Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson BTEC Level 3 Nationals Certificate

Centre Number	Learner Registration Number

Wednesday 22 May 2019

Afternoon (Time: 40 minutes) | Paper Reference **31617H/1P**

Applied Science / Forensic and Criminal Investigation

Unit 1: Principles and Application of Science I

Physics

SECTION C: WAVES IN COMMUNICATION

You will need:
A calculator and a ruler.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The exam comprises three papers worth 30 marks each.
  Section A: Structure and functions of cells and tissues (Biology).
  Section B: Periodicity and properties of elements (Chemistry).
  Section C: Waves in communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- The formulae sheet can be found at the back of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows a stationary wave on a vibrating string.

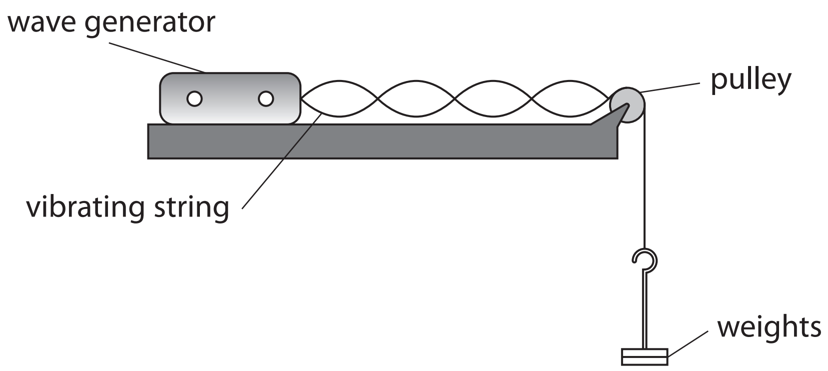

Figure 1

(a) (i) Give the number of complete wavelengths shown on the string in Figure 1.

(1)

number of complete wavelengths = ...

(ii) Add a letter X to Figure 1 to show the position of **one** antinode.

(1)

(iii) Which process causes the stationary wave on the string in Figure 1?

(1)

☒ **A** compression

☒ **B** diffraction

☒ **C** regeneration

☒ **D** resonance

(iv) The string in Figure 1 is 1.0 m long.

The string has a mass of 2.1 g.

The tension in the string is 3.6 N.

Calculate the speed, v, of the wave on the string in Figure 1.

Use the equation: $v = \sqrt{\frac{T}{\mu}}$

Show your working.

(4)

speed of wave = ... m/s

(b) Stringed instruments, such as guitars, produce a range of musical notes.

Changing the tension of the strings is one factor that can alter the pitch of the notes.

Give **two** other factors that can be changed to alter the pitch of the notes that the strings produce.

(2)

1 ....

....

2 ....

....

(Total for Question 1 = 9 marks)

2 Figure 2 shows a transmitter, satellite and receiver in a communication system.

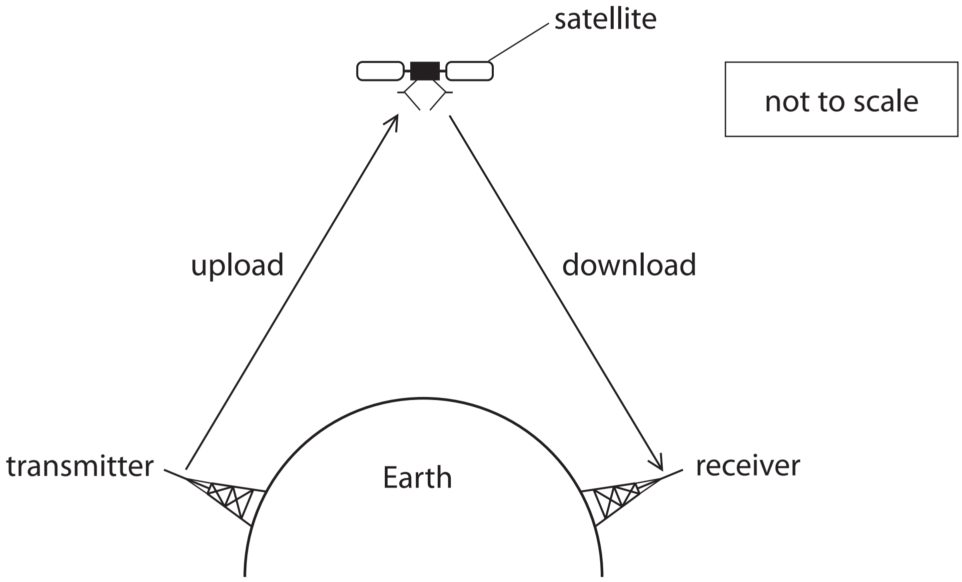

Figure 2

A microwave signal is uploaded to the satellite from a transmitter on Earth.

The satellite transmits a new microwave signal.

The new microwave signal is downloaded to the receiver on Earth.

(a) Which statement about microwaves is correct?

(1)

- ☒ **A** microwaves are longitudinal waves
- ☒ **B** microwaves travel at the speed of light in a vacuum
- ☒ **C** microwaves travel faster than radio waves in a vacuum
- ☒ **D** microwaves have a higher frequency than ultraviolet waves

(b) Explain **one** advantage of using microwaves to carry the signal for satellite communication.

(2)

....

....

....

....

(c) The upload signal received at the satellite is different from the download signal transmitted from the satellite in frequency and amplitude.

(i) Give **one** reason why the upload signal and download signal have different frequencies.

(1)

....

....

(ii) Give **one** reason why the satellite needs to amplify the upload signal.

(1)

....

....

(Total for Question 2 = 5 marks)

3 A microphone converts sound waves to electrical signals.

Figure 3 shows an analogue signal from the microphone.

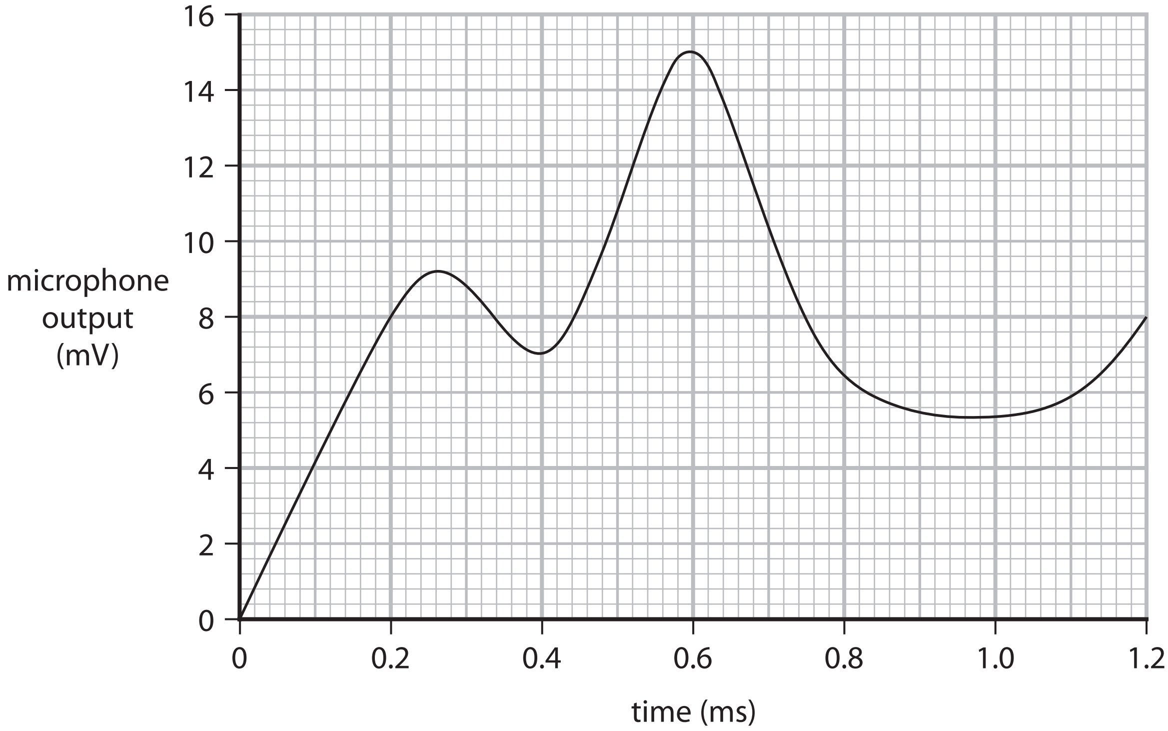

Figure 3

(a) Give the maximum voltage of the signal in Figure 3.

(1)

maximum voltage = ... mV

(b) Figure 3 shows an example of an analogue signal.

Complete Sentence 1 for the correct definition of an analogue signal.

(2)

The signal in Figure 3 is analogue because the .... varies .... with time.

Sentence 1

(c) Describe how an analogue signal can be converted into a digital signal.

(3)

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(Total for Question 3 = 6 marks)

4 (a) Which diagram correctly shows the refraction of light when passing from air into an optical fibre?

(1)

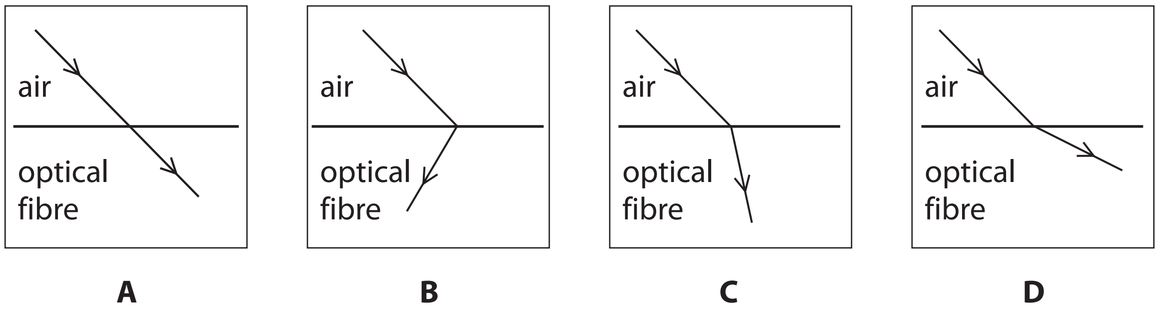

Figure 4

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) The speed of light in air is $3.0 \times 10^8\,\text{m s}^{-1}$.

The light passes into an optical fibre.

The refractive index of the optical fibre is 1.55

Calculate the speed of light in the optical fibre, *v*.

Use the equation: $n = \frac{c}{v}$

Show your working.

(3)

speed of light in the optical fibre = ... m s^{-1}

(c) A doctor uses a medical endoscope to see inside the stomach of a patient.

Figure 5 shows the medical endoscope inside the stomach of the patient.

Medical endoscopes contain optical fibres.

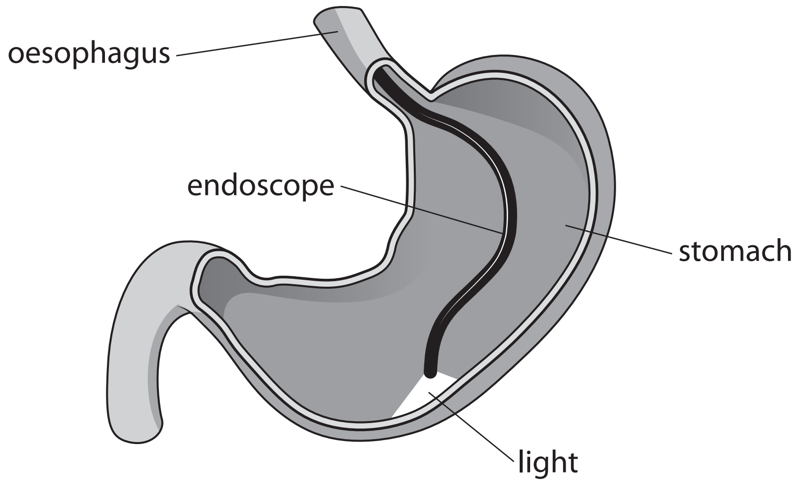

Figure 5

Explain how the optical fibres transmit light so that the doctor can see inside the stomach.

You may include annotated diagrams to support your answer.

(6)

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(Total for Question 4 = 10 marks)

TOTAL FOR SECTION C = 30 MARKS
TOTAL FOR EXAM = 90 MARKS

P 6 1 8 1 1 A 0 9 1 2

Turn over

Formulae sheet

Wave speed $v = f\lambda$

Speed of a transverse wave on a string $v = \sqrt{\frac{T}{\mu}}$

Refractive index $n = \frac{c}{v} = \frac{\sin i}{\sin r}$

Critical angle $\sin C = \frac{1}{n}$

Inverse square law in relation to the intensity of a wave $I = \frac{k}{r^2}$

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