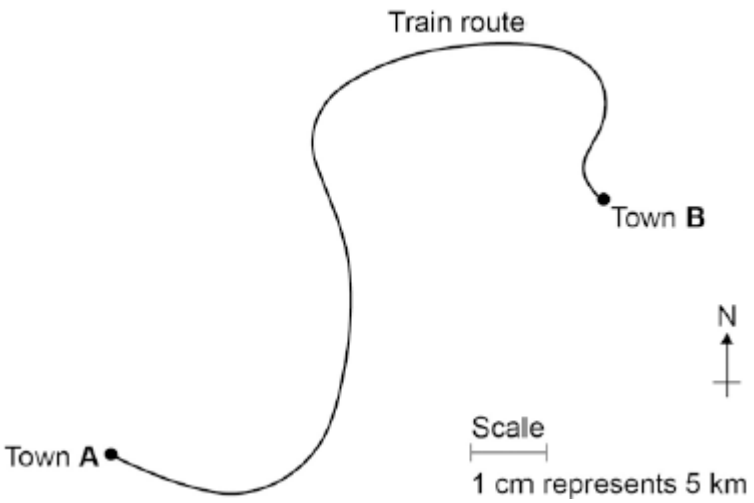
Q1.A train travels from town **A** to town **B**.

Figure 1 shows the route taken by the train.
Figure 1 has been drawn to scale.

Figure 1



(a) The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

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.....

.....

(1)

(b) Use **Figure 1** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

.....

.....

Displacement = ... km

Direction = ...

(2)

(c) There are places on the journey where the train accelerates without changing

speed.

Explain how this can happen.

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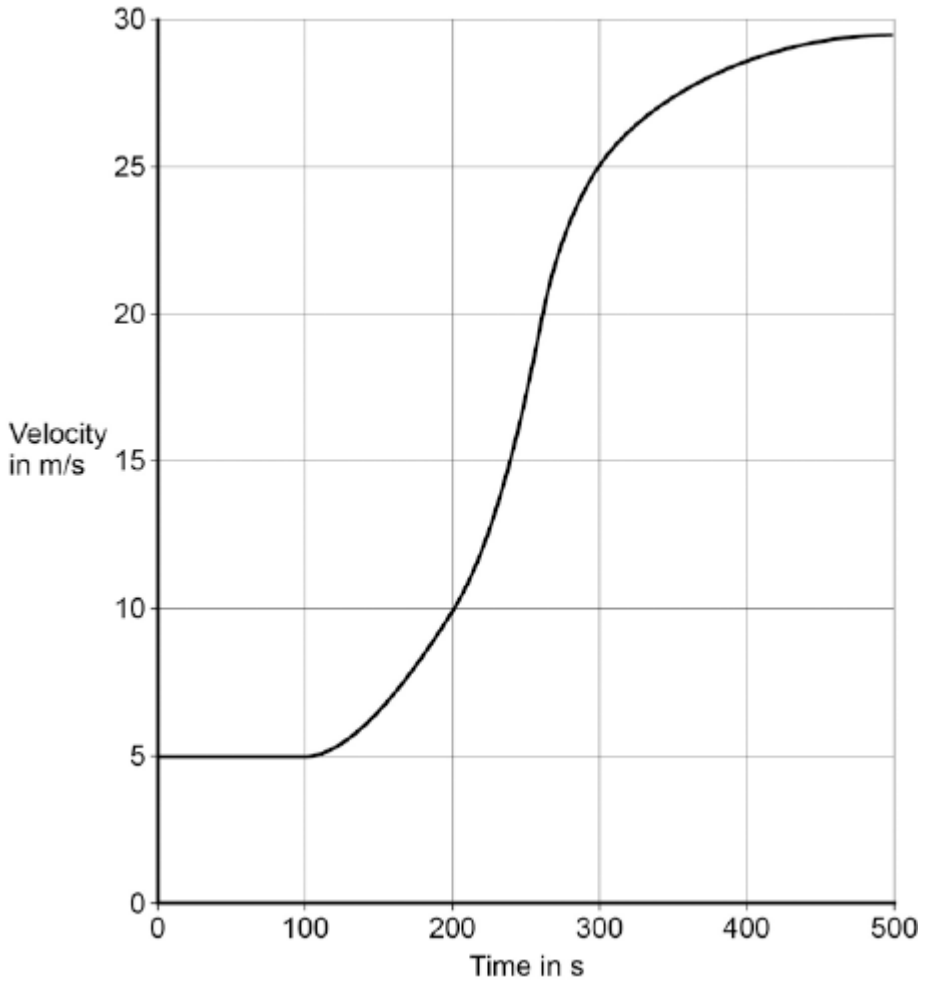
(2)

(d) **Figure 2** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 2



Estimate the distance travelled by the train along the section of the journey shown in **Figure 2**.

To gain full marks you must show how you worked out your answer.

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Distance = ... m

(3)

(Total 8 marks)

Q2. When a gun is fired, a very large force acts on the bullet for a very short time.

The change in momentum of the bullet is given by the following relationship:

force (N) × time(s) = change in momentum (kg m/s)

(a) An average force of 4000 newton acts for 0.01 seconds on a bullet of mass 50g.

Calculate the speed of the bullet. (*Show your working*.)

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.....

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Answer ..... m/s

(4)

(b) The bullet is fired horizontally. In the short time it takes for the bullet to reach its target, its horizontal speed has fallen to 80% of its initial speed.

(i) Explain why the speed of the bullet decreases so quickly.

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(2)

(ii) Calculate the percentage of its original kinetic energy the bullet still has when it reaches its target.

(Show your working.)

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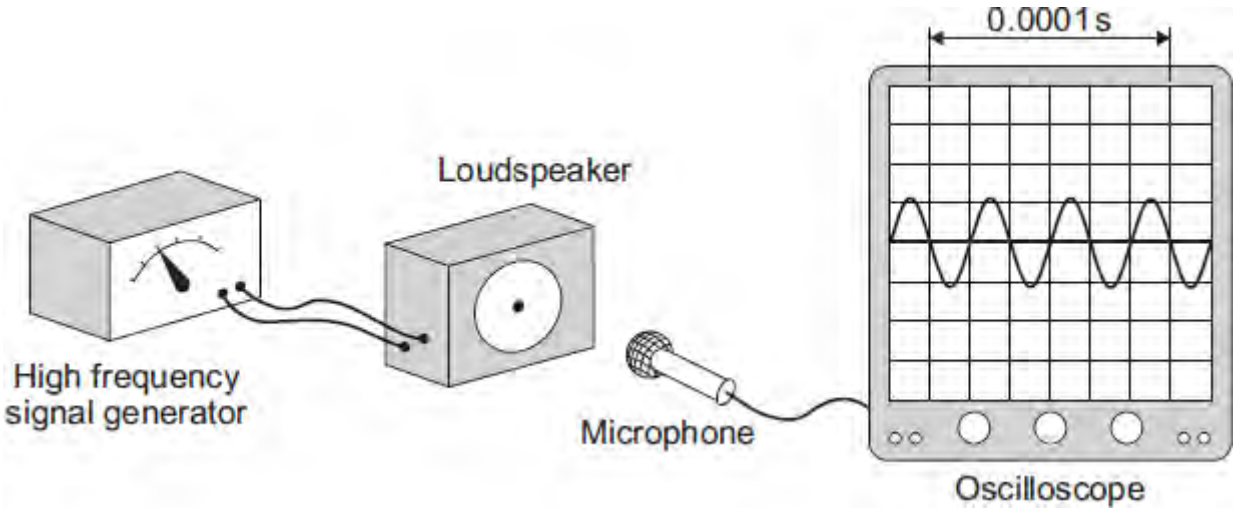
(4)

(Total 10 marks)

Q3. (a) The diagram shows a microphone being used to detect the output from a loudspeaker.
The oscilloscope trace shows the wave pattern produced by the loudspeaker.



(i) How many waves are produced by the loudspeaker in 0.0001 seconds?

.....

(1)

(ii) How many waves are produced by the loudspeaker every second?
Assume the input to the loudspeaker does not change.

.....

.....

(1)

(iii) A person with normal hearing cannot hear the sound produced by the loudspeaker.

Explain why.

.....

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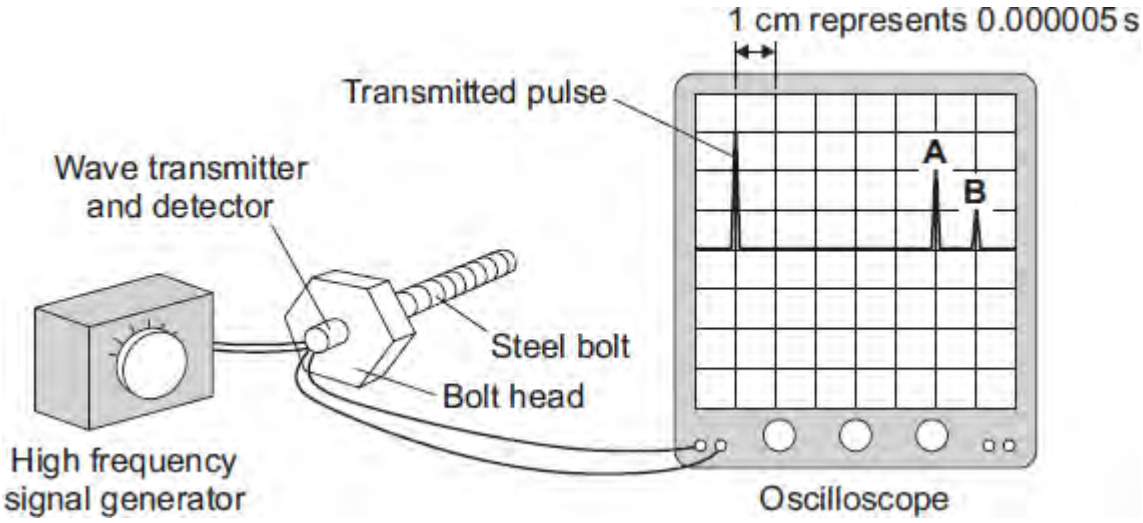
(2)

(b) The diagram shows how a very high frequency sound wave can be used to check for internal cracks in a large steel bolt. The oscilloscope trace shows that the bolt does have an internal crack.



(i) Explain what happens to produce pulse **A** and pulse **B**.

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(2)

(ii) Use the information in the diagram and the equation in the box to calculate the distance from the head of the bolt to the internal crack.

distance = speed × time

Speed of sound through steel = 6000 m/s

Show clearly how you work out your answer.

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(3)
(Total 9 marks)

Q4. (a) The diagrams show oscilloscope traces for the same musical note played on two different instruments. The oscilloscope settings are not changed.

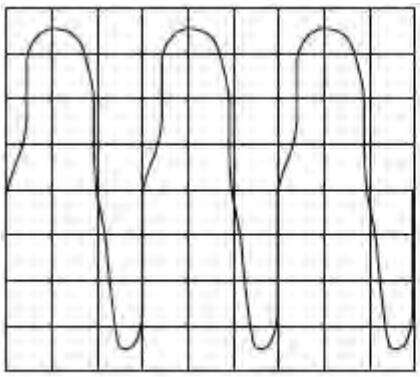

Diagram X

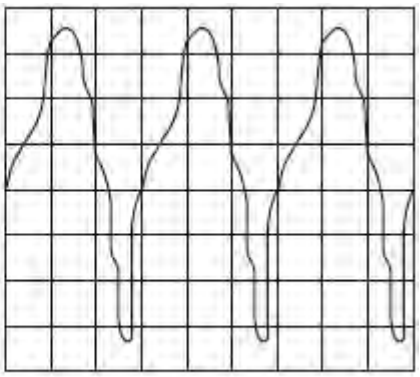

Diagram Y

(i) How can you tell, from the diagrams, that it is the same musical note?

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(1)

(ii) How can you tell, from the diagrams, that the musical note has been played on different instruments?

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(1)

(b) This passage is from an electronics magazine.

Electronic systems can be used to produce ultrasound waves. These waves have a higher frequency than the upper limit for hearing in humans.
Ultrasound waves are partially reflected when they meet a boundary between two different media.

(i) Approximately what is the highest frequency that humans can hear?

State the number and the unit.

.....

(1)

(ii) What does the word *media* mean when it is used in this passage?

.....

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(1)

(iii) What happens to the ultrasound which reaches the boundary between two different media and is **not** reflected?

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(2)

(Total 6 marks)