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 15 January 2020

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 ▶

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P 6 3 9 4 3 A 0 1 1 6

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 pendulum pulled to the right-hand side.

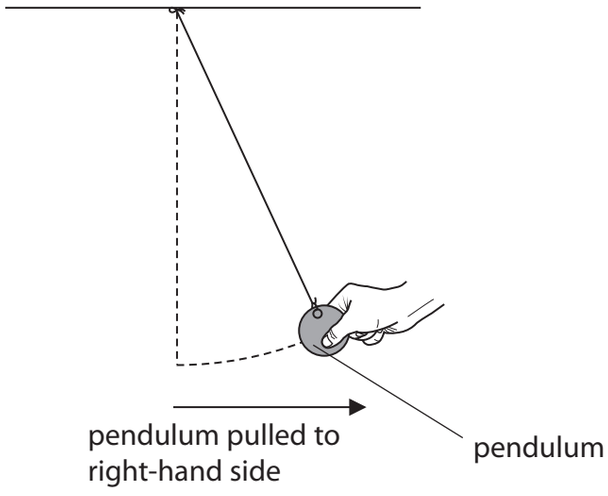

Figure 1

The pendulum is released and starts to swing.

Figure 2 shows how the displacement of the pendulum changes with time.

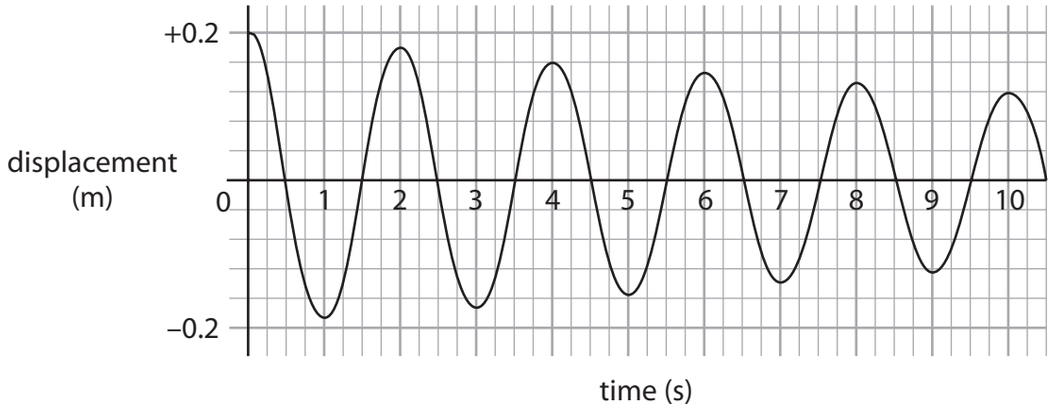

Figure 2

(a) (i) Give the time taken for **one** complete oscillation.

(1)

time for one complete oscillation = ... s

(ii) Which statement correctly describes the amplitude of the oscillations in Figure 2?

(1)

☒ **A** The amplitude is constant.

☒ **B** The amplitude decreases then increases.

☒ **C** The amplitude increases then decreases.

☒ **D** The amplitude gradually decreases.

(b) A learner uses a different pendulum.

The time for one complete oscillation (T) is 5.0 seconds.

Calculate the frequency (f).

Use the equation: f = 1/T

(2)

frequency = ... Hz

(Total for Question 1 = 4 marks)

2 (a) Figure 3 shows the emission spectra of four elements, W, X, Y and Z.

The emission spectrum of an unknown substance is also shown in Figure 3.

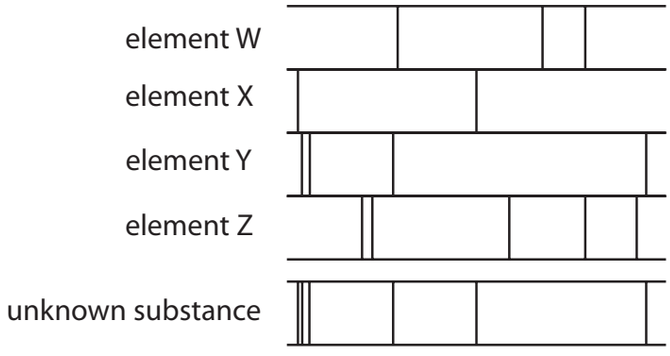

Figure 3

Identify the elements contained in the unknown substance.

(1)

☒ **A** W and X

☒ **B** W and Y

☒ **C** X and Y

☒ **D** X and Z

(b) A hydrogen lamp contains hydrogen atoms.

Light from the hydrogen lamp is used to produce an emission spectrum.

Figure 4 shows the visible part of the emission spectrum for hydrogen.

The emission spectrum is a set of coloured lines on a black background.

Each coloured line has a specific frequency.

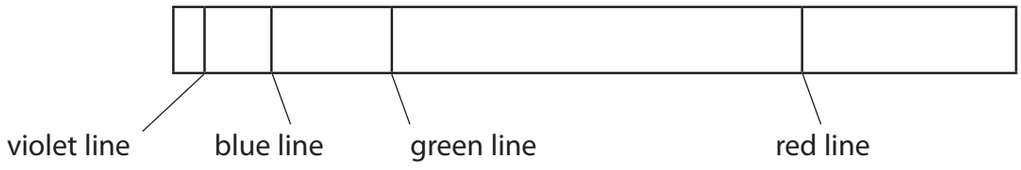

Figure 4

Explain why hydrogen atoms only produce light of specific frequencies.

You may include diagrams to support your answer.

(3)

(c) Describe how a diffraction grating affects the light from a hydrogen lamp.

(2)

.....

.....

.....

.....

(d) The red line in the hydrogen emission spectrum has a wavelength of 656 nm.

The speed of light is $3.00 \times 10^8\,ms^{-1}$.

Calculate the frequency of the red line in the hydrogen emission spectrum.

Use the equation: $v = f\lambda$

(4)

frequency of the red line = ... Hz

(Total for Question 2 = 10 marks)

3 Many cars have rain sensors attached to the windscreen.

Rain sensors automatically switch on the car's windscreen wipers when it rains.

The rain sensor consists of a light source and a light detector.

Figure 5 shows light travelling from the light source to the light detector.

When the light reaches the light detector, the windscreen wiper does not turn on.

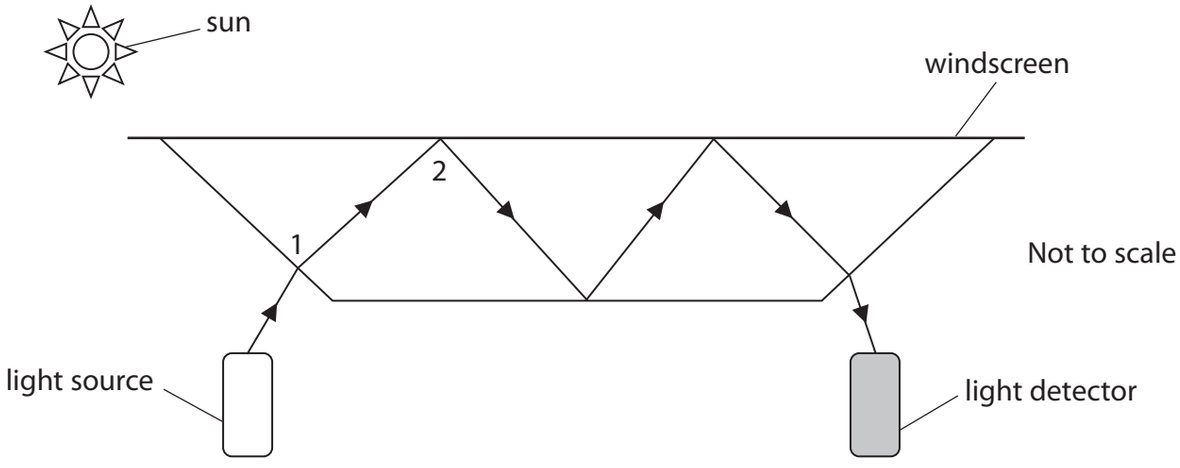

Figure 5

(a) (i) Name the effect that occurs to the light at point 1 in Figure 5.

(1)

.....

(ii) Name the effect that occurs to the light at point 2 in Figure 5.

(1)

.....

(b) Figure 6 shows what happens to the ray of light when there is a raindrop on the windscreen.

The raindrop increases the critical angle of the light from 42° to 62°.

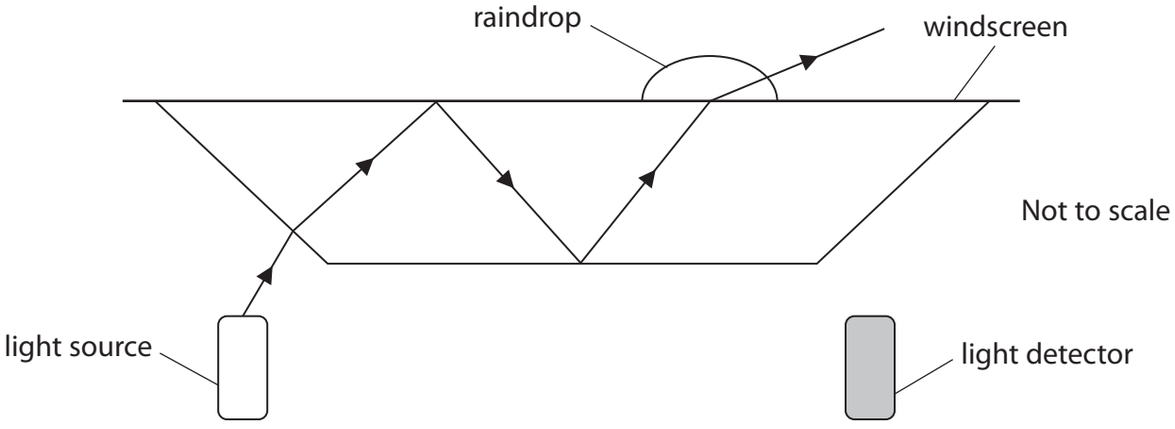

Figure 6

Explain why the windscreen wiper turns on when a raindrop falls on the windscreen.

(3)

(Total for Question 3 = 5 marks)

4 Analogue and digital electronic signals are used for communication.

(a) Sketch a graph of an **analogue** signal.

(2)

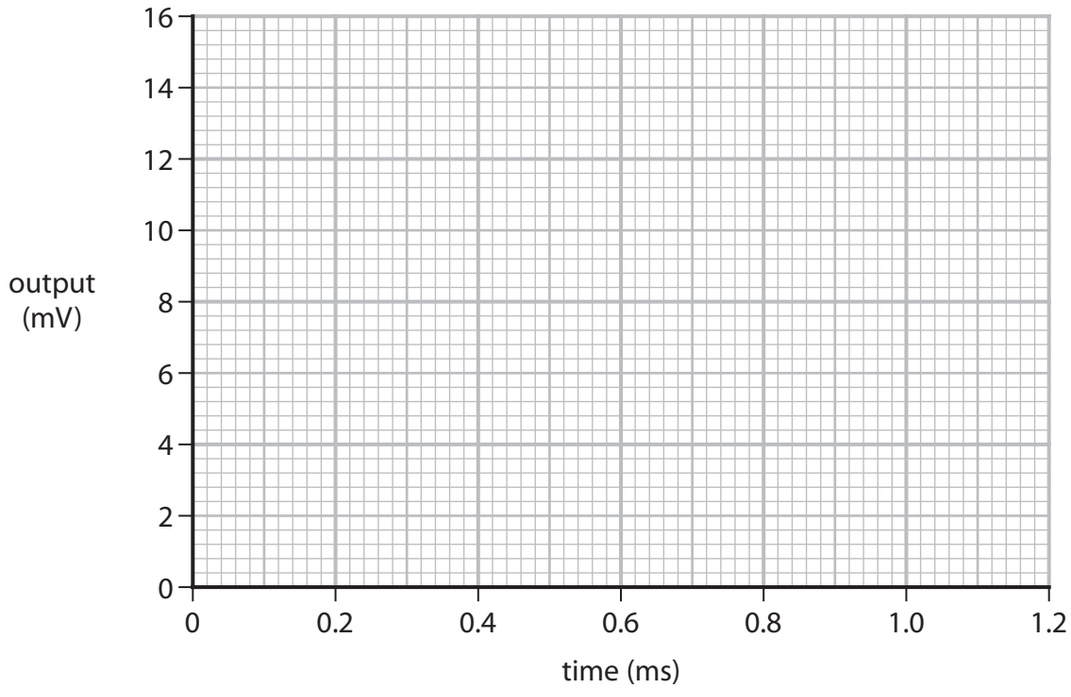

Figure 7

(b) Explain **one** advantage of using electronic digital signals instead of using analogue signals for communication.

(2)

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.....

(c) Figure 8 shows a series of digital pulses.

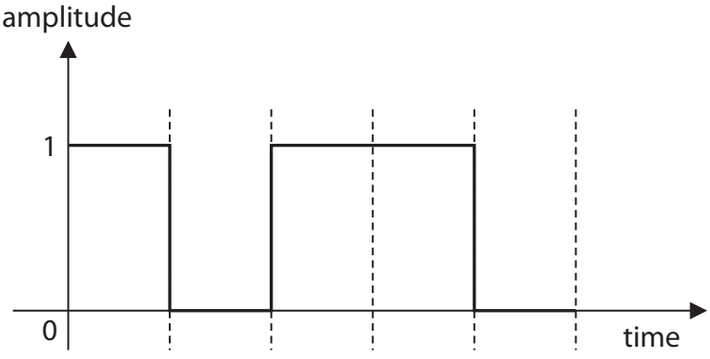

Figure 8

Identify the correct coding for this series of pulses.

(1)

☒ **A** 01001

☒ **B** 01011

☒ **C** 10100

☒ **D** 10110

(Total for Question 4 = 5 marks)

5 Infrared and Bluetooth© are both used for short range wireless communication.

Compare the similarities and differences of the waves produced by infrared and Bluetooth© devices.

(6)

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(Total for Question 5 = 6 marks)

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

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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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