

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson BTEC Level 3  
Nationals Certificate,  
Extended Certificate,  
Foundation Diploma,  
Diploma, Extended  
Diploma

Centre Number

--	--	--	--	--	--	--

Learner Registration Number

--	--	--	--	--	--	--	--	--	--

**Wednesday 13 January 2021**

Afternoon (Time: 40 minutes)

Paper Reference **31617H/1P**

**Applied Science/ Forensic and  
Criminal Investigation**

**Unit 1: Principles and Applications of Science I**

**Physics**

**SECTION C: WAVES IN COMMUNICATION**

**You must have:**

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: Structures 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 ►

P67505A

©2021 Pearson Education Ltd.

1/1/1/1/1/1/1/1/1



  
**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 An earthquake produces both longitudinal and transverse waves.

(a) (i) Figure 1 is a diagram of the particles in a longitudinal wave.

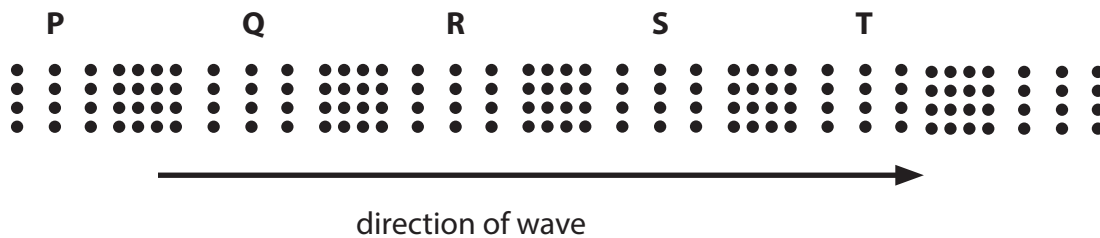


Figure 1

Which of these pairs of letters gives the wavelength of this wave?

(1)

- A PQ
- B PR
- C PS
- D PT

(ii) Complete Sentence 1 to describe a longitudinal wave.

(1)

A longitudinal wave consists of a series of compressions  
and .....

Sentence 1

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

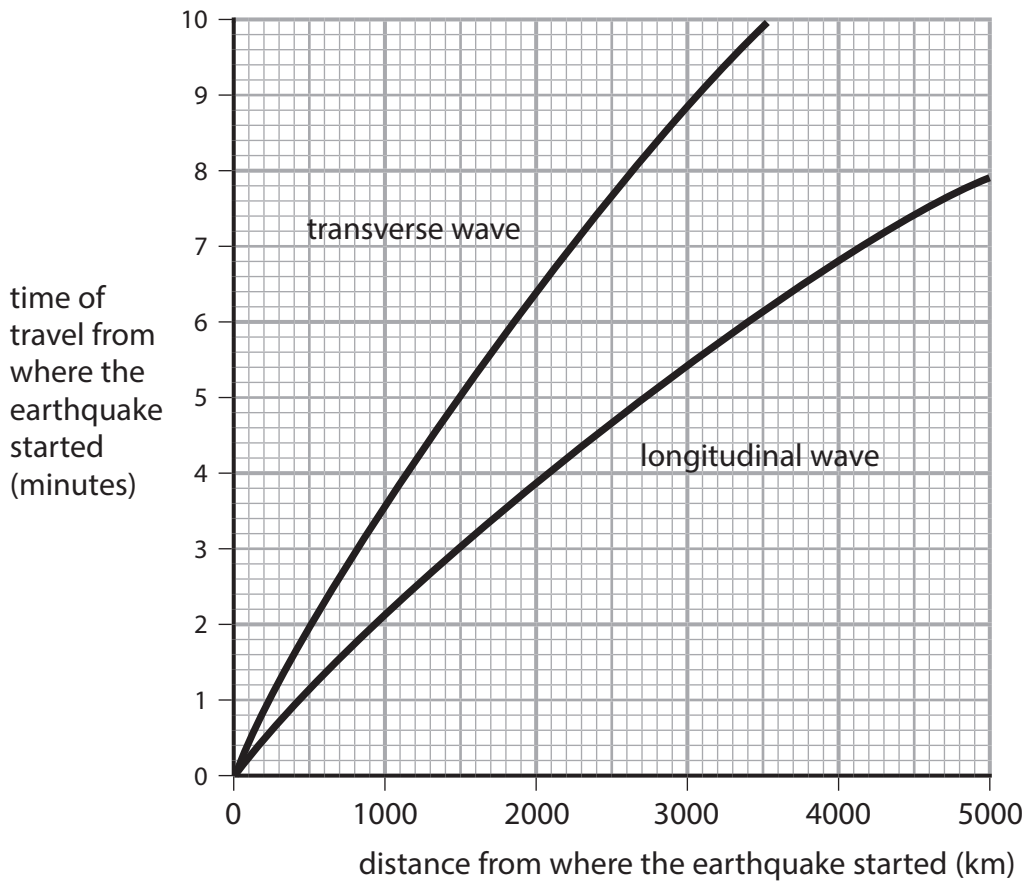
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(b) Figure 2 shows the time taken for the earthquake waves to travel through the Earth from where the earthquake started.



**Figure 2**

(i) Give, using Figure 2, the time taken for the longitudinal wave to travel 4000 km from where the earthquake started.

(1)

time = ..... minutes



(ii) The transverse wave travels 6000 km in a time of 1010 s.

Calculate the speed of the transverse wave in  $\text{km s}^{-1}$ .

(2)

Use the equation:

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

Show your working.

speed of transverse wave = .....  $\text{km s}^{-1}$

**(Total for Question 1 = 5 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



2 Figure 3 shows a stationary wave on a wire.



Figure 3

(a) Describe **how** the stationary wave is produced on the wire.

(3)

.....

.....

.....

.....

.....

.....

(b) Identify the number of nodes on the stationary wave shown in Figure 3.

(1)

- A 2
- B 3
- C 4
- D 5



(c) The speed ( $v$ ) of the wave on the wire is  $60.1 \text{ m s}^{-1}$ .

The mass per unit length ( $\mu$ ) of the wire is  $0.0056 \text{ kg m}^{-1}$ .

Calculate the tension ( $T$ ) in the wire.

(4)

Use the equation:

$$v = \sqrt{\frac{T}{\mu}}$$

Show your working.

tension in the wire = ..... N

**(Total for Question 2 = 8 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**



3 The regions of the electromagnetic spectrum are arranged in order of frequency.

(a) Identify the correct statement about the frequency of the electromagnetic spectrum regions.

(1)

- A Infrared has a lower frequency than microwaves.
- B Infrared has a higher frequency than visible light.
- C Microwaves have a higher frequency than radio waves.
- D Microwaves have a higher frequency than visible light.

(b) Bluetooth® devices use short wavelength, high frequency radio signals.

Give **two other** features of Bluetooth® signals.

(2)

1 .....

.....

2 .....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



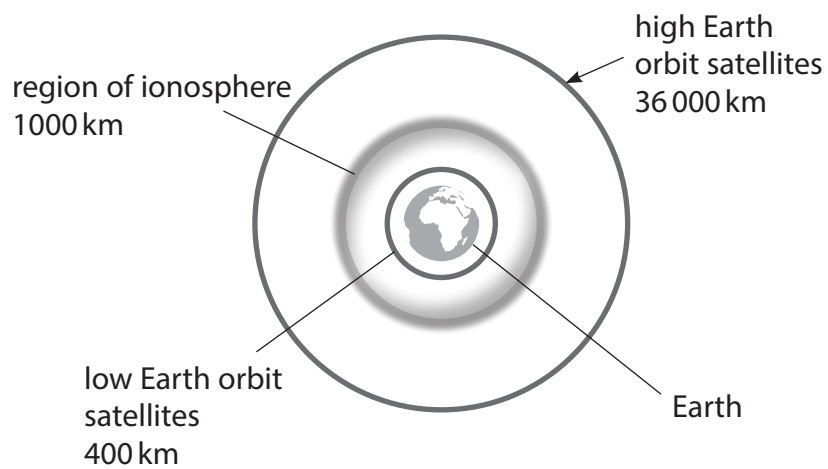


(c) Figure 4 shows the positions of two satellites in orbit around the Earth.

Low Earth orbit satellites orbit about 400 km above the Earth.

High Earth orbit satellites orbit about 36 000 km above the Earth.

The region of ionosphere is about 1000 km above the Earth.



**Figure 4 - not to scale**

Explain why radio waves can be used for low Earth orbit satellite communication but cannot be used for high Earth orbit satellite communication.

(2)

.....

.....

.....

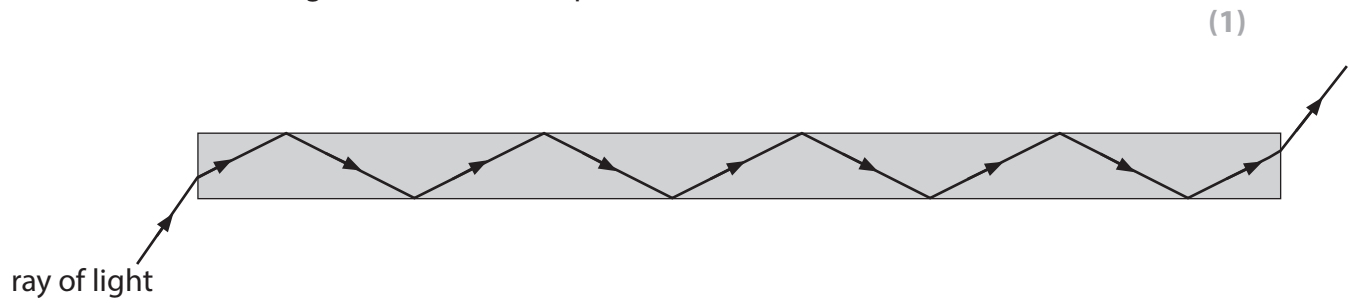
.....

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



4 Figure 5 shows a ray of light entering, travelling through and leaving an optical fibre.

(a) Add **one** X to Figure 5 to show **one** point of total internal reflection.



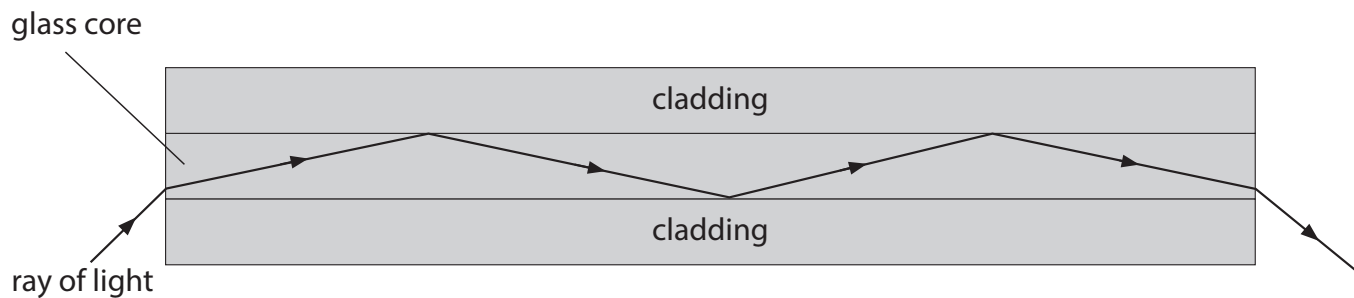
**Figure 5**

(b) Figure 6 shows a ray of light travelling along another optical fibre.

The optical fibre has a glass core.

Cladding surrounds the glass core.

The cladding has a smaller refractive index than the glass core but a higher refractive index than air.



**Figure 6**

Explain how the cladding affects the loss of energy from the ray of light travelling along the optical fibre.

(3)

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(c) Explain why broadband uses multiplexing to send data through fibre optic cables. (2)

.....

.....

.....

.....

**(Total for Question 4 = 6 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



5 Diffraction gratings can be used to produce emission spectra.

Figure 7 shows some apparatus used to produce an emission spectrum.



**Figure 7 – not to scale**

Light from the sodium lamp passes through the diffraction grating.

The light makes a pattern of bright lines on the dark screen.

Discuss how this pattern of bright lines is produced.

(6)

You may add to Figure 7 to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

.....

.....

.....

.....

.....

**(Total for Question 5 = 6 marks)**

**TOTAL FOR SECTION C = 30 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

$$I = \frac{k}{r^2}$$

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**



P 6 7 5 0 5 A 0 1 5 1 6



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**

