if shape has affected heat transfer.

Which containers should the student compare to do this?

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Give a reason for your answer.

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**(1)**

(ii)     Explain why the temperature of the water in both containers **A** and **B** fell by the same amount.

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**(2)**

(iii)    A central heating system has several radiators joined together. The hot water goes from the boiler, through each radiator in turn and then back to the boiler for reheating.

Give **one** reason, other than appearance, why it might **not** be a good idea to paint radiators black.

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**(1)**

**(Total 8 marks)**

**Q11.**          (a)     Infra red radiation can be reflected, absorbed and transmitted by glass.



(i)      What percentage of infra red is absorbed by the glass?

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**(1)**

(ii)     Complete the following sentence by drawing a ring around the correct word or phrase.

|  |  |  |
| --- | --- | --- |
| The absorbed infra red | increasesdoes not changedecreases | the temperature of the glass. |

**(1)**

(b)     **Two** of the following statements are true. **One** of the statements is false.

Tick () the boxes next to the **two** true statements.

|  |  |
| --- | --- |
| All objects absorb infra red radiation. |   |
| Black surfaces are poor emitters of infra red radiation. |   |
| A hot object emits more infra red than a cooler object. |   |

**(1)**

(c)     The following statement is false.

|  |
| --- |
| Black surfaces are good reflectors of infra red radiation. |

Change **one** word in this statement to make it true.

Write down your **new** statement.

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**(1)**

**(Total 4 marks)**

**Q12.**          The diagram shows four identical pieces of aluminium. Each had been painted with a different type of paint. A drop of water was placed on each and they were then heated by a radiant heater held about one metre above them.



(i)      Suggest in which order the pieces of aluminium would become dry.

first ..................... ....................    ......................  ................... last

**(1)**

(ii)      Explain why you chose your order.

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**(2)**

**(Total 3 marks)**

**Q13.**Under the same conditions, different materials heat up and cool down at different rates.

(a)     What is meant by specific heat capacity?

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**(2)**

(b)     Quenching’ is a process used to change the properties of steel by cooling it rapidly.

The steel is heated to a very high temperature and then placed in a container of cold water.

(i)      A metalworker quenches a steel rod by heating it to a temperature of 900 °C before placing it in cold water. The mass of the steel rod is 20 kg.

The final temperature of the rod and water is 50 °C.

Calculate the energy transferred from the steel rod to the water.

Specific heat capacity of steel = 420 J / kg °C.

Use the correct equation from the Physics Equations Sheet.

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Energy transferred = ........................................ J

**(3)**

(ii)     The temperature of the steel rod eventually returns to room temperature.

Compare the movement and energies of the particles in the steel rod and in the air at room temperature.

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**(3)**

(iii)    When the steel rod is being quenched, the temperature of the water rises to 50 °C. After a few hours the water cools down to room temperature.

Some of the cooling of the water is due to evaporation.

Explain in terms of particles how evaporation causes the cooling of water.

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**(4)**

**(Total 12 marks)**

**Q14.**All objects emit and absorb infrared radiation.

(a)     Use the correct answer from the box to complete each sentence.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **dark matt** | **dark shiny** | **light matt** | **light shiny** |

The best emitters of infrared radiation have

......................................................................... surfaces.

The worst emitters of infrared radiation have

......................................................................... surfaces.

**(2)**

(b)     **Diagram 1** shows a sphere which is at a much higher temperature than its surroundings.

**Diagram 1**

 

Energy is transferred from the sphere to the surroundings.

The table shows readings for the sphere in three different conditions, **A**, **B** and **C**.

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Condition** | **Temperature ofsphere in °C** | **Temperature ofsurroundings in °C** |
|   | **A** | 70 | 5 |
|   | **B** | 80 | 0 |
|   | **C** | 90 | 30 |

In each of the conditions, **A**, **B** and **C**, the sphere transfers energy to the surroundings at a different rate.

Put conditions **A**, **B** and **C** in the correct order.

        

Give a reason for your answer.

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**(2)**

(c)     **Diagram 2** shows a can containing water.

A student investigates how quickly a can of water heats up when it is cooler than room temperature.

**Diagram 2**

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The student has four cans, each made of the same material, with the following outer surfaces.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **dark matt** | **dark shiny** | **light matt** | **light shiny** |

The student times how long it takes the water in each can to reach room temperature.

Each can contains the same mass of water at the same starting temperature.

(i)      Which can of water will reach room temperature the quickest?

Give a reason for your answer.

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**(2)**

(ii)     Apart from material of the can, mass of water and starting temperature, suggest **three** control variables for the student’s investigation.

1 ............................................................................................................

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2 ............................................................................................................

................................................................................................................

3 ............................................................................................................

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**(3)**

(d)     The photographs show two different foxes.

     **Fox A                                                Fox B**

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             By Algkalv (Own work) [CC-BY-3.0],                                                          © EcoPic/iStock
                    via Wikimedia Commons

Which fox is better adapted to survive cold conditions?

Give reasons for your answer.

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**(3)**

**(Total 12 marks)**

**Q15.**          The diagram shows a side view of a double-glazed window.



          (a)     Use each of the terms in the box to explain how heat is lost from inside a house through the window.

|  |
| --- |
| **conduction**                 **convection**                 **radiation** |

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**(3)**

(b)     Besides heat, state **one other** form of energy that passes through double-glazed windows.

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**(1)**

(c)     Explain why plastic foam cavity wall insulation cuts down energy transfer between warm inner walls and cooler outer walls.

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**(2)**

(d)     When it rains the walls and windows of a house get wet.

          Explain how the drying process can increase the cooling of the house.

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**(2)**

**(Total 8 marks)**