Woldingham School

Entrance Examinations

14+ Entry 2009

Physics

30 Minutes

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Current School: Sepulveda Middle School
1. The drawing below shows a space buggy on the surface of Mars.

(a) The distance between Earth and Mars is 192 000 000 km.
It took a spacecraft 200 days to take the buggy from Earth to Mars.
Calculate the speed at which the spacecraft travelled.
Give the unit.

The spacecraft is traveling at 960 000 km per day.

2 marks

(b) The weight of the buggy was 105 N on Earth and 40 N on Mars.
Why was the weight of the buggy less on Mars than on Earth?
The weight of the buggy is less on Mars because there is less gravity.

1 mark

(c) The buggy uses solar panels to generate electrical energy.
The solar panels generate less electrical energy on Mars than on Earth.
Give a reason why.
The solar panels generate less electrical energy on Mars because it is further away from the sun.

1 mark
(d) The weight of the buggy was 40 N on Mars. When the buggy landed on Mars it rested on an area of 0.025 m². Calculate the pressure exerted by the buggy on the surface of Mars.

Give the unit.

The buggy weighs 2000 N for each m².

2. Zena has a model plane attached to a rod as shown below. The plane is balanced by a sliding counterweight.

(a) The rod is balanced horizontally.

(i) Calculate the turning moment produced by the counterweight about the pivot. Give the unit.

The turning movement would be 75 N.
(ii) What is the turning moment produced by the plane about the pivot?

The turning moment is 30N for the plane.

1 mark

(iii) Calculate the weight, W, of the plane.

The weight of the plane is 35N.

1 mark

(b) There is a solar cell on the surface of the model plane. Zena connected the solar cell to the motor of the plane. The plane moved in a circle around the pivot.

Part of the path of the plane was in a shadow.
What happened to the speed of the plane as it moved from bright light into low light in the shadow?

From bright light to low light the speed decreased.

Explain your answer.

When there is low light the plane has less energy.

1 mark

maximum 5 marks
The dotar is a musical instrument with two strings.

(a) Aftal plays the dotar very quietly.

What must he do to the strings to make a louder sound?

In order to make the strings louder, Aftal would have to play or add more pressure to the strings.

(b) Aftal makes the strings tighter so they vibrate more quickly.

How does this affect the sound produced by the strings? Tick the correct box.

- The sound has a lower pitch.
- The sound is louder. [X]
- The sound has a higher pitch.
- The sound is quieter.
(c) One of the strings is thicker than the other, so it vibrates more slowly.

In what way is the sound made by the thicker string different from the sound made by the thinner string?

The thicker the string, the lower the pitch.

(d) Aftal played the dotar near a microphone connected to an oscilloscope. The diagrams below show the patterns made by four sounds.

![Diagram A](image1)

![Diagram B](image2)

![Diagram C](image3)

![Diagram D](image4)

(i) How does the sound shown in trace A differ from the sound in trace B?

The sound in trace A was quicker than trace B.

(ii) How does the sound shown in trace A differ from the sound in trace C?

The sound in trace A was further apart than in trace C.
Keith has a wind-up radio. It does not use batteries. It is powered by a steel spring.

(a) Keith winds up the spring. As the spring unwinds, potential energy in the spring is transferred to a generator, which then turns.

The generator provides electrical energy for the radio.

Fill the gaps in the sentences below to show the useful energy changes which take place in the generator and the speaker.

(i) As the generator turns, potential energy is changed to electrical energy.

(ii) In the speaker, electrical energy is changed to battery energy.
(b) When Keith turns the volume up so that the radio is louder, the spring unwinds more quickly.

Why does the spring unwind more quickly?

The spring unwinds more quickly because it takes more energy for the radio's volume to be louder.

(c) The radio has a solar cell which can also provide electrical energy.

Keith winds up his radio and takes it outside without changing the volume. The steel spring unwinds more slowly when sunlight falls on the solar cell. Explain why.

The spring unwinds more slowly when there is sunlight at the solar cell because there is energy pouring into the solar cell.

(d) The wind-up radio was designed for use in poorer countries.

Suggest why wind-up radios are useful in poorer countries.

Wind-up radios are useful in poor countries because people won't have to spend money on batteries for the radio.
5. John used an electrical heater to heat a cup of water. He kept stirring the water. When the temperature reached 20°C, he started his stopwatch and measured the temperature of the water every half minute.

He switched off the heater after 4 minutes, but continued to record the temperature. His results are shown in the table.

One measurement is missing and another appears to be wrong.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>20</td>
</tr>
<tr>
<td>0.5</td>
<td>26</td>
</tr>
<tr>
<td>1.0</td>
<td>31</td>
</tr>
<tr>
<td>1.5</td>
<td>36</td>
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<tr>
<td>2.0</td>
<td>41</td>
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<tr>
<td>2.5</td>
<td>46</td>
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</tr>
<tr>
<td>5.0</td>
<td>59</td>
</tr>
<tr>
<td>5.5</td>
<td>59</td>
</tr>
</tbody>
</table>

(a) Use the results in the table to draw a graph on the grid. Label the axes. Plot the points and draw a smooth curve of best fit.
(b) From your curve, estimate the temperature of the water after three minutes.

\[ 51 \, ^\circ\text{C} \]

1 mark
maximum 5 marks

6. Some pupils investigate whether double glazing or roof insulation is more efficient at reducing heat loss from houses.

They have a model house which can have these features:

- window with single glazing
- window with double glazing
- roof without insulation
(a) A temperature sensor and a small lamp are placed inside the house. The lamp is used as a heat source. When the model house reaches a given temperature, the lamp is switched off. A datalogger then records temperature regularly over time.

(i) What can the combination of single glazing and no roof insulation tell pupils that is relevant to their investigation?

The combinations are that with single glazing and no roof insulation the material is thin and the temperature would be cold.

1 mark

(ii) Which two combinations must they use to find the more efficient way of preventing heat loss in their model house?

- Window with single glazing and roof with insulation
- Window with double glazing and roof without insulation

1 mark

(b) The pupils predicted that the roof insulation will be more effective than double glazing at reducing heat loss.

What evidence would support this prediction?

The thicker the roof is, in a home, the less heat would be able to escape through.

1 mark
(c) On the grid below, sketch the shape of the two graphs you would expect to see on the datalogger if the pupils' prediction is correct.

You do not need to add scales to the axes.

Use a solid line (———) to show the graph for double glazed windows.
Use a dotted line (-----) to show the graph for roof insulation.

7. A reed switch is made of two iron strips inside a glass tube. The iron strips close together when a magnet is brought near. They spring apart again when the magnet is removed.
Hilary set up the circuit shown below. She tried to close the reed switch using an electromagnet.

She closed switch E but the electromagnet was not strong enough to close the reed switch.

(i) Give two ways Hilary could increase the strength of the electromagnet.
1. She could have more iron core.
2. She could make the circuit smaller.

(ii) Hilary increased the strength of the electromagnet. The reed switch closed. The iron strips were magnetised as shown below.

She reversed the current in the coil of the electromagnet. On the diagram below, label the poles of the iron strips when the current was reversed.
(b) (i) Iron and steel are both magnetic materials. Explain why the strips must be made of iron and not steel.

The strips must be made of iron because only energy can pass through iron.

1 mark

(ii) She replaced the reed switch with a piece of copper wire. The current through the bulb increased.

Explain why more current flowed through the bulb when the reed switch was replaced with copper wire.

With copper wire, energy can pass through more easily than with a reed switch.

1 mark

maximum 5 marks