Q1.  
(a) The diagram shows the traces produced on an oscilloscope when it is connected across different electricity supplies.

Which of the traces could have been produced by the mains electricity supply?
___________________________________________________________________  
Give a reason for your answer.
___________________________________________________________________  
___________________________________________________________________  
___________________________________________________________________  

(2)

(b) The picture shows two adaptors being used to plug five electrical appliances into the same socket.

Explain why it is dangerous to have all five appliances switched on and working at the same time.
___________________________________________________________________  
___________________________________________________________________  
___________________________________________________________________  
___________________________________________________________________  

(2)  
(Total 4 marks)

Q2.  
(a) The resistance of a 24 W, 12 V filament lamp depends on the current flowing through the lamp. For currents up to 0.8 A, the resistance has a constant value of
2.5 Ω.

(i) Use the equation in the box to calculate the potential difference across the lamp when a current of 0.8 A flows through the lamp.

\[
\text{potential difference} = \text{current} \times \text{resistance}
\]

Show clearly how you work out your answer.

______________________________________________________________

______________________________________________________________

Potential difference = ______________________________ V

(ii) When the potential difference across the lamp is 12 V, the current through the lamp is 2 A.

On the axes below, draw a current–potential difference graph for the filament lamp over the range of potential difference from 0 to 12 volts.

(b) The lamp is now included in a circuit. The circuit is switched on for 2 minutes. During this time, 72 coulombs of charge pass through the lamp.

(iii) Why does the resistance of the lamp change when the current through the lamp exceeds 0.8 A?

______________________________________________________________

______________________________________________________________

(1)
Use the equation in the box to calculate the energy transformed by the lamp while the circuit is switched on.

\[
\text{energy transformed} = \text{potential difference} \times \text{charge}
\]

Show clearly how you work out your answer.

___________________________________________________________________
___________________________________________________________________

Energy transformed = ______________________________ J

(2)
(Total 7 marks)

Q3.

The appliances shown below transfer electrical energy to other types of energy.
(a) The vacuum cleaner is designed to transfer electrical energy to kinetic energy.

Three more of the appliances are also designed to transfer electrical energy to kinetic energy. Which three?

Draw a ring around each correct appliance.

(b) Which two of the following statements are true?

Tick (✓) two boxes.

- Appliances only transfer part of the energy usefully.
- The energy transferred by appliances will be destroyed.
- The energy transferred by appliances makes the surroundings warmer.
- The energy output from an appliance is bigger than the energy input.
Q4.

(a) The bar chart shows the power of three different electric hairdryers.

![Bar Chart]

(i) Which one of the hairdryers, A, B or C, would transfer the most energy in 5 minutes?

Write the correct answer in the box.

(ii) A small ‘travel’ hairdryer has a power of 500 watts.

Draw a fourth bar on the bar chart to show the power of the ‘travel’ hairdryer.

(b) A family shares the same hairdryer.

The hairdryer has a power of 1.2 kW. The hairdryer is used for a total of 2 hours each week.

(i) Calculate how many kilowatt-hours (kWh) of energy the hairdryer transfers in 2 hours.

Show clearly how you work out your answer.

\[
\text{Energy transferred} = \frac{1.2 \text{ kW} \times 2 \text{ hours}}{1 \text{ kWh}} = \frac{2.4 \text{ kWh}}{1 \text{ kWh}} = 2.4 \text{ kWh}
\]

(ii) Electricity costs 15 pence per kWh.

Calculate the cost of using the hairdryer for 2 hours.

Show clearly how you work out your answer.

\[
\text{Cost} = 2.4 \text{ kWh} \times 15 \text{ pence/kWh} = 36 \text{ pence}
\]
Q5.
(a) The diagram shows a simple circuit.

(i) Calculate the total resistance of the two resistors in the circuit.

\[ \text{Total resistance} = \text{______________} \Omega \]  

(ii) Calculate the reading on the voltmeter.

Show clearly how you work out your answer.

\[ \text{Voltmeter reading} = \text{______________} \text{V} \]  

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

Replacing one of the resistors with a resistor of higher value will ___ the reading on the ammeter.

(b) The voltmeter in the circuit is replaced with an oscilloscope.

Which one of the diagrams, X, Y or Z, shows the trace that would be seen on the oscilloscope?

Write your answer, X, Y or Z, in the box.
Q6.
A student used the apparatus below to find out how the resistance of a light-dependent resistor (LDR) depends on light intensity.

The resistance of the LDR was measured directly using a multimeter.

(a) (i) Which one of the following is the correct circuit symbol for a LDR?

Draw a ring around your answer.

(ii) Name one factor that will affect the intensity of the light hitting the LDR.

__________________________________________________________________________________________________________
(b) The manufacturer of the LDR provides data for the LDR in the form of a graph.

![Graph showing the relationship between light intensity in lux and resistance in kilohms](image)

Describe how the resistance of the LDR changes when the light intensity increases from 100 lux to 300 lux.

(c) The student only obtained three results. These are given in the table.

<table>
<thead>
<tr>
<th>Light intensity</th>
<th>Resistance in kilohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark</td>
<td>750</td>
</tr>
<tr>
<td>Bright</td>
<td>100</td>
</tr>
<tr>
<td>Very bright</td>
<td>1</td>
</tr>
</tbody>
</table>

(i) The student could not use the results to draw a line graph. Why not?

(ii) Do the student's results agree with the data the manufacturer provided?
(d) Which one of the following circuits probably includes a LDR?

Tick (✓) one box.

A circuit that automatically switches outside lights on when it gets dark.  

A circuit that automatically switches central heating on and off.  

A circuit that automatically turns lights off when no one is in the room.

(Total 7 marks)

Q7.

(a) The diagram shows a piece of two-core cable and a piece of three-core cable.

Two-core cable

Insulation  Copper wire  

Three-core cable

Insulation  Live wire  Earth wire  Neutral wire  

(i) Which one of the wires inside a three-core cable is missing from a two-core cable?

Draw a ring around your answer.

earth wire  live wire  neutral wire

(1)

(ii) Use a word from the box to complete the following sentence.

<table>
<thead>
<tr>
<th>double</th>
<th>extra</th>
<th>totally</th>
</tr>
</thead>
</table>

A pottery table lamp fitted with a two-core cable is safe to use because it is
(b) The cables connecting the power sockets in a building contain wires 1.8 mm thick. The maximum current that can safely pass through these wires is 20 amps. A fuse is included in the circuit to protect the wiring.

Explain how a fuse protects the wiring of a circuit.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(Total 5 marks)

Q8.

The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.

(a) What is the meaning of the following terms?

electric current
(b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases. Explain why.

(c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V. Show clearly how you work out your answer.

Rate of energy transfer = _______________ W

Q9.

Each letter, A, B, C, D and E, represents an energy transformation.

A electrical to chemical
B electrical to heat
C electrical to kinetic
D electrical to light
E electrical to sound

Match each of the following devices to the useful energy transformation that the device is designed to make.

Write the correct letter, A, B, C, D or E, in the box below each device.

Use each letter no more than once.
Q10.

(a) The diagram shows the energy transformations produced by a television.

When the television is working, 1200 joules of energy are supplied to the television every second. The useful energy transferred by the television is 720 joules every second.

(i) Use the equation in the box to calculate the efficiency of the television.

\[
\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}
\]

Show clearly how you work out your answer.

\[\text{Efficiency} = \frac{720}{1200} = 0.6\]

(ii) Use one word from the diagram to complete the following sentence.

The electrical energy that is not usefully transformed by the television is wasted as ______________________________.
(b) A homeowner is sent an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 800 kilowatt-hours. Electrical energy costs 15p per kilowatt-hour.

Use the equation in the box to calculate the cost of the energy transferred from the mains electricity supply.

\[
\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}
\]

Show clearly how you work out your answer and give the unit.

\[
\text{Cost} = \underline{}\\(2)\\text{ (Total 5 marks)}
\]

Q11.

A homeowner had a new gas boiler installed.

(a) The following information is an extract from the information booklet supplied with the boiler.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water temperature</td>
<td>60 °C</td>
</tr>
<tr>
<td>Energy supplied to boiler</td>
<td>8.0 kJ/s (8.0 kW)</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.95</td>
</tr>
</tbody>
</table>

(i) Calculate the energy transferred each second by the gas boiler to the water inside the boiler.

Show clearly how you work out your answer.

\[
\text{Energy transferred by the gas boiler each second} = \underline{}\\(2)\\text{ (Total 5 marks)}
\]

(ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Calculate the total number of hours that the gas boiler would operate for £30.

Show clearly how you work out your answer.
(b) Although the gas boiler is very efficient, some energy is wasted. Explain what happens to the waste energy.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2) (Total 6 marks)

Q12. (a) The diagram shows the circuit that a student used to investigate how the current through a resistor depends on the potential difference across the resistor.

(i) Each cell provides a potential difference of 1.5 volts.

What is the total potential difference provided by the four cells in the circuit?

___________________________________________________________________
Total potential difference = _________________________ volts

(1)

(ii) The student uses the component labelled X to change the potential difference across the resistor.

What is component X?

Draw a ring around your answer.
(iii) Name a component connected in parallel with the resistor.

______________________________________________________________

(b) The results obtained by the student have been plotted on a graph.

(i) One of the results is anomalous.

Draw a ring around the anomalous result.

(ii) Which one of the following is the most likely cause of the anomalous result?

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

- The student misread the ammeter.
- The resistance of the resistor changed.
- The voltmeter had a zero error.

(iii) What was the interval between the potential difference values obtained by the student?

______________________________________________________________

______________________________________________________________
(c) Describe the relationship between the potential difference across the resistor and the current through the resistor.

__________________________________________________________________________

__________________________________________________________________________

(1)

(Total 7 marks)

Q13.

The diagram shows a helicopter being used to rescue a person from the sea.

(a) (i) The mass of the rescued person is 72 kg.

Use the equation in the box to calculate the weight of the rescued person.

\[
\text{weight} = \text{mass} \times \text{gravitational field strength}
\]

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

______________________________

______________________________

Weight = _________________________ N

(2)

(ii) An electric motor is used to lift the person up to the helicopter. The motor lifts the person at a constant speed.

State the size of the force, \( T \), in the cable.

\[
\text{Force} \ T = _________________________ \text{ N}
\]

(1)

(b) To lift the person up to the helicopter, the electric motor transformed 21 600 joules of energy usefully.
(i) Use a form of energy from the box to complete the following sentence.

gravitational potential  heat  sound

The electric motor transforms electrical energy to kinetic energy. The kinetic energy
is then transformed into useful ___________________________ energy.  

(ii) It takes 50 seconds for the electric motor to lift the person up to the helicopter.

Use the equation in the box to calculate the power of the electric motor.

\[
\text{power} = \frac{\text{energy transformed}}{\text{time}}
\]

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

- coulomb (C)
- hertz (Hz)
- watt (W)


Power = _________________________  

(Total 7 marks)

Q14.

The diagram shows an electric circuit used in a dolls’ house.
The switches are 2-way switches; this means that each switch has a connecting wire that
can be in one of two positions.
(a) (i) With the connecting wire in each switch in the position shown in the diagram, the lamp is off. Why?

______________________________________________________________

______________________________________________________________

(1)

(ii) When switched on, the lamp has a resistance of 18 \( \Omega \) and draws a current of 0.5 A from the power supply.

Use the equation in the box to calculate the potential difference of the power supply used in the circuit.

\[
\text{potential difference} = \text{current} \times \text{resistance}
\]

Show clearly how you work out your answer.

______________________________________________________________

______________________________________________________________

Potential difference = _________________________ V

(2)

(iii) A second, identical lamp is added to the circuit. The two lamps are joined in series.

Calculate the total resistance of the two lamps.

______________________________________________________________

Total resistance = _________________________ \( \Omega \)

(1)

(b) This type of circuit is also used in real houses. One of the switches is at the top of the stairs, and the other switch is at the bottom of the stairs.

What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

______________________________________________________________

______________________________________________________________

(1)

(c) The diagram shows an old type of metal lamp fitting.
The cable has been connected to the lamp fitting in a way that makes the lamp fitting unsafe.

(i) What is the possible risk to someone touching the lamp fitting while the lamp is switched on?

______________________________________________________________

(1)

(ii) What should be done to make this lamp fitting safe to use?

______________________________________________________________

______________________________________________________________

(1)

(Total 7 marks)

Q15.

The diagram shows the circuit set up by a student.

(a) The student uses the circuit to test the following hypothesis:

‘The current through a resistor is directly proportional to the potential difference across the resistor.’

(i) If the hypothesis is correct, what should the student predict will happen to the current through the resistor when the potential difference across the resistor is doubled?

______________________________________________________________
(ii) Name the component in the circuit used to change the potential difference across the resistor.

(b) The student used the data obtained to plot the points for a graph of current against potential difference.

(i) Why has the student plotted the points for a line graph and not drawn a bar chart?

(ii) One of the points has been identified by the student as being anomalous. What is the most likely cause for this anomalous point?

(iii) Draw a line of best fit for these points.

(iv) Does the data the student obtained support the hypothesis? Give a reason for your answer.
Q16.
The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.

(a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

(i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

(ii) The battery supplies a direct current (d.c.).

What is a direct current (d.c.)?

(iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Calculate the maximum charge that the battery stores.

Show clearly how you work out your answer and give the unit.

(b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the
bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

(i) Calculate the maximum kinetic energy of the bicycle and rider when the rider is not pedalling.

Show clearly how you work out your answer.

Kinetic energy = ______________________________ J

(ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

Give a reason for your answer.

Q17.

(a) The lamps in the circuits drawn below are all identical. Each of the cells has a potential difference of 1.5 volts.

(i) What is the potential difference across the 3 cells that are joined in series?

Potential difference = __________________________ V

(ii) What will be the reading on the voltmeter labelled $V_3$?

Voltmeter reading $V_3$ = __________________________ V
(iii) Which voltmeter, \( V_1 \), \( V_2 \) or \( V_3 \), will give the highest reading?

Draw a ring around your answer.

\[ V_1 \quad V_2 \quad V_3 \]

(1)

(b) The diagram below shows a simple circuit.

\[ \begin{array}{c}
\text{A} 0.4 \text{A} \\
10 \Omega \\
\text{V} \\
20 \Omega \\
\end{array} \]

(i) Calculate the total resistance of the two resistors in the circuit.

\[
\text{Total resistance} = \text{______________________________} \ \Omega
\]

(1)

(ii) Use the equation in the box to calculate the reading on the voltmeter.

\[
\text{potential difference} = \text{current} \times \text{resistance}
\]

Show clearly how you work out your answer.

\[
\text{Voltmeter reading} = \text{______________________________} \ \text{V}
\]

(2)

(iii) The current through a resistor at constant temperature changes when the potential difference across the resistor changes.

Which one of the graphs, \( X \), \( Y \) or \( Z \), shows how the current changes?

Write your answer, \( X \), \( Y \) or \( Z \), in the box.
Q18.

The diagrams show the inside of a 13 amp plug.

(a) (i) Which **one** of the plugs, A, B, C or D, is correctly wired?

Write your answer, A, B, C or D, in the box.

![Diagram of plugs A, B, C, D](image)

The plug that is correctly wired is

(ii) What material is the outside casing of a plug made from?

______________________________________________________________

(b) An electric drill draws a current of 2 amps from the 230 volt mains electricity supply.

Use the equation in the box to calculate the power of the drill.

\[
\text{power} = \text{current} \times \text{potential difference}
\]

Show clearly how you work out your answer.
A householder needs to replace a damaged plug. Most replacement plugs are sold with a 13 amp fuse fitted inside. The householder thinks it would be better for shops to sell the plugs without a fuse. He could then buy either a 3 A, 5 A or 13 A fuse to fit inside the plug.

Explain an advantage of selling plugs without a fuse, rather than with a 13 amp fuse fitted.

Q19.

The current-potential difference graph for one type of electrical component is drawn below.

(a) What is the component?
(b) Complete the diagram to show a circuit that can be used to obtain the data needed to plot the graph. Use the correct circuit symbol for each component that you add to the diagram.

![Circuit Diagram](image)

(c) (i) What is the current through the component when the potential difference across the component is 0.8 volts?

Current _________________________ amps

(ii) Calculate the resistance of the component when the potential difference across it is 0.8 volts.

Show clearly how you work out your answer.

______________________________________________________________

______________________________________________________________

Resistance = _________________________ Ω

(Total 6 marks)

Q20.

A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.

(a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.
(i) What is the total current drawn from the mains supply?
____________________________________________________________________ (1)

(ii) Calculate the charge passing through one of the lamps in 5 minutes.
     Show clearly how you work out your answer and give the unit.
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Total charge = __________________________________________________________________ (3)

(b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a
     fault occurs. A short time after the lights are switched on, a fault causes the filament
     inside the fuse lamp to melt and all the lamps go out.

     The householder cannot find another fuse lamp so connects a piece of aluminium
     foil across the contacts inside the fuse lamp holder.
     When switched on, the nineteen remaining lamps work.
     What the householder has done is dangerous.

     Explain why.
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________ (2)
(Total 6 marks)

Q21.
The diagram shows four electrical appliances. Each appliance is designed to transform
electrical energy into one form of output energy.

(a) Which one of the appliances is designed to give a different form of output energy
    from the other three appliances?
Give a reason for your answer.

(b) The power of each appliance is given in the table.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kettle</td>
<td>2.5 kW</td>
</tr>
<tr>
<td>Toaster</td>
<td>920 W</td>
</tr>
<tr>
<td>Radio</td>
<td>15 W</td>
</tr>
<tr>
<td>Hair straighteners</td>
<td>75 W</td>
</tr>
</tbody>
</table>

Each appliance is switched on for 5 minutes.

Which appliance transforms the most energy?

(c) The 75 watt hair straighteners are switched on for a few minutes each day. In one year, the amount of energy transferred from the mains electricity supply to the hair straighteners is 4 kilowatt-hours.

Electricity costs 15 p per kilowatt-hour.

Use the equation in the box to calculate the yearly cost of using the hair straighteners.

\[
\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}
\]

Show clearly how you work out your answer.

(d) The graph shows how the time to boil water in an electric kettle depends on the volume of water in the kettle.
A householder always fills the electric kettle to the top, even when only enough boiling water for one small cup of coffee is required.

Explain how the householder is wasting money.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)
(Total 8 marks)

Q22.

Diagram 1 shows a hairdryer.  
Diagram 2 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.  
The hairdryer does not have an earth wire.
(a) What colour is the insulation around the wire connected to the live pin inside the plug?

(b) Why does the hairdryer **not** need an earth wire?

(c) All the switches are shown in the OFF position.

(i) Which switch or switches have to be ON to make:

1. only the fan work; ______________________________________
2. heater 2 work? ______________________________________

(ii) The heaters can only be switched on when the fan is also switched on. Explain why.

(d) The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.
Calculate the maximum power of the hairdryer.
Show clearly how you work out your answer and give the unit.

Maximum power = ______________________________

(Questions worth 9 marks)

Q23.
The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch. This makes the electrical resistance of the wire change.

(a)
(i) Using the correct symbols, add to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating...
(b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

(i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

\[
\text{Resistance} = \frac{3.0 \text{ V}}{0.040 \text{ A}} = 75 \Omega
\]

(ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

(iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

(Total 7 marks)

Q24.

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

___________________________________________________________________

(1)

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

```
Model – Wash 3000
Energy A

<table>
<thead>
<tr>
<th>More efficient</th>
<th>Less efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>D</td>
<td>E</td>
</tr>
</tbody>
</table>

Energy consumption
kWh/wash cycle
(based on 40 °C wash)

1.1
```

An ‘A’ rated washing machine is more energy efficient than a ‘C’ rated washing machine.

Explain what being more energy efficient means.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(2)

(c) 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.

\[
\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}
\]

Show clearly how you work out your answer.

\[\text{Money saved} = \] p

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

\[\text{Money saved} = \] p

(Total 6 marks)

Q25.

A circuit diagram is shown below.
(a) Use a word from the box to label component X.

| fuse | switch | thermistor |

(b) Calculate the total resistance of the two resistors in the circuit.

Total resistance = ________________Ω

(c) The reading on the ammeter is 0.25 A.
The current through the 6Ω resistor will be:

bigger than 0.25 A
equal to 0.25 A
smaller than 0.25 A

Draw a ring around your answer

(d) The 6 V battery is made by correctly joining several 1.5 V cells in series.
Calculate the number of cells needed to make the battery.

Number of cells = ________________

(Total 4 marks)

Q26.
The diagram shows a simple circuit.

(a) The circuit includes an LDR.
What do the letters LDR stand for?
Draw a ring around your answer.

Light-dependable resistor light-dependent resistor light-direct resistor

(b) The graph shows how the resistance of an LDR changes with light intensity.
Describe in detail how the resistance of the LDR changes as the light intensity increases from 0 to 50 lux.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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

A decrease in the light intensity of light on the LDR will __________ the reading on the ammeter.

| decrease | not change | increase |

(1)
(ii) Give a reason for your answer to part (c)(i).

__________________________________________________________________________
__________________________________________________________________________

(1)

(d) An LDR can be used to switch a circuit on and off automatically.

In which one of the following would an LDR be used?

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

- a circuit to switch on central heating when it gets cold
  
- a circuit to switch on security lighting when it gets dark
  
- a circuit to switch on a water sprinkler when the soil in a greenhouse is dry

(1)

(Total 7 marks)

Q27.

The diagram shows a simple light-sensing circuit.

(a) The graph, supplied by the manufacturer, shows how the resistance of the component labelled X varies with light intensity.
(i) What is component X?

______________________________________________________________________

(1)

(ii) Use the graph to find the resistance of component X when the light intensity is 20 lux.

______________________________________________________________________

(1)

(iii) When the light intensity is 20 lux, the current through the circuit is 0.0002 A. Calculate the reading on the voltmeter when the light intensity is 20 lux. Show clearly how you work out your answer.

______________________________________________________________________

______________________________________________________________________

Voltmeter reading = ____________________________ volts

(2)

(b) Use the grid below to show how the voltmeter reading in the light-sensing circuit varies with light intensity.

(i) Add a suitable scale to the y-axis (vertical axis).
(ii) Complete the sketch graph by drawing a line on the grid to show how the voltmeter reading will vary with light intensity.

![Graph of Light Intensity and Resistance]

(c) The following passage is taken from the technical data supplied for component $X$ by the manufacturer.

For any given light intensity, the resistance of this component can vary by plus or minus 50% of the value shown on the graph of light intensity and resistance.

(i) Calculate the maximum resistance that component $X$ could have at 20 lux light intensity.

Maximum resistance = _______________ kilohms

(ii) Explain why this light-sensing circuit would not be used to measure values of light intensity.

______________________________________________________________

______________________________________________________________

______________________________________________________________

(2)

Q28.

(a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Power in kW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(i) When both switches are on, the heater works at the high power setting.

What is the power of the heater when it is switched to the **high** power setting?

\[
\text{Power} = \text{(value from table)} \text{ kW}
\]

(1)

(ii) The heater is used on the **medium** power setting. It is switched on for three hours.

Use the equation in the box to work out the energy transferred from the mains to the heater in three hours.

\[
\text{energy transferred (kilo\text{-}watt\text{-}hour, kWh)} = \text{power (kilo\text{-}watt, kW)} \times \text{time (hour, h)}
\]

Show clearly how you work out your answer.

\[
\text{Energy transferred} = \text{(value from calculation)} \text{ kWh}
\]

(2)

(iii) Electricity costs 12 pence per kilowatt-hour.

Use the equation in the box to calculate how much the heater costs to use on **medium** power for three hours.

\[
\text{total cost} = \text{number of kilowatt\text{-}hours} \times \text{cost per kilowatt\text{-}hour}
\]

Show clearly how you work out your answer.

\[
\text{Total cost} = \text{(value from calculation)} \text{ pence}
\]

(2)

(b) The heater is used to warm a room.

The graph shows how the temperature of the room changes from the moment the heater is switched on.
The heater was first used on the medium setting.

(i) At what time was the heater setting changed to the high setting?

______________________________________________________________

Give a reason for your answer.

______________________________________________________________

______________________________________________________________

(ii) From 7 pm until 10 pm, the temperature of the room is not changing.

Which one of the following statements gives the reason why the temperature of the room is not changing?

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

The room is losing energy slower than the heater supplies energy.  

The room is losing energy as fast as the heater supplies energy.  

The room is losing energy faster than the heater supplies energy.  

(Total 8 marks)

Q29.

A student used a joulemeter to measure the energy transformed by a lamp.
The student set the joulemeter to zero, and then switched on the power supply.

After 120 seconds (2 minutes), the reading on the joulemeter had increased to 2880.

(a) In the space below, draw the circuit symbol used to represent a lamp.

(b) (i) Use the equation in the box to calculate the power of the lamp.

\[
\text{power} = \frac{\text{energy transformed}}{\text{time}}
\]

Show clearly how you work out your answer.

________________________________________________________________________

________________________________________________________________________

Power = ____________________

(ii) Which one of the following is the unit of power?

Draw a ring around your answer.

joule  newton  watt

(c) Complete the following sentence using one of the phrases from the box.

larger than  the same as  smaller than

If the lamp was left switched on for 10 minutes, the amount of energy transformed would be __________________________ the amount of energy transformed in 2 minutes.
Q30.
Complete each of the following sentences, A, B, C, D and E, by choosing the correct ending from K, L, M, N or O.

The first one has been done for you.

A The current through a resistor depends ______________________________

B A direct current _________________________________________________

C In a series circuit, the potential difference __________________________

D An alternating current ____________________________________________

E In a parallel circuit, the potential difference __________________________

K _______________________________________ across each component is the same.

L ___________________________________________ is supplied by a cell or battery.

M ___________________________________________ is constantly changing direction.

N _____________________________ of the power supply is shared by the components.

O ________________________________ on the potential difference across the resistor.

(Total 3 marks)

Q31.
An oscilloscope is connected to an alternating current (a.c.) supply.
The diagram shows the trace produced on the oscilloscope screen.
Each horizontal division on the oscilloscope screen represents 0.002 s.

(a) Calculate the frequency of the alternating current supply.

Show clearly how you work out your answer and give the unit.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Frequency = ______________________________________

(3)

(b) What is the frequency of the a.c. mains electricity supply in the UK?

_____________________________________________________________________

(1) (Total 4 marks)

Q32.

A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

(a) What is an electric current?

_____________________________________________________________________

(1)

(b) The graph shows how the power output of an underfloor heating system depends on the area of the floor that is heated.
The area of the homeowner’s kitchen floor is 9.0 m².

Calculate, using the graph, the current drawn from the 230 V mains supply by the heating system.

Show clearly how you work out your answer and give the unit.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

Current = __________________________________

(4)
(Total 5 marks)

Q33.
The pictures show three different types of electric heater.
The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in joules, the amount of energy transferred from the mains to the heater.

\[
\text{energy transferred} = \text{power} \times \text{time}
\]

Show clearly how you work out your answer.

___________________________________________________________________
___________________________________________________________________

Energy transferred = _______________ joules

(2)

(b) Which heater will be the most expensive to run on its highest heat setting?

___________________________________________________________________

(1)

(c) A heater is needed for a small office.

Comparing each type of heater with the other two, give one advantage of using each type of heater in the office.

oil-filled panel heater ________________________________________________
___________________________________________________________________

fan heater __________________________________________________________
___________________________________________________________________

ceramic heater ______________________________________________________
___________________________________________________________________

(3)

(Total 6 marks)
(a) Use numbers given in the box to complete the following sentences.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>50</td>
<td>110</td>
<td>230</td>
</tr>
</tbody>
</table>

In the UK, the mains electricity supply is ________________________________ volts.

The frequency of the UK mains electricity supply is ______________________ hertz.

(2)

(b) The diagram shows a hairdryer designed to be used with the UK mains supply.

The cable connecting the hairdryer to the plug does not have an earth wire.

(i) Why does the hairdryer not need a cable with an earth wire?

________________________________________________________________________

________________________________________________________________________

(1)

(ii) Which one of the following materials are the two wires inside the cable made from?

Draw a ring around your answer.

- aluminium
- copper
- steel

(1) (Total 4 marks)

Q35.

(a) The diagram shows the circuit used by a student to measure the power of a filament lamp.
Name a component connected in parallel with the filament lamp.

(b) By adding another component to the circuit, the student is able to obtain a range of ammeter and voltmeter readings.

<table>
<thead>
<tr>
<th>Ammeter reading in amps</th>
<th>Voltmeter reading in volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>1.0</td>
</tr>
<tr>
<td>0.15</td>
<td>2.0</td>
</tr>
<tr>
<td>0.20</td>
<td>4.0</td>
</tr>
<tr>
<td>0.25</td>
<td>7.0</td>
</tr>
<tr>
<td>0.30</td>
<td>11.0</td>
</tr>
</tbody>
</table>

(i) Which one of the following components did the student add to the circuit?

- fuse
- switch
- variable resistor

(ii) What is the range of ammeter readings taken by the student?

from _______________ amps to _______________ amps

(iii) Use the data in the table and the equation in the box to calculate the maximum power of the filament lamp.

\[
\text{Power} \left( \text{watt, W} \right) = \frac{\text{Current} \left( \text{ampere, A} \right)}{\text{Potential Difference} \left( \text{volt, V} \right)} \times \text{Potential Difference} \left( \text{volt, V} \right)
\]

Show clearly how you work out your answer.
Power = _______________ W

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

As the temperature of a filament lamp increases, its resistance

- increases
- remains constant
- decreases

(Total 7 marks)
Q1.

(a) A

only scores if A chosen

it is alternating / a.c.
accept because B and C are d.c.
or
it changes direction/p.d.
accept voltage for p.d.
it goes up and down is insufficient
it is constantly changing is insufficient
an answer B and/or C with the reason because it is direct current/d.c scores 1 mark

(b) too much current (through socket)
accept electricity for current
accept too much power
accept socket/circuit overloaded
do not accept voltage/p.d for current

wiring / socket gets hot
accept melts for gets hot
accept risk of fire
risk of fire in appliances is insufficient
ignore reference to sparking
overloaded plugs and plugs getting hot or fuses melting is insufficient

Q2.

(a) (i) 2

allow 1 mark for correct substitution i.e. $0.8 \times 2.5$ provided no further step shown

(ii) straight line drawn from origin to 2, 0.8
or
their (a)(i), 0.8

curve from 2, 0.8 to 12,2
or
their (a)(i) 0.8 to 12,2
accept curve from 2, 0.9 to 12,2
or
their (a)(i) 0.9 to 12,2
‘convex’ curve required
accept a curve that flattens between 10 and 12V

(iii) filament / lamp gets hot
accept temperature increases

(b) 108
allow 1 mark for correct substitution i.e. \(1.5 \times 72\) provided no further step shown

Q3.
(a) fan

(drill

washing machine
\textit{four circled including correct three scores 1 mark}
\textit{five circled scores zero}

(b) Appliances only transfer part of the energy usefully

The energy transferred by appliances makes the surroundings warmer

Q4.
(a) (i) \(A\)

(ii) bar drawn with correct height
\textit{ignore width of bar}

(b) (i) \(E = P \times t\)

\[2.4\]
allow 1 mark for correct substitution
\textit{ie} \(1.2 \times 2\)
\textit{provided no subsequent step shown}

(ii) 36 or their (b)(i) \(\times 15\) correctly calculated

\textit{or}

their (b)(i) \(\times 0.15\) correctly calculated with an answer given in £
allow 1 mark for correct substitution
\textit{ie} \(2.4 \times 15\)
Q5.

(a) (i) 15

(ii) 4.5 or their (a)(i) x 0.3 correctly calculated

   *allow 1 mark for correct substitution, ie 0.3 x 15/their (a)(i), provided no subsequent step*

   *an answer £0.36 gains both marks*

(b) Y

   *accept any correct indication*

   *reason only scores if Y is chosen*

   *accept voltage for p.d.*

   *(only one that) shows a direct current / p.d.*

   *or*

   *a battery / cell gives a direct current*

   *accept both X and Z are a.c.*

   *or*

   *a battery/cell gives a constant current/p.d.*

   *accept it’s a constant current/p.d.*

   *it is not changing is insufficient*

Q6.

(a) (i) correct symbol ringed

   *(diagram)

   *(ii) accept any suggestion that would change light intensity, eg:*

   *torch on or off*

   *accept power of torch*

   *do not accept watts / wattage of torch*
• distance between torch and LDR
• lights in room on or off
• shadow over the LDR

(b) resistance decreases from 600 kΩ to 200 kΩ
   accept by 400 kΩ

(c) (i) no numbers for light intensity
   or
   light intensity is categoric / a description / not continuous
   not enough results is insufficient

(ii) YES
   mark is for the reason
   both show that resistance increases with decreasing (light)
   intensity / brightness
   accept they both get the same results / pattern

(d) A circuit that automatically switches outside lights on when it gets dark.

Q7.
(a) (i) earth wire
(b) if too much current flows through the wire
   accept power for current
   do not accept electricity for current
   accept if more than 20 amps flows through the wire
   the fuse (overheats and) melts
   accept ‘blows’ for melts
   do not accept explodes / breaks / snaps etc
   breaking the circuit
   accept stopping the current flow

Q8.
(a) electric current
(rate of) flow of (electric) charge / electrons

\[ I = \frac{Q}{t} \]

accept with \( Q \) and \( t \) correctly named

potential difference
work done / energy transferred per coulomb of charge
(that passes between two points in a circuit)

\[ \nu = \frac{W}{Q} \]

accept with \( W \) and \( Q \) correctly named

(b) metals contain free electrons (and ions)
accept mobile for free

as temperature of filament increases ions vibrate faster / with a bigger amplitude
accept atoms for ions
accept ions/atoms gain energy
accept vibrate more for vibrate faster
do not accept start to vibrate

electrons collide more (frequently) with the ions
or (drift) velocity of electrons decreases
do not accept start to collide
accept increasing the p.d. increases the temperature (1 mark)

and (and) resistance increases with temperature (1 mark) if no other marks scored

(c) 7.8
allow 1 mark for obtaining value 1.3 from graph
or allow 1 mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive

Q9.
Fan C
Kettle B
Lamp D
Radio E
Q10.

(a) (i) 0.6

or

60%

allow 1 mark for correct substitution ie \( \frac{720}{1200} \) provided no subsequent step shown

an answer of 0.6 / 60 with a unit gains 1 mark only

an answer of 60 gains 1 mark only

(ii) heat

allow thermal

1

(b) 12 000 p

or

£120

to score both marks the unit must be consistent with the numerical answer

answers 12 000 and 120 gain 1 mark only

allow 1 mark for correct substitution ie 800 \times 15 or 800 \times 0.15

provided no subsequent step shown

2

Q11.

(a) (i) 7.6

allow 1 mark for correct substitution and / or transformation

\[
0.95 = \frac{x}{8}
\]

ie

\[95 \times 8.0\]

2

(ii) 25 (hours)

allow 1 mark for obtaining number of kWh = 200

an answer of 26(.3) gains both marks

2

(b) any two from

- transferred to the surroundings / air / atmosphere
- becomes spread out
- shared between (many) molecules
- (wasted as) heat / sound

2
Q12. 
(a) (i) 6
  
(ii) variable resistor
  
(iii) voltmeter
  
(b) (i) point at 3 V ringed
  
(ii) The student misread the ammeter.
  
(iii) 1 (volt)
      accept every volt
  
(c) as one increases so does the other
    or
    directly proportional
    or
    positive correlation
      accept a numerical description, eg when one doubles the
      other also doubles
  
Q13. 
(a) (i) 720
      allow 1 mark for correct substitution,
      ie 72 × 10 provided no subsequent step shown
  
(ii) 720
      or
      their (a)(i)
  
(b) (i) gravitational potential
      allow gravitational
      allow potential
  
(ii) 432
      allow 1 mark for correct substitution, ie \( \frac{21600}{50} \) provided no
      subsequent step shown
      watt / W
  
Q14.
(a) (i) circuit not complete
   accept circuit is broken
   accept switch/s are open/off

   1

(ii) 9
   allow 1 mark for correct substitution, ie $0.5 \times 18$ provided no
   subsequent step shown

   2

(iii) 36

   1

(b) can be switched on/off from top or bottom of stairs

   1

(c) (i) (electric) shock
   accept fitting becomes live
   accept answers giving a possible consequence of electric
   shock, eg death

   1

(ii) connect the earth wire

   1

[7]

Q15.
(a) (i) also double
   increases is insufficient

   1

(ii) variable resistor
   accept rheostat/potentiometer

   1

(b) (i) the data/results/variables are continuous
   accept data/results/variables are not categoric/discrete

   1

(ii) misreading the ammeter
   do not accept misreading the meter/results
   do not accept misreading the ammeter and/or voltmeter
   reading/human error is insufficient

   1

(iii) straight line from the origin drawn passing close/through
   points at 1 V, 5 V, 6 V and ignoring anomalous point
   do not accept line drawn ‘dot-to-dot’

   1

(iv) yes
   mark is for the reason
   supports prediction
   or
   (straight) line passes through the origin
   accept a mathematical argument, eg when p.d. went from 2
to 4 the current went from 0.3 to 0.6
it’s directly proportional is insufficient

Q16.
(a) (i) (connect) 30 (cells)
in series
1

(ii) current always flows in the same direction
or
current only flows one way
1

(iii) 36 000
allow 1 mark for correctly converting 2 hours to 7200
seconds
answers 10 or 600 score 1 mark
2
coulombs / C
do not accept c

(b) (i) 2160
allow 1 mark for correct substitution, ie \( \frac{1}{2} \times 120 \times 6 \)
answers of 1620 or 540 score 1 mark
2

(ii) reduce it
1

any one from:

• draws a larger current (from battery)

• motor draws greater power (from battery)
accept energy per second for power
accept more energy needed to move the bicycle

• greater resistance force (to motion) / air resistance / drag / friction
accept less streamlined
more mass to carry is insufficient

Q17.
(a) (i) 4.5
1

(ii) 2.25 or their (a)(i) ÷ 2 correctly calculated
1

(iii) \( V_z \)
Q18.
(a) (i) D
(ii) plastic or rubber
   \textit{accept a specific type of plastic}
   \textit{accept electrical insulator}
(b) 460
   \textit{allow 1 mark for correct substitution ie 2 \times 230}
(c) any two from:
   • not all appliances need a 13 A fuse
     \textit{idea that 13 A is (much) bigger than required by many appliances}
     \textit{do not accept some appliances require more than 13 A}
     \textit{do not accept 13 A fuse will blow}
   • can choose the most suitable fuse (for the appliance)
     \textit{accept install correct fuse for the appliance}
   • (in the event of a fault) 13 A fuse may allow too much current to flow through an appliance
     or
     fuse may not melt (before appliance is damaged)
   • may already have the fuse
     \textit{idea of reusing a fuse}
     \textit{do not accept cheaper unless explained correctly}

Q19.
(a) diode
   \textit{accept LED}
(b) all symbols correct
must include at least voltmeter and diode

\textbf{diode}

allow ecf from part (a) if the component is not identified as a diode
allow symbol without the line through triangle
ignore polarity of diode

voltmeter in parallel with component added in series
any additional components must not affect the ability to measure \( V \) and \( I \) for the diode / their (a)

(c) (i) 0.05
accept 50 mA
accept between 0.048 and 0.050 inclusive

(ii) 16
\[
\frac{0.8}{0.05} \quad \text{or} \quad \frac{0.8}{\text{their (c)(i)}}
\]
allow 1 mark for correct transformation and substitution
allow 17 if using 0.048

Q20.

(a) (i) 0.25 (A)

(ii) 75
allow 1 mark for converting 5 minutes to 300 seconds
\textbf{or} allow 1 mark for correct substitution
ie 0.25 \times 300
allow 1 mark for an answer 1.25
allow 1 mark only for their (a)(i) \times 300 correctly calculated

coulombs or C
\textbf{do not} accept c

(b) any \textbf{two} from:
- fault not repaired
  accept if a fault was to occur
- larger current will (still) flow
• aluminium foil will not melt (if a fault)
  accept aluminium foil needs a higher current / charge to melt

• wiring will overheat / (may) cause a fire
  accept idea of fire hazard
  do not accept explode etc

Q21.
(a) radio
  radio must be chosen for reason to score
  gives out sound
    inclusion of other forms of energy negates mark
  or
  others give out heat / thermal energy

(b) Kettle
  accept 2.5 (kW)

(c) 60 (p)
  accept £0.6(0)
  allow 1 mark for correct substitution ie 4 × 15
  substitution only scores if no subsequent step shown
  £60 scores 1 mark

(d) (bigger volume) takes more time (to boil)
  accept explanation using data from graph
  (so) more energy transferred
    do not accept electricity for energy
  (and) this costs more money
    ignore references to cost of water

Q22.
(a) brown

(b) outside / case is plastic / an insulator
  accept is double insulated
  accept non-conductor for plastic
  do not accept it / hairdryer is plastic

(c) (i) 1
and no other

(2) S₁ and S₃
both required, either order

(ii) S₁ must be ON (for either heater to work)
do not accept reference to ‘fan’ switch

S₁ switches the fan on

(d) 1495
allow 1 mark for correct substitution
ie, 6.5 × 230

watt(s) or W
an answer of 1.495 kW gains 3 marks
although the unit is an independent mark for full credit
the unit and numerical value must be consistent
accept joules per second or J/s

Q23.
(a) (i) ammeter and battery in series with the gauge
symbols must be correct
ignore a voltmeter drawn in series
accept

not

or cells reversed to cancel out

voltmeter in parallel with the gauge
symbol must be correct
accept a freestanding circuit
diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

(ii) d.c. flows only in one direction
    a.c. changes direction is insufficient

(b)  (i) 75
    this answer only
    allow 1 mark for correct substitution and transformation,
    \[
    \frac{3.0}{0.040}
    \]
    ie resistance = 0.040

(ii) increases

(iii) elastic / strain potential
    do not accept potential

Q24.

(a) 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

(b) a smaller proportion / percentage 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

(c)  (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 \times 12
    allow 1 mark for calculating cost at 40 °C (13.2 p)
    or
    cost at 30 °C (10.8 p)

(ii) any one from:
Q25.
(a) switch
allow answer circled in box

(b) 24

(c) equal to 0.25 A

(d) 4

Q26.
(a) a light-dependent resistor

(b) any three from:
• resistance starts at 500 (kilohms)
• (resistance) falls rapidly as intensity increases from 0
  accept resistance falls
  accept brightness for intensity
• (resistance) halves between 10 and 20 lux
• (resistance) falls slightly between 20 and 50 lux
  or
• (resistance) almost constant / levels out between 20 and 50 lux
• at 50 lux, resistance = 10 (kilohms)
  for full credit the word resistance must be used correctly at least once
  an answer resistance falls as intensity increases gains 2 marks - this may be combined with one of the bullet point marks for full credit

(c) (i) decrease
(ii) resistance increases
   *this can score without (c)(i)*

(d) A circuit to switch on security lighting when it gets dark.

Q27.

(a)  
(i) light dependent resistor / LDR
    *accept ldr*

(ii) 25 (kilohms)
    *accept 24 - 26 inclusive*
    *accept 25 000 Ω*

(iii) 5 (V) or their (a)(ii) correctly converted to ohms × 0.0002 correctly calculated
    *allow 1 mark for converting 25 kΩ /
     their (a)(ii) to ohms
    or
    *allow 1 mark for correct substitution
    ie 0.0002 × 25(000)
    or 0.0002 × their (a)(ii)
    allow an incorrect conversion from kilohms providing this is clearly shown*

(b)  
(i) linear scale
    *using all of the available axis
    must cover the range 4 - 6 v
    or their (a)(iii) - 6 v and lie within the range 0 - 15 inc.*

(ii) negative gradient line
    *do not allow lines with both positive and negative gradients*
    passing through 20 lux and their (a)(iii)
    *only scores if the first mark is awarded
    only scores if line does not go above 6 volts*

(c)  
(i) 37.5 (kΩ) or their (a)(ii) + 50 % (a)(ii) correctly calculated

(ii) light intensity value would be unreliable / not accurate
    due to variation in resistance value
    *accept because resistance varies by ± 50 %
    accept tolerance of resistor is too great
    *do not accept results are not accurate*
Q28.
(a) (i) 2.0
   accept 2000 W or 2000 watt(s)
   accept answer given in table
   do not accept 2000

(ii) 4.5
   allow 1 mark for correct substitution
   ie 1.5 × 3
   allow 1 mark for the answers 1.5 or 6.0

(iii) 54
     or
     their (a)(ii) × 12 correctly calculated
     allow 1 mark for correct substitution
     ie 4.5 × 12
     or
     their (a)(ii) × 12
     allow 1 mark if correct answer is given in pounds eg £54

(b) (i) 6 pm
    temperature starts to rise faster
    only scores if 6 pm given
    or
    graph (line) is steeper / steepest
    it refers to graph gradient or temperature
    accept answers in terms of relative temperature rise
    eg 5 to 6 pm 2 °C rise, 6 to 7 pm 6 °C rise
    accept temperature rises sharply / rapidly / quickly
    do not accept temperature starts to rise

(ii) middle box ticked

Q29.
(a) [Diagram]
   accept ‘the humpback bridge’ symbol
   accept circle with cross but no lines
   if more than one symbol drawn, no mark unless lamp is labelled
(b) (i) 24

\[
\frac{2800}{120}
\]

allow 1 mark for correct substitution ie \[
\frac{2800}{120}
\]
allow 1 mark for an answer 1440
ignore any unit

(ii) watt

1

(c) larger than

accept correct indication inside the box
accept an answer meaning larger than ie greater than

1 [5]

Q30.

L
N
M
K

all four in the correct order
2 marks for 2 correct
1 mark for 1 correct

[3]

Q31.

(a) 125

allow 1 mark for obtaining time period = 0.008 (s)
or
frequency = 1 / time period (or their calculated time period)

2

hertz
or
Hz

do not accept hz

1

(b) 50 (hertz)

1 [4]

Q32.

(a) (rate of) flow of charge / electrons / ions
accept movement for flow
do not accept flow of electricity

1

(b) 7(.0)
accept 6.96 / 6.95 or an answer that would approximate to 6.96 if rounded
allow 1 mark for obtaining correct power and changing to watts ie 1600
or
allow 2 marks for correct substitution and transformation ie 1600 ÷ 230
an answer 0.00696 / 0.007 gains 2 marks
allow 1 mark for 1.6 / 230 or 1.7 / 230
an answer 7.39 or 7.4 gains 2 marks

amp (ere)
accept A

Q33.
(a) 32,400,00 J
allow 1 mark for correct substitution
3.24 × 10^7 J

(b) (3kW) fan heater
accept 3kW
accept the middle one

(c) features common to more than one heater, treat as neutral

- oil-filled
- low level heat
- cannot be knocked over / space saving / no trailing wires
do not accept just wall-mounted

- or more control over heat output
do not accept just 3 heat settings

- fan
  - warms (office) rapidly or can be used to cool air (in summer)
  accept can be used as a fan
  accept cool air fan (setting)
  accept ‘it has a cool air setting in case it gets too hot’
do not accept a specific reference to cooling the heater

- ceramic
  - can be switched on for set periods of time
  do not accept just has a timer
or can be switched on before office is used / switched off automatically at night

Q34.
(a) 230
(b) (i) has a plastic case
   accept outside is plastic
   accept cover / handle/ hair dryer is plastic / non-conductor
   or does not have a metal case or plastic is an insulator
   accept is double insulated
(ii) copper

Q35.
(a) voltmeter
   and no other
   do not accept voltage
(b) (i) variable resistor
(ii) 0.10 – 0.30
   accept 0.1 – 0.3
   accept 0.3 – 0.1
   accept 0.30 – 0.10
(iii) 3.3 (W)
   allow 1 mark for correct data choice
   allow 2 marks for substitution of correct data i.e. 0.30 × 11.0
   the following answers gain 2 marks
   0.10 / 0.30 / 0.80 / 1.75
   allow 1 mark for substitution of incorrect of data incorrectly calculated e.g.
   0.20 × 4.0 = 0.6 scores 1 mark
(c) increases