Q1. The diagram shows a supermarket worker stacking jars of coffee onto a shelf.

(a) The mass of each jar of coffee is 0.4 kg.

Calculate the weight of each jar of coffee.

gravitational field strength = 10 N/kg

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

.....

.....

.....

.....

Weight = ... N

(2)

(b) The distance between the floor and the middle shelf is 1.2 m.

Calculate the work done to lift one jar of coffee from the floor onto the shelf.

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

.....

.....

.....

.....

.....

.....

Work done = ...

(3)

(Total 5 marks)

Q2. Forces have different effects.

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

slowing	**stretching**	**turning**

The moment of a force is the ..... effect of the force.

(1)

(ii) What is meant by the centre of mass of an object?

.....

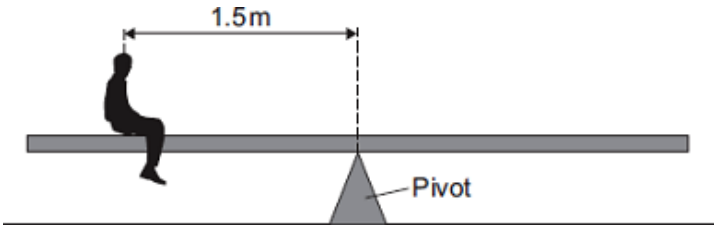
.....

(1)

(b) Some children build a see-saw using a plank of wood and a pivot.
The centre of mass of the plank is above the pivot.

Figure 1 shows a boy sitting on the see-saw. His weight is 400 N.

Figure 1



Calculate the anticlockwise moment of the boy in Nm.

Use the correct equation from **Section A** of the Physics Equations Sheet.

.....

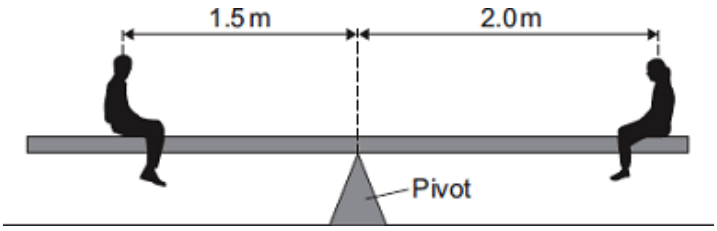
.....

Anticlockwise moment = ... Nm

(2)

(c) **Figure 2** shows a girl sitting at the opposite end of the see-saw. Her weight is 300 N.

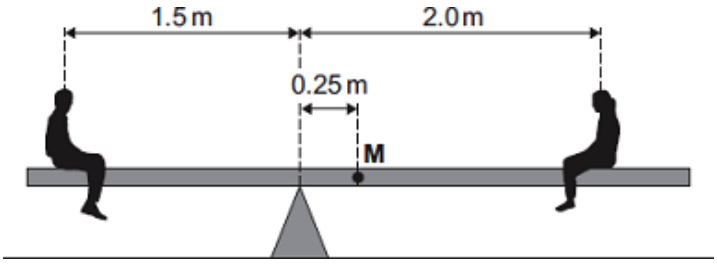
Figure 2



The see-saw is now balanced.

The children move the plank. Its centre of mass, **M**, is now 0.25 m from the pivot as shown in **Figure 3**.

Figure 3



The boy and girl sit on the see-saw as shown in **Figure 3**.

(i) Describe **and** explain the rotation of the see-saw.

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) The boy gets off the see-saw and a bigger boy gets on it in the same place. The girl stays in the position shown in **Figure 3**. The plank is balanced. The weight of the plank is 270 N.

Calculate the weight of the bigger boy.

.....

.....

.....

.....

.....

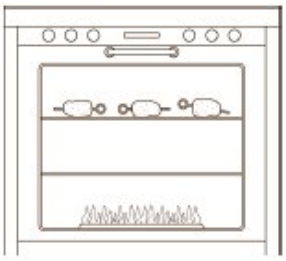
.....

Weight of the bigger boy = ... N

(3)

(Total 10 marks)

Q3. The diagram shows potatoes being baked in a gas oven. Each potato has a metal skewer pushed through it.



(a) Explain how heat is transferred by the process of convection from the gas flame at the bottom of the oven to the potatoes at the top of the oven.

.....

.....

.....

.....

.....

.....

(3)

(b) The metal skewers help the potatoes to cook by transferring heat to the inside of the potatoes.

By what method is heat transferred through a metal skewer?

.....

(1)

(c) When the potatoes are taken from the oven, they start to cool down.

Suggest **one** factor that will affect how fast a potato cools down.

.....

(1)

(d) If the potatoes need to be kept hot, they may be wrapped in shiny aluminium foil.

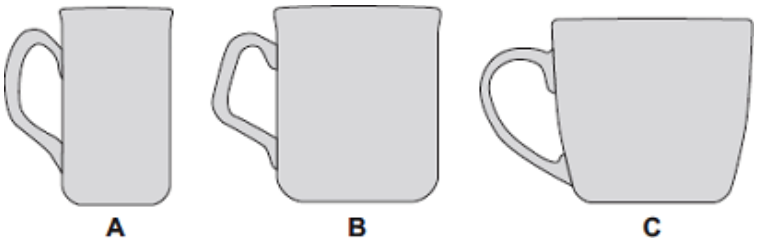
Why does this help to keep the potatoes hot?

.....

(1)

(Total 6 marks)

Q4. The diagram shows three cups **A**, **B** and **C**.



Energy is transferred from hot water in the cups to the surroundings.

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

condensation	**conduction**	**convection**

Energy is transferred through the walls of the cup by ..... .

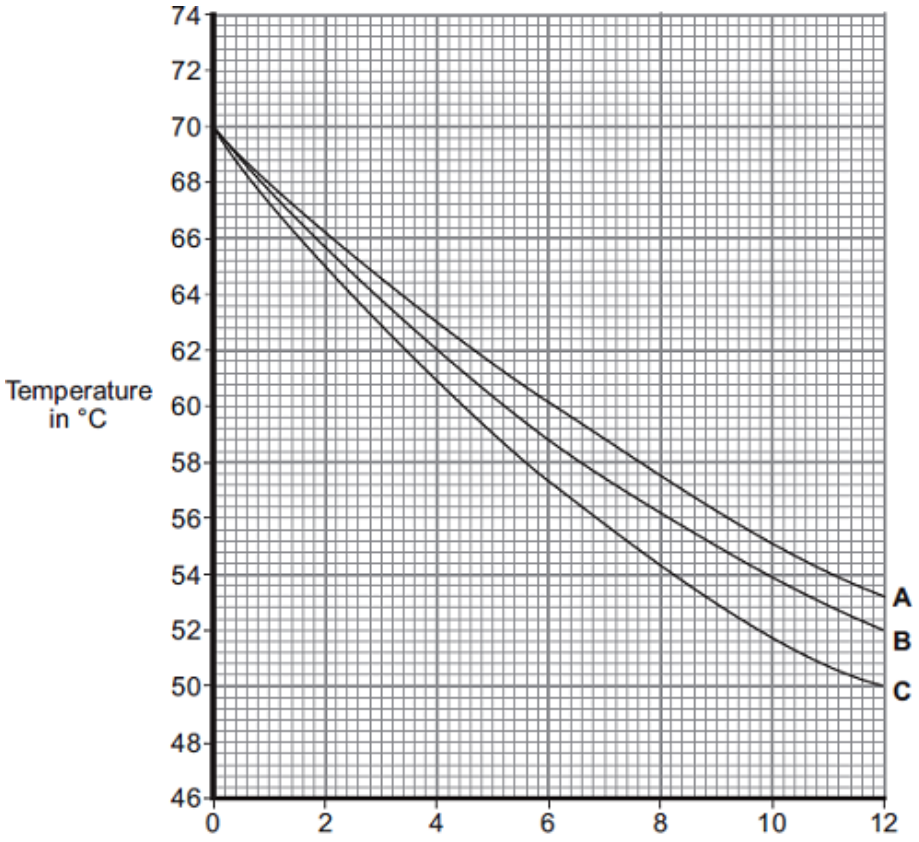
In the air around the cup, energy is transferred by ..... .

(2)

(b) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups **A**, **B** and **C**. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.



(i) What was the starting temperature of the water for each cup?

Starting temperature = ... °C

(1)

(ii) Calculate the temperature fall of the water in cup **B** in the first 9 minutes.

.....

Temperature fall = ... °C

(2)

(iii) Which cup, **A**, **B** or **C**, has the greatest rate of cooling? ☐

Using the graph, give a reason for your answer.

.....

.....

(2)

(iv) The investigation was repeated using the bowl shown in the diagram.

The same starting temperature and volume of water were used.

Draw on the graph in part **(b)** another line to show the expected result.

(1)

(v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20° C.

Suggest why the temperature does **not** fall below 20°C.

.....

(1)

(c) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

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

Use the correct equation from **Section B** of the Physics Equations Sheet.

.....

.....

.....

Energy transferred = ... J

(3)

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

.....

.....

.....

.....

.....

.....

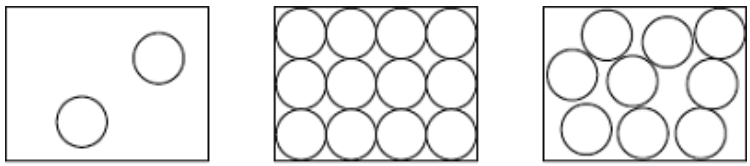
.....

.....

(4)

(Total 16 marks)

Q5. (a) The diagrams, **X**, **Y** and **Z**, show how the particles are arranged in the three states of matter.



X **Y** **Z**

(i) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a liquid?

Write the correct answer in the box. ☐

(1)

(ii) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a gas?

Write the correct answer in the box. ☐

(1)

(b) Draw a ring around the correct answer in each box to complete each sentence.

(i) In a gas, the particles are

vibrating in fixed positions.

moving randomly.

not moving.

(1)

(ii) In a solid, the forces between the particles are

stronger than

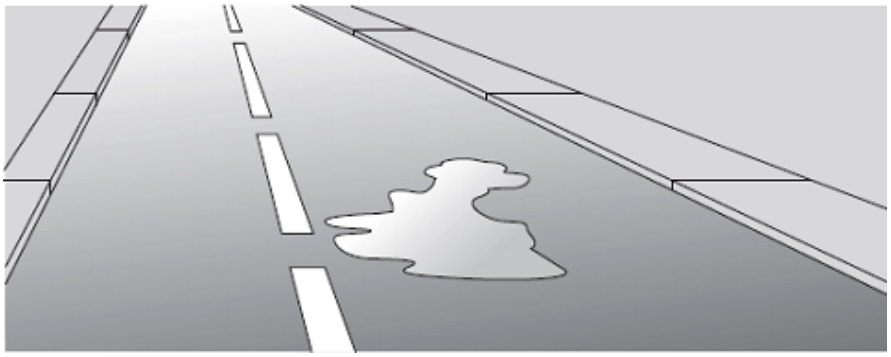
equal to

weaker than

the forces between the particles in a liquid.

(1)

(c) The picture shows a puddle of water in a road, after a rain shower.



(i) During the day, the puddle of water dries up and disappears. This happens because the water particles move from the puddle into the air.

What process causes water particles to move from the puddle into the air?

Draw a ring around the correct answer.

condensation **evaporation** **radiation**

(1)

(ii) Describe **one** change in the weather which would cause the puddle of water to dry up faster.

.....

.....

(1)
(Total 6 marks)

Q6. (a) The weightlifter in the picture has lifted a weight of 2250 newtons above his head. The weight is held still.

(i) In the box are the names of three forms of energy.

gravitational potential	kinetic	sound

Which **one** of these forms of energy does the weight have?

.....

(1)

(ii) What force is used by the weightlifter to hold the weight still?

Size of force = ... N

Give a reason for your answer .....

.....

.....

(2)

(b) To lift the weight, the weightlifter does 4500 joules of work in 3.0 seconds.

Use the following equation to calculate the power developed by the weightlifter. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

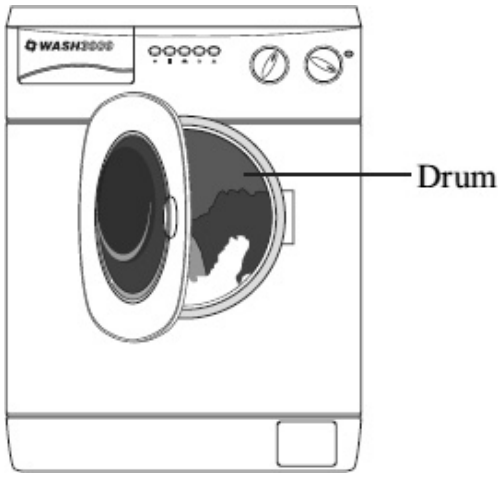
.....

Power = ... watts

(2)

(Total 5 marks)

Q7. The picture shows a new washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

..... energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1)

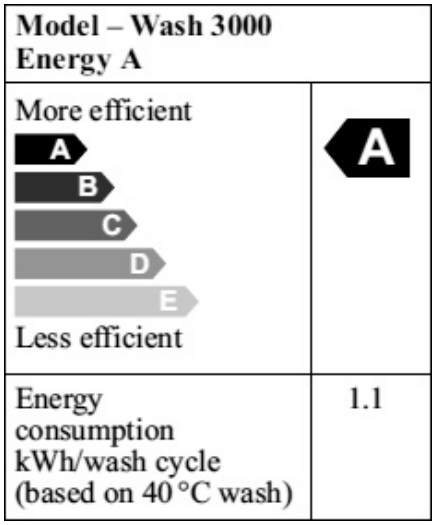
(b) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(c) The diagram shows the label from the new washing machine.



An 'A' rated washing machine is *more energy efficient* than a 'C' rated washing machine.

Explain what being *more energy efficient* means.

.....

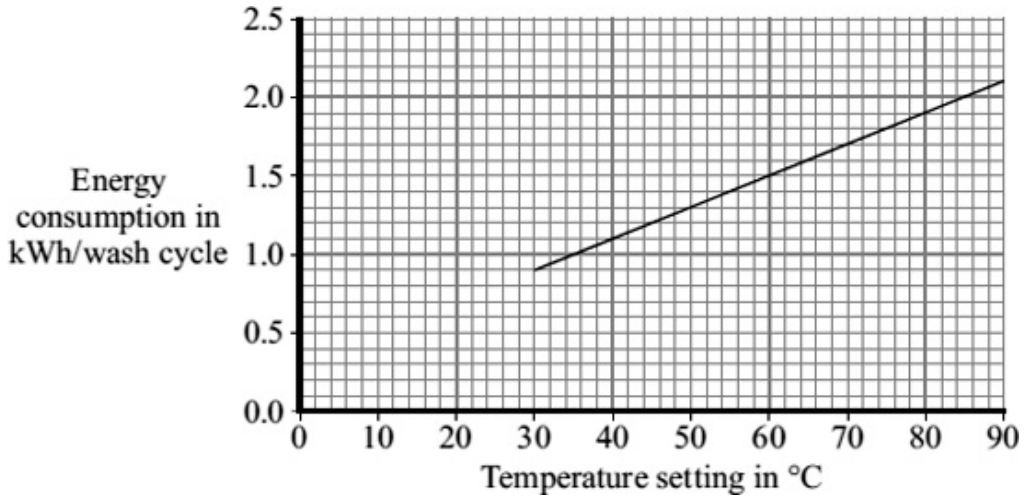
.....

.....

.....

(2)

(d) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 12 p per kilowatt-hour (kWh).
The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

Money saved = ... p

(2)

(ii) Suggest why reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

.....

.....

(1)

(Total 8 marks)

Q8. Wind and tides are renewable energy sources that are used to generate electricity.

(a) Complete each sentence by putting a tick (✓) in the box next to the correct answer.

(i) The wind is:

a predictable energy source. ☐

a constant energy source. ☐

an unreliable energy source. ☐

(1)

(ii) The tides are:

a predictable energy source. ☐

a constant energy source. ☐

an unreliable energy source. ☐

(1)

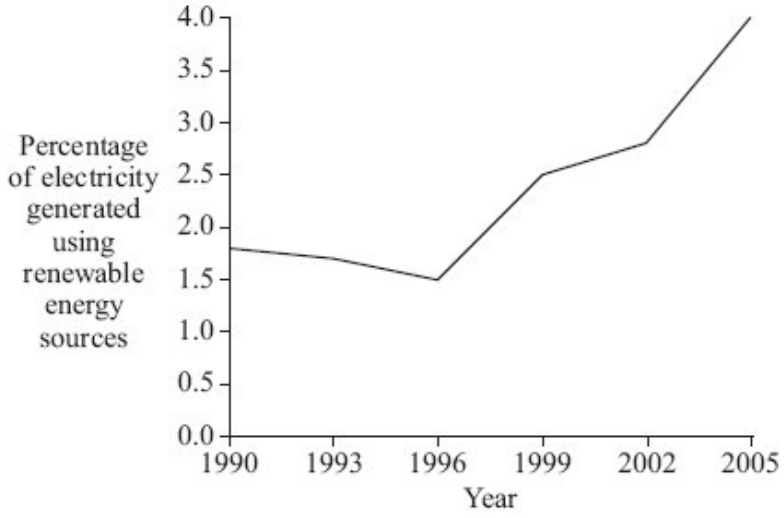
(b) If wood is to be used as a renewable energy source, what must be done each time a tree is chopped down?

.....

.....

(1)

(c) In the UK, electricity is generated using renewable and non-renewable energy sources. The graph shows the percentage of electricity generated using renewable energy sources between 1990 and 2005.



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

In 2015, the percentage of electricity generated using renewable energy sources is most likely to be

greater than 4%
equal to 4%
less than 4%

.

(1)
(Total 4 marks)

Q9. (a) Coal, gas, oil and wood are all examples of fuels.

(i) What are fuels?

.....

(1)

(ii) Write the names of these fuels in the table below to show which are renewable and which are non-renewable.

RENEWABLE FUELS	NON-RENEWABLE FUELS

(2)

(b) The list below shows energy resources which are not fuels.

geothermal **nuclear** **solar** **tides** **wind**

Write the names of the energy resources in the table below to show which are renewable and which are non-renewable.

RENEWABLE FUELS	NON-RENEWABLE FUELS

(2)

(c) Why is it better to use more renewable energy resources rather than non-renewable resources?

.....

.....

.....

.....

(2)

(Total 7 marks)

M1. (a) 4 (N)

*allow **1** mark for correct substitution into correct equation*
ie 0.4 × 10

2

(b) 4.8

*their (a) × 1.2 correctly calculated gains **2** marks*
*allow **1** mark for substitution into correct equation*
ie 4 × 1.2 or their (a)(i) × 1.2

2

joule or J

1

[5]

M2. (a) (i) turning

accept turning ringed in the box

1

(ii) point at which mass (or weight) may be thought to be concentrated

accept the point from which the weight appears to act
allow focused for concentrated
*do **not** accept most / some of the mass*
*do **not** accept region / area for point*

1

(b) 600 (Nm)

*400 × 1.5 gains **1** mark provided no subsequent steps shown*

2

(c) (i) plank rotates clockwise

accept girl moves downwards
*do **not** accept rotates to the right*

1

(total) CM > (total) ACM

accept moment is larger on the girl's side

1

weight of see-saw provides CM

answer must be in terms of moment
*maximum of **2** marks if there is no reference to the weight of the see-saw*

1

(ii) W = 445 (N)

*W × 1.5 = (270 × 0.25) + (300 × 2.0) gains **2** marks*

*allow for **1** mark:*

total CM = total ACM either stated or implied

or

(270 × 0.25) + (300 × 2.0)

if no other marks given

3

[10]

M3. (a) any **three** from:

ignore reference to skewer

- (air) particles / molecules / atoms gain energy
- (air) particles / molecules / atoms move <u>faster</u>

  *do **not** accept move more*

  *do **not** accept move with a bigger amplitude / vibrate more*
- (air) particles / molecules / atoms move apart
- air expands

  *do **not** accept particles expand*
- air becomes less dense
- warm / hot air rises

  *do **not** accept heat rises*

  *if credit is to be given for answers in terms of particles it must be clear they are air particles **not** gas particles*

3

(b) conduction

accept conductor

1

(c) any **one** from:

- temperature of the potato
  *do **not** accept heat for temperature*
- temperature of the surroundings / room / surface / atmosphere
  accept how hot the potato / room is
- size / mass / weight / volume of the potato
- shape of the potato
- surface area of the potato
  potato cut open insufficient
- nature of the surface of the potato
- type of surface it is placed on
- in a draught
- type of potato
- whether the skewers are left in or taken out

1

(d) (foil) reflects heat (back towards potato)
reduces heat loss is insufficient
*do **not** accept reflects hot air*

or (foil) is a poor emitter (of heat radiation)
accept reduces / stops heat loss by <u>radiation</u>
*do **not** accept heat is trapped*

1

[6]

M4. (a) conduction
must be in correct order

1

convection

1

(b) (i) 70
accept ± half a square
(69.8 to 70.2)

1

(ii) 15
*accept 14.6 to 15.4 for **2** marks*
*allow for **1** mark 70 − 55*
ecf from (b)(i) ± half a square

2

(iii) C

1

biggest drop in temperature during a given time

accept it has the steepest gradient this is a dependent

1

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

1

(v) because 20 °C is room temperature

accept same temperature as surroundings

1

(c) (i) 6720

*correct answer with or without working gains **3** marks*
*6 720 000 gains **2** marks*
*correct substitution of E = 0.2 × 4200 × 8 gains **2** marks*
*correct substitution of E = 200 × 4200 × 8 gains **1** mark*

3

(ii) the fastest particles have enough energy

accept molecules for particles

1

to escape from the surface of the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

the lower the mean energy of particles the lower the temperature (of the water)

accept speed for energy

1

[16]

M5. (a) (i) Z

1

(ii) X

1

(b) (i) moving randomly

1

(ii) stronger than

1

(c) (i) evaporation

1

(ii) any **one** from:

- becomes windy
- temperature increases
  accept (becomes) sunny
  "the sun" alone is insufficient
- less humid

1

[6]

M6. (a) (i) gravitational potential
accept gravitational
accept potential

1

(ii) 2250 (N)

1

forces must be balanced
or
forces are equal and opposite
*do **not** accept because it is not moving*
*do **not** accept 'equilibrium' by itself*
*do **not** accept 'it is not balanced'*
*do **not** accept 'forces are equal'*
*do **not** accept 'forces are the same'*

1

(b) 1500
***1** mark for correct substitution*

2

[5]

M7. (a) (i) kinetic
*do **not** accept movement*

1

(ii) thermal
accept heat for thermal

sound
*do **not** accept noise for sound*
both answers required in either order

1

(b) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(c) a smaller <u>proportion / percentage</u> of the energy supplied is wasted

owtte

*accept a statement such as 'less energy is wasted' for **1** mark*

*do **not** accept costs less to run*

ignore references to uses less energy

2

(d) (i) 2.4 (p)

accept 2 p if it is clear from the working out this is rounded from 2.4 p

*allow **1** mark for correct substitution of correct values*

ie 0.2 × 12

*allow **1** mark for calculating cost at 40 °C (13.2 p)*

or

cost at 30 °C (10.8 p)

2

(ii) any **one** from:

- less electricity needed

  ignore answers in terms of the washing machine releasing less energy

  an answer in terms of the washing machine releasing CO_2 negates the mark

  *do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is <u>burned</u>

  accept a correctly named fuel

  *do **not** accept less fuel is needed*

1

[8]

M8. (a) (i) an unreliable energy source

1

(ii) a predictable energy source

1

(b) plant / grow (at least) one new tree

1

(c) greater than 4 %

1

[4]

M9. (a) (i) sources of energy

for 1 mark

(ii) wood coal
oil
gas

all correct gains 2 marks
3 correct gains 1 mark

3

(b) geothermal nuclear
tides
wind
solar

all correct gains 2 marks
4 correct gains 1 mark

2

(c) non-renewable fuels cause pollution (or reverse)
conserve/limit use of coal/gas/oil;
so supplies last longer/renewable sources can be replaced

any 2 from 4 for 1 mark each

2

[7]

E2. (a) (i) Nearly all students knew that the moment of a force is the turning effect of the force.

(ii) Less than half of the students were able to state what is meant by centre of mass of an object. Many referred to a region within the object rather than a point.

(b) Almost all students were able to calculate a moment of a force.

(c) (i) Very few students scored the three marks for describing and explaining the movement of a previously-balanced plank whose pivot had been moved away from the centre of mass of the plank. The idea that the weight of the plank now provided a moment was not understood.

(ii) This high-demand calculation was successfully performed by about a quarter of the students.

E3. Foundation Tier

(a) Many candidates appeared to be led astray by the presence of the metal skewer, and were thus basing their answers on the process of conduction. Many of the other candidates simply stated that the heat was transferred by the process of convection; as this fact was stated in the stem of the question, they therefore gained no marks. A number of candidates wrote 'heat rises' rather than 'heated air rises' and so did not gain credit. Overall there was a disappointing response to this question.

(b) Most candidates correctly identified the process of conduction.

(c) A well-answered question, with most candidates referring either to the temperature of the room or to whether or not the skewer was removed as being the main factor influencing the rate at which the potatoes will cool down. Some candidates appeared not to understand the term 'factor'.

(d) Some candidates offered vague answers such as "The foil traps the heat inside". Many candidates however realised that the shiny foil will reflect the heat back into the potatoes.

Higher Tier

(a) Candidates who answered in terms of the bulk movement of air tended to score better than those who referred to particles. Although the fact that particles gained energy was correctly stated, many candidates answered in terms of the particles vibrating or expanding. Many candidates used the expression 'heat rises' rather than 'heated air rises'. A significant number of candidates misinterpreted the question and explained about the conduction of heat through the skewer and potato.

(b) This was correctly answered by the majority of candidates.

(c) A well answered question with very few failing to gain a mark. A variety of responses was seen with the most popular referring to temperature of surroundings, surface area or the metal skewer.

(d) There were many good answers in terms of the heat being reflected, or the foil being a poor emitter of radiation. More general answers referring to insulation or reducing heat loss failed to score a mark.

E4. (a) Nearly all students recognised two situations that represented conduction and convection.

(b) (i) Almost all students were able to read the starting value of temperature from a cooling curve.

(ii) Nearly all students correctly calculated the temperature fall from the cooling curve. Those who got it wrong gave the value of the temperature reached rather than the change in temperature.

(iii) The given graph showed the cooling curves for three cups of different cross-sectional areas. Students were asked which cup showed the greatest rate of cooling. Only half of the students were able to give a reason because they did not refer to temperature drop in a given time.

(iv) A diagram of a fourth container was given and students had to draw the expected cooling curve on the same axes. This was well done with four-fifths of students scoring full marks.

(v) Nearly all students recognised that the lowest temperature reached after four hours was also room temperature.

(c) (i) The calculation of energy transferred from the water, where the mass of water was given in grams, was correctly done by two-thirds of the students.

(ii) The explanation of evaporation causing the cooling of water was very poorly answered with half of the students scoring zero marks. Many students described convection and very few referred to the reduction in the mean energy of the particles when the most energetic had escaped from the surface of the water. Only a tenth of students scored three or four marks.

E5. (a) (i) Nearly all students answered this correctly.

(ii) Nearly all students answered this correctly.

(b) (i) Nearly all students answered this correctly.

(ii) Nearly all students answered this correctly.

(c) (i) The majority of students correcty chose evaporation.

(ii) Most students knew that if the weather became warmer or more windy the puddle of water would evaporate faster. A few students were unspecific and simply wrote “temperature” or “the Sun”.

E6. This question was generally answered well although very few achieved the maximum 5 marks. The principal error was in part (a)(ii) where statements purely confirming the correct choice of 2250 N could not be credited. Candidates failed to state that if the weight is held still then the force used by the weightlifter must act in the opposite direction to the downward force of the weight.

E7. (a) (i) Kinetic energy was correctly identified by most candidates.

(ii) Most candidates correctly stated that sound and thermal / heat were the two forms of wasted energy.

(b) This was poorly answered, with only just over a quarter of candidates realising that the energy was transferred to the surroundings.

(c) Most candidates were able to earn 1 mark here for stating that the more efficient machine would waste less energy. Very few candidates answered in terms of the **proportion** of the input energy that was wasted was less.

(d) (i) Few candidates were able to score both marks here. Many of the weaker candidates had difficulty in placing the decimal point correctly. Another common mistake was to calculate the cost for either 40 °C or for 30 °C, but not work out the difference.

(ii) Few correct answers. Many candidates thought that washing machines produced carbon dioxide directly.

E8. (a) (i)(ii) Surprisingly less than half of the candidates realised that the wind is an unreliable energy source and that the tides are a predictable energy source. A significant proportion of candidates thought that both were a constant energy source.

(b) The great majority of candidates were able to state that a new tree or trees must be planted to replace the one that had been chopped down. Some candidates however misread the question and talked about what must happen to the tree after it had been chopped down, eg being made into paper.

(c) The majority of candidates were able to interpret the graph correctly, and so deduce that the percentage is most likely to be greater than 4 %.

E9. This was a good start to the paper with almost all candidates gaining at least some marks. In (a)(i) many correct answers were forthcoming but also a number of vague statements. Both tables presented no problems to the more able candidates and many others gained at least part marks. Answers to (c) were often confused.