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Candidate surname

Other names

**Pearson BTEC  
Level 3  
Nationals  
Certificate**

Centre Number

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Learner Registration Number

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**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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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.

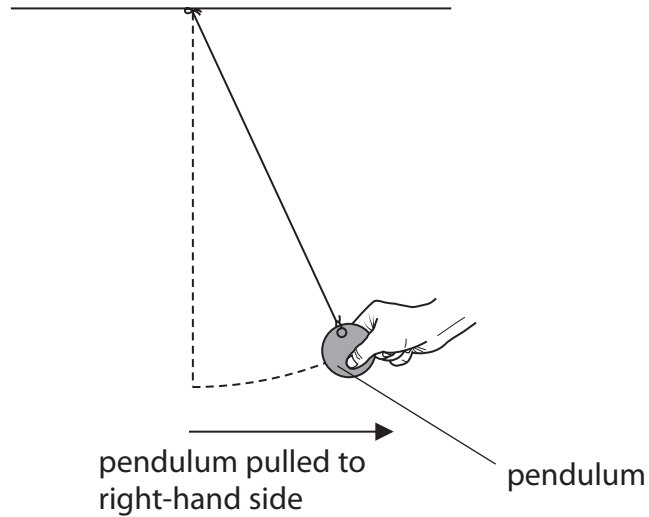


Figure 1

The pendulum is released and starts to swing.

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

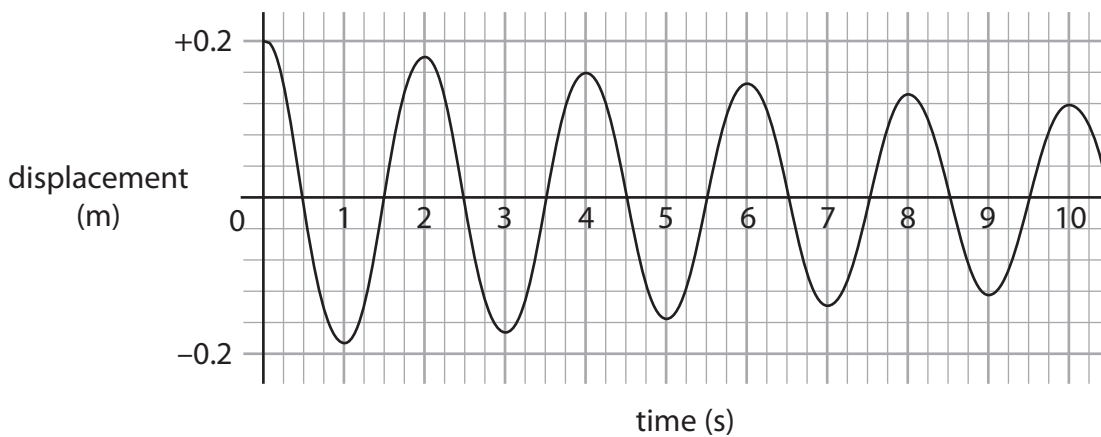


Figure 2



(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)

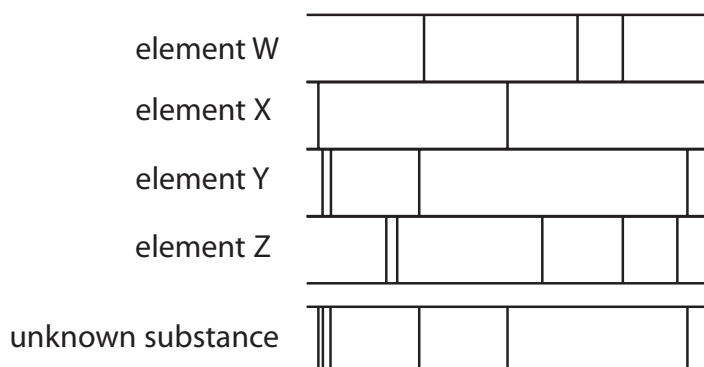
frequency = ..... Hz

**(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



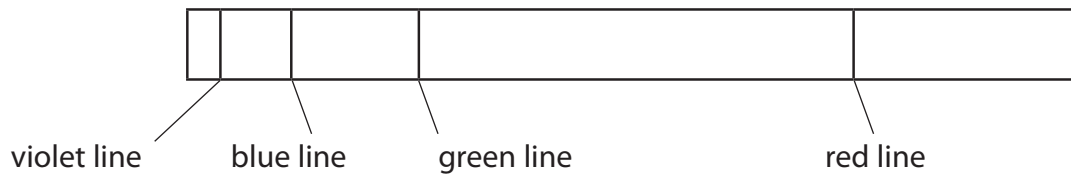
(b) A hydrogen lamp contains hydrogen atoms.

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  $3.00 \times 10^8 \text{ ms}^{-1}$ .

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)**



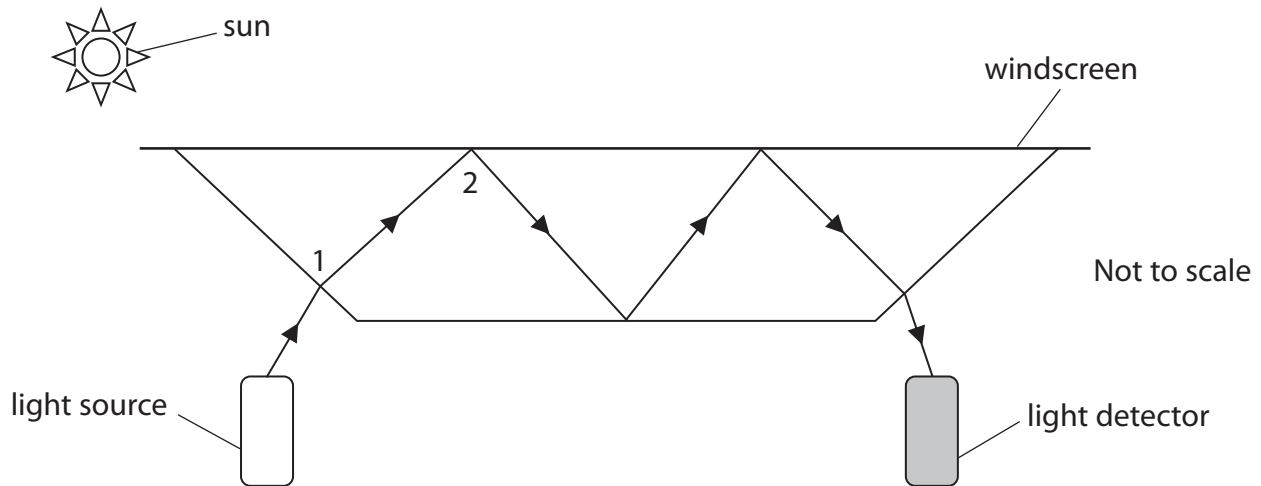
3 Many cars have rain sensors attached to the windscreen.

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.



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**Figure 5**

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

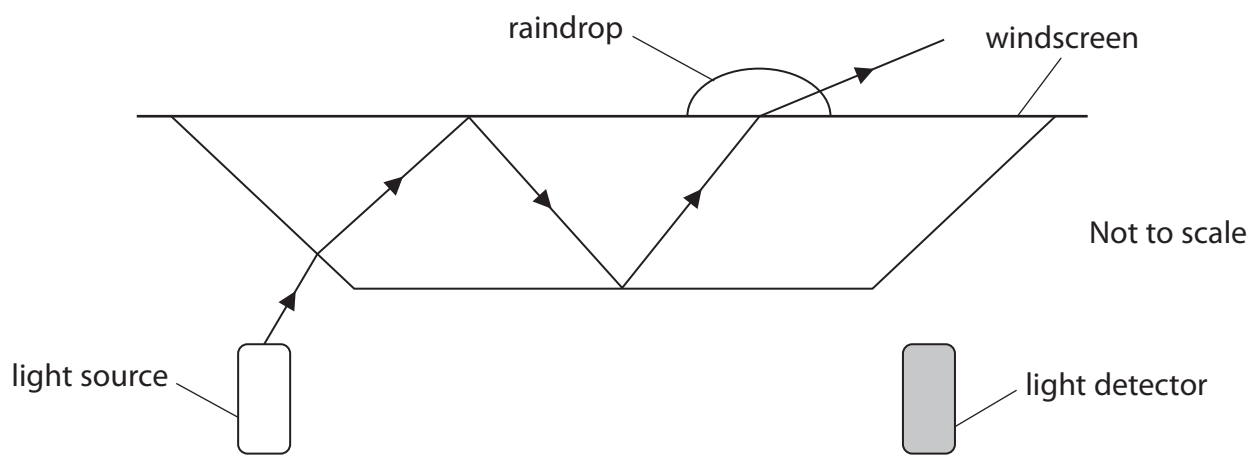
(1)

(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  $42^\circ$  to  $62^\circ$ .



**Figure 6**

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

(3)

**(Total for Question 3 = 5 marks)**





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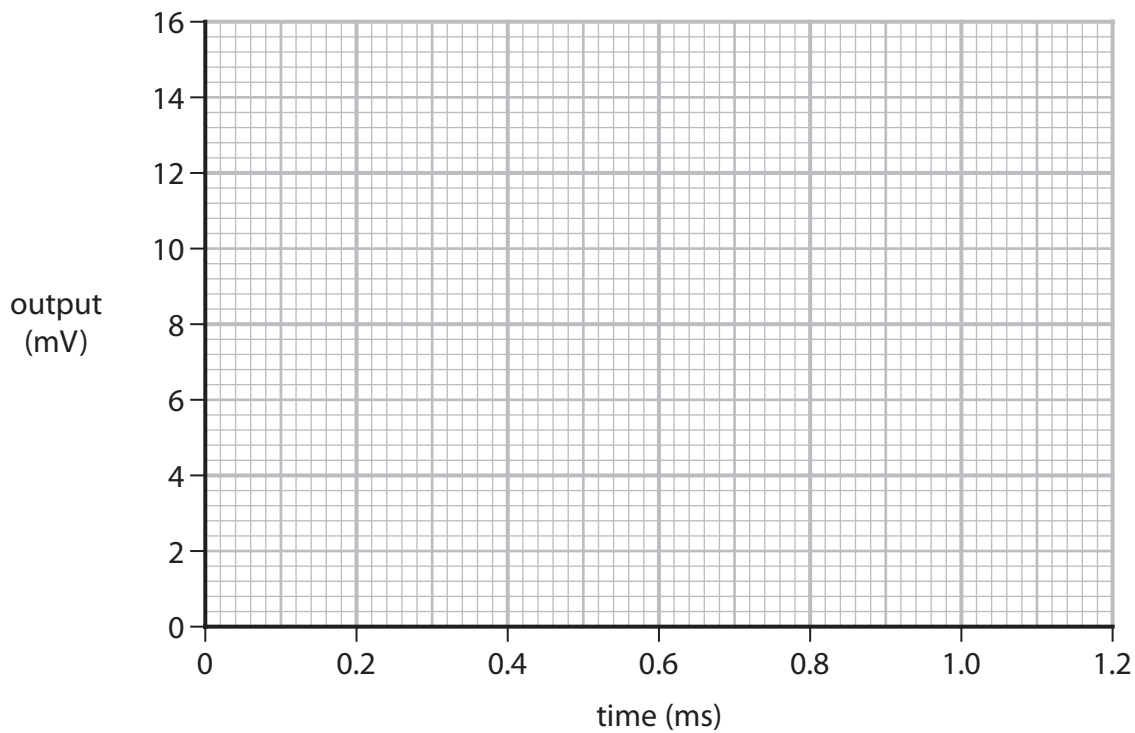
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4 Analogue and digital electronic signals are used for communication.

(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)

.....

.....

.....

.....



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

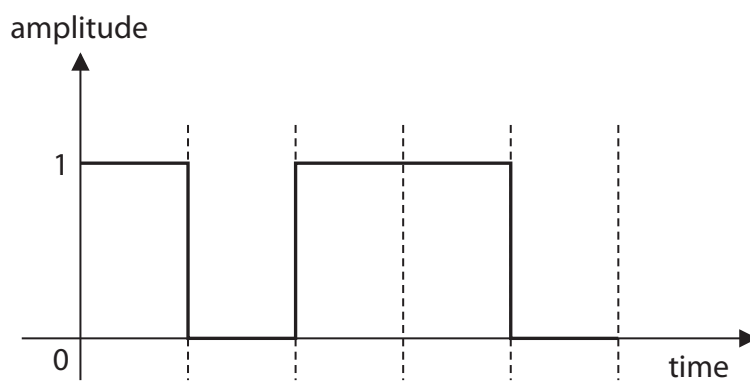


Figure 8

Identify the correct coding for this series of pulses.

(1)

- A 01001
- B 01011
- C 10100
- D 10110

(Total for Question 4 = 5 marks)



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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)

Area with horizontal dotted lines for writing the answer.



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(Total for Question 5 = 6 marks)

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



## 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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