**Q1.** (a)     **Figure 1** shows the horizontal forces acting on a moving bicycle and cyclist.

**Figure 1**

****

(i)      What causes force **A**?

Draw a ring around the correct answer.

**friction                gravity                weight**

**(1)**

(ii)     What causes force **B**?

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**(1)**

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

**Figure 2** shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

**Figure 2**

****        Time

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

•        between the points **X** and **Y**

•        and between the points **Y** and **Z**, marked on the graph in **Figure 2**.

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**(6)**

(b)     (i)      The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

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Work done = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(ii)     Complete the following sentences.

When the brakes are used, the bicycle slows down. The kinetic energy of the

bicycle \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

At the same time, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the brakes

increases.

**(2)**

**(Total 13 marks)**

**Q2.** The diagram shows a boat pulling a water skier.



(a)     The arrow represents the force on the water produced by the engine propeller.
This force causes the boat to move.

Explain why.

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**(2)**

(b)     The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

(i)      Calculate the acceleration of the water skier and give the unit.

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Acceleration = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(ii)     The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

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Resultant force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ N

**(2)**

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

The force from the boat pulling the water skier forwards

|  |  |  |
| --- | --- | --- |
|  | less than |  |
| will be | the same as | the answer to part **(b)(ii)**. |
|  | greater than |  |

Give the reason for your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

**(Total 9 marks)**

**Q3.** A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit.

The monitor unit then displays an image of the baby and emits the noises the baby makes.

(a)     Compare the properties of the waves that transmit images and noises from the monitor unit.

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**(4)**

(b)     The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

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**(1)**

(c)     Write down the equation that links frequency, wave speed and wavelength.

Equation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(d)     The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

Wave speed of electromagnetic waves = 3 × 108 m / s

Calculate the frequency of the signal.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Frequency = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

**(3)**

**(Total 9 marks)**

**Q4.** (a)     The picture shows a speed gun being used to measure how fast a tennis player hits the ball.



          Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

(i)      Complete the following sentence by choosing **one** of the phrases from the box.

|  |
| --- |
|           **longer than**                **the same as**               **shorter than** |

         The wavelength of the microwaves reflected from the ball are

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the wavelength of the microwaves

from the speed gun.

**(1)**

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

|  |  |
| --- | --- |
|   | decrease slightly |
| When the ball absorbs microwaves, its temperature will | not change |
|   | increase slightly |

**(1)**

(b)     The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.

                          

(i)      Describe the pattern that links the difference between the two frequencies and the speed of the ball.

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**(1)**

(ii)     The speed gun measures the difference between the two frequencies as 3200 Hz.

         Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m/s

**(2)**

(iii)     Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

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

|  |  |
| --- | --- |
| Frequency and speed are both categoric variables. |   |
| Frequency and speed are both continuous variables. |   |
| Speed is a continuous variable and frequency is a categoric variable. |   |

**(1)**

**(Total 6 marks)**

**Q5.** (a)     Complete the description of the device shown below by drawing a ring around the correct line in each box.



|  |  |  |
| --- | --- | --- |
|   |   | an electric motor. |
| (i) | The device is being used as | a generator. |
|   |   | a transformer. |

**(1)**

(ii)     The coil needs a flick to get started. Then one side of the coil is pushed by the

|  |  |
| --- | --- |
| cell |   |
| coil | and the other side is pulled, so that the coil spins. |
| force |   |

**(1)**

(b)     Suggest **two** changes to the device, each one of which would make the coil spin faster.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(c)     Suggest **two** changes to the device, each one of which would make the coil spin in the opposite direction.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2) (Total 6 marks)**

**Q6.** An electric current is a flow of electrical charge through a circuit.

(a)     Complete the sentence.

Use a word from the box.

|  |  |  |  |
| --- | --- | --- | --- |
| **atoms** | **electrons** | **ions** | **molecules** |

Metals are good conductors of electricity because electrical charge is transferred

by delocalised \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**(1)**

(b)     Draw **one** line from each symbol to the name of the component.

     **Standard symbol**                                           **Name of component**

**** **(3)**

(c)     The table below shows information about some electrical appliances.

|  |  |
| --- | --- |
| **Electrical appliance** | **Power in watts** |
|  Hairdryer | 1500 |
|  Kettle | 2500 |
|  Electric hob | 3000 |
|  Television | 360 |

A student plugs all four of the appliances into one multi-way socket.

The mains electricity is 230 V.

The highest safe current in the socket is 30 A.

Explain why it is not safe to use all four appliances at the same time.

In your answer you should:

•        calculate the total power needed

•        use the equation

      current = power ÷ potential difference

to calculate the total current needed.

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**(4)**

(d)     The figure below shows how electrical power is transferred from power stations to consumers using the National Grid.



Transformer 1 is a step-up transformer.

Explain why step-up transformers are used in the National Grid.

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**(3)**

(e)     What is the purpose of Transformer 2?

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**(1)**

(f)     In a power station 900 MJ of thermal energy were released by burning natural gas.

Write down the equation that links efficiency, useful input energy transfer and useful output energy transfer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(g)     In a power station 900 MJ of thermal energy were released by burning natural gas.

Only 405 MJ was generated.

Calculate the efficiency of this energy transfer.

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Efficiency = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 15 marks)**