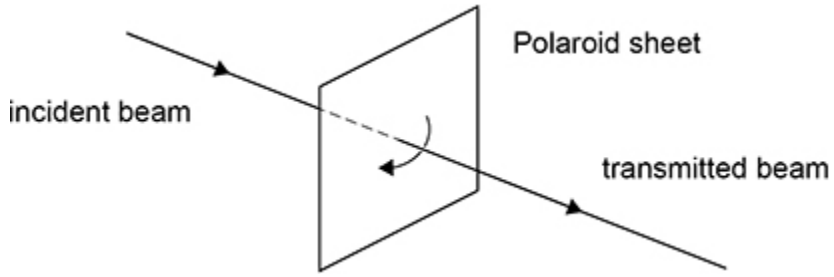
A-Level Physics

Progressive and Stationary Waves (Multiple Choice)

Question Paper

Time available: 23 minutes
Marks available: 21 marks

1. A narrow beam of light is incident on a sheet of Polaroid material. The intensity of the transmitted beam is a maximum.



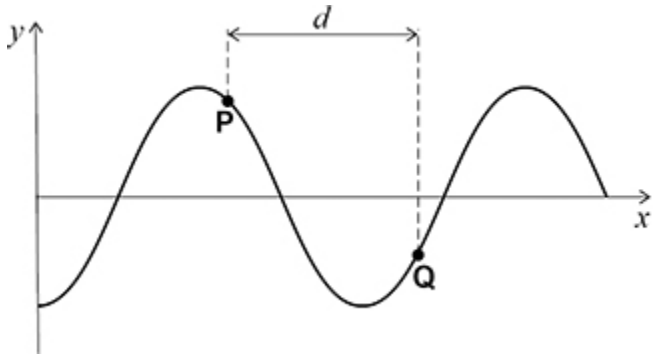
The Polaroid sheet is rotated about the beam by 90° and the intensity of the transmitted beam decreases to zero.

Which row explains this observation?

	Nature of incident beam	Action of Polaroid material as it is rotated	
A	unpolarised	polarises the incident beam	⬭
B	unpolarised	absorbs the incident beam	⬭
C	polarised	absorbs the incident beam	⬭
D	polarised	changes the plane of polarisation of the incident beam	⬭

(Total 1 mark)

2. Two points **P** and **Q** on a progressive wave are separated by distance d.



The phase difference between **P** and **Q** is θ rad.

What is the wavelength?

A $\frac{\theta d}{2\pi}$ ⬭

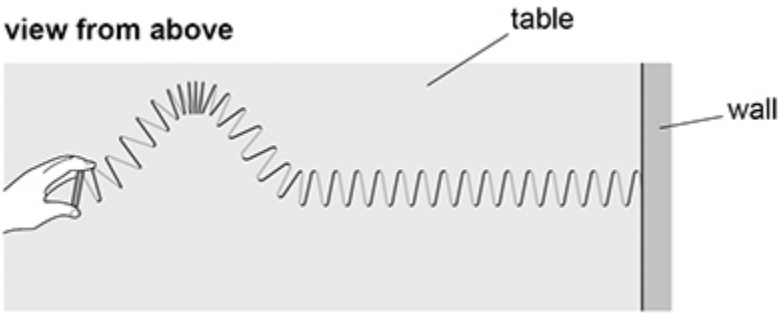
B θd ⬭

C $\frac{2\pi d}{\theta}$ ⬭

D $\frac{d}{\theta}$ ⬭

(Total 1 mark)

3. A long spring is used to demonstrate wave motion. The spring lies horizontally on a table. One end of the spring is attached to a wall.



The free end of the spring is quickly moved to one side and then back to the centre, creating a pulse.

This movement takes 0.40 s.

The pulse travels 4.0 m along the spring in a time of 2.0 s.

What is the length of the pulse?

A 0.8 m ⬭

B 1.6 m ⬭

C 2.0 m ⬭

D 10.0 m ⬭

(Total 1 mark)

4. A stretched wire vibrates between two fixed points.

The frequency of the first harmonic of the vibrating wire is 300 Hz.

Without making any other change, the tension in the wire is doubled.

What is the frequency of the new first harmonic of the wire?

A 150 Hz ⬭

B 420 Hz ⬭

C 600 Hz ⬭

D 1200 Hz ⬭

(Total 1 mark)

5. A stationary wave forms on a uniform string.

Which statement is correct?

A The amplitude of oscillations is a maximum at the nodes. ⬭

B The distance between two adjacent nodes equals one wavelength. ⬭

C The oscillations at two adjacent antinodes are in antiphase. ⬭

D The time period of oscillating sections varies along the string. ⬭

(Total 1 mark)

6. A longitudinal wave of frequency $660\ \text{Hz}$ travels through a medium.
The wave speed is $330\ \text{m s}^{-1}$.

Which statement describes the motion of a particle in the wave?

A It is travelling at a speed of $330\ \text{m s}^{-1}$. ⬭

B It moves in phase with a particle in the wave $25\ \text{cm}$ away. ⬭

C It oscillates with a time period of $1.5\ \text{ms}$. ⬭

D It changes direction 660 times every second. ⬭

(Total 1 mark)

7. The diagram shows a stationary wave on a string at one instant in time.

P, **Q** and **R** are three points on the string.

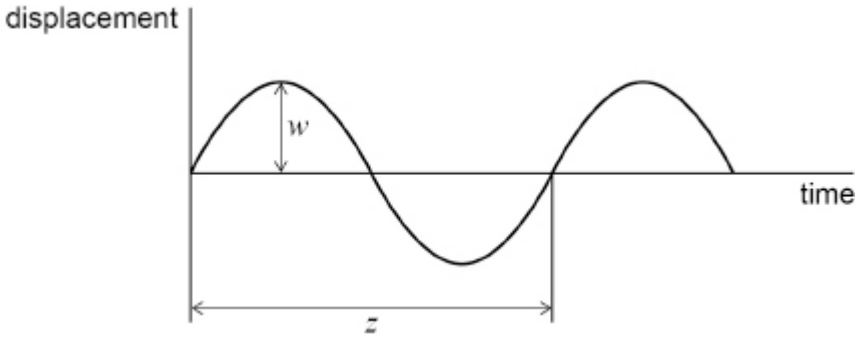
Which row is correct?

A	**P** is in antiphase with **R**	**P** has the same amplitude as **Q**	⬭
B	**P** is out of phase with **R**	**P** has the same amplitude as **R**	⬭
C	**P** is in phase with **Q**	**P** has the same amplitude as **R**	⬭
D	**P** is out of phase with **Q**	**P** has a smaller amplitude than **R**	⬭

(Total 1 mark)

8. A wave travels along a water surface.

The variation with time of the displacement of a water particle at the surface is shown.

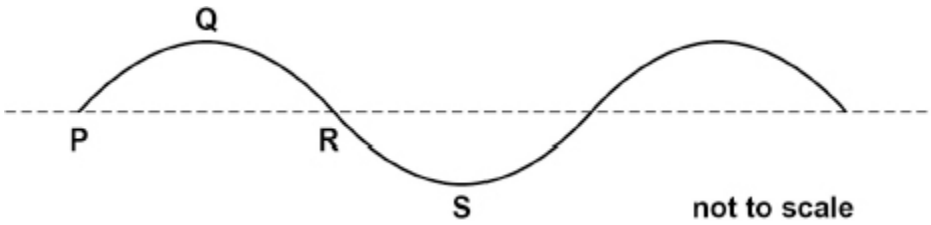


What properties of the wave are represented by *w* and *z*?

	w	***z***	
A	phase	frequency	⬭
B	amplitude	wavelength	⬭
C	wavelength	phase	⬭
D	amplitude	period	⬭

(Total 1 mark)

9. The diagram shows the cross-section of a progressive transverse wave travelling at 24 cm s^{-1} on water. The amplitude of the wave is 2.0 cm and the frequency is 4.0 Hz.



Which statement is correct?

A The phase difference between particles at **P** and **S** is $\frac{\pi}{2}$ rad. ⬭

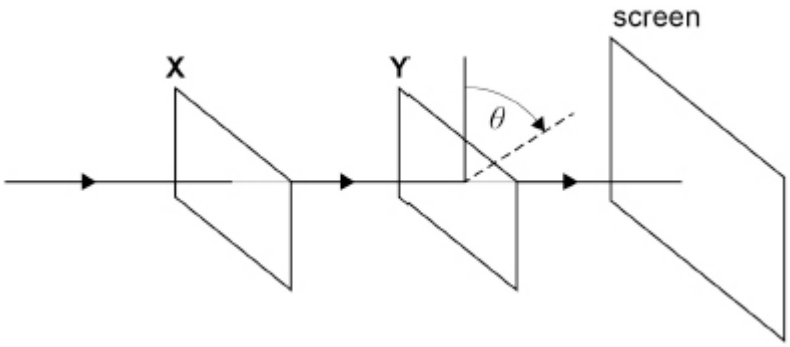
B The distance between **P** and **R** is 6.0 cm. ⬭

C The particle velocity at **Q** is a maximum. ⬭

D Particles at **P** and **R** are in phase. ⬭

(Total 1 mark)

10. Unpolarised light travels through two polarising filters **X** and **Y** and is then incident on a screen. When **X** and **Y** are arranged as shown, there is a maximum intensity on the screen.
X is held stationary but **Y** is rotated in a plane at right angles to the beam so that θ increases.



What are the next three values of θ, in rad, for which the beam hits the screen with maximum intensity?

A $\frac{\pi}{2}, \frac{2\pi}{2}, \frac{3\pi}{2}$ ⬭

B $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}$ ⬭

C $\pi, 2\pi, 3\pi$ ⬭

D $2\pi, 4\pi, 6\pi$ ⬭

(Total 1 mark)

11. The frequency of the first harmonic of a wire fixed at both ends is 300 Hz.
The tension in the wire is now doubled.

What is the frequency of the first harmonic after this change?

A 150 Hz ⬭

B 210 Hz ⬭

C 420 Hz ⬭

D 600 Hz ⬭

(Total 1 mark)

12. Which row correctly shows electromagnetic radiations in order of decreasing wavelength?

A gamma > ultraviolet > microwave ⬭

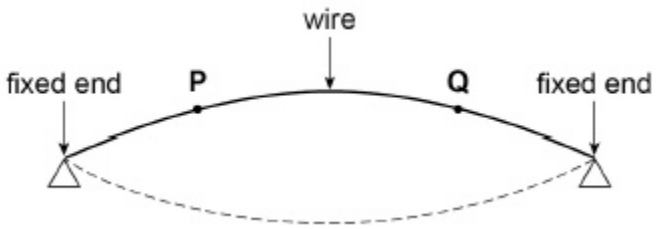
B ultraviolet > gamma > microwave ⬭

C microwave > ultraviolet > gamma ⬭

D gamma > microwave > ultraviolet ⬭

(Total 1 mark)

13. A uniform wire, fixed at both ends, is plucked in the middle so that it vibrates at the first harmonic as shown.



What is the phase difference between the oscillations of the particles at **P** and **Q**?

A zero ⬭

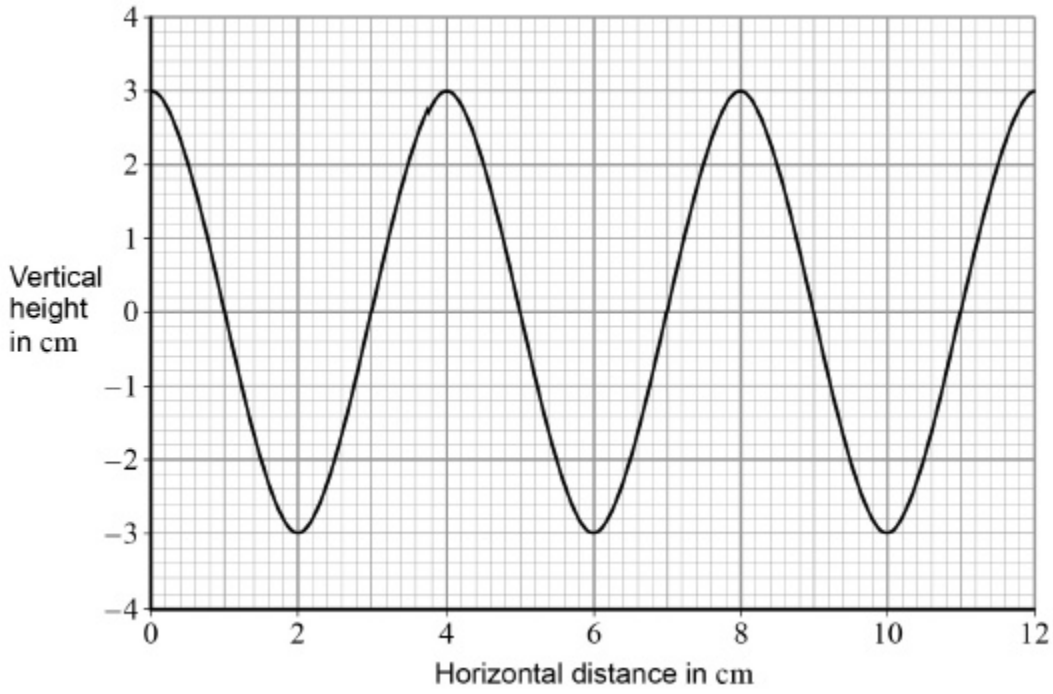
B $\frac{\pi}{4}$ rad ⬭

C $\frac{\pi}{2}$ rad ⬭

D $\frac{3\pi}{4}$ rad ⬭

(Total 1 mark)

14. The graph shows how the vertical height of a travelling wave varies with distance along the path of the wave.



The speed of the wave is 20 cm s^{-1}.

What is the period of the wave?

A 0.1 s ⬭

B 0.2 s ⬭

C 5.0 s ⬭

D 10.0 s ⬭

(Total 1 mark)

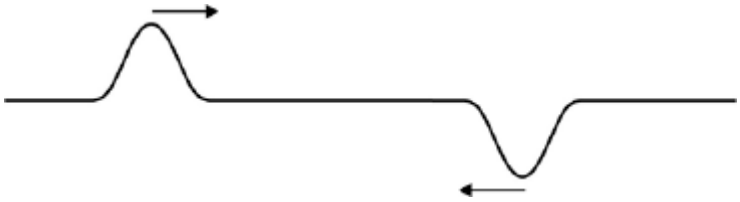
15. What is the correct order of increasing photon energy in the electromagnetic spectrum?

1 is least energy, 4 is greatest energy.

	Radio waves	γ rays	Visible light	Infrared	
A	1	4	3	2	⬭
B	4	1	2	3	⬭
C	1	4	2	3	⬭
D	4	1	3	2	⬭

(Total 1 mark)

16. The diagram shows two pulses on a string travelling towards each other.

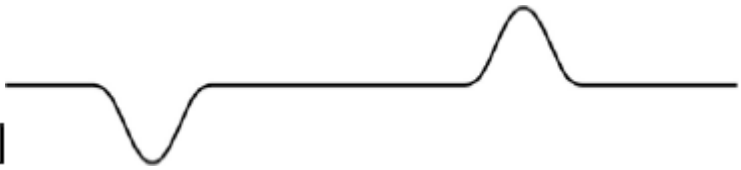


Which of the following diagrams shows the shape of the string when the pulses have passed through each other?

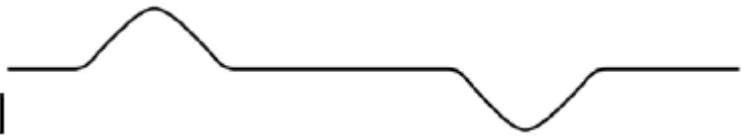
A ⬭

B ⬭

C ⬭



D ⬭



(Total 1 mark)

17. Stationary waves are set up on a length of rope fixed at both ends. Which one of the following statements is true?

A Between adjacent nodes, particles of the rope vibrate in phase with each other.

B The mid point of the rope is always stationary.

C Nodes need not necessarily be present at each end of the rope.

D Particles of the rope at adjacent antinodes always move in the same direction.

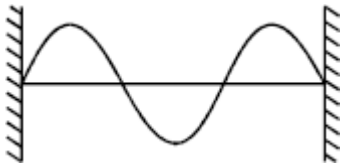
(Total 1 mark)

18. Which line, **A** to **D**, in the table gives a correct difference between a progressive wave and a stationary wave?

	progressive wave	**stationary wave**
A	all the particles vibrate	some of the particles do not vibrate
B	none of the particles vibrate with the same amplitude	all the particles vibrate with the same amplitude
C	all the particles vibrate in phase with each other	none of the particles vibrate in phase with each other
D	some of the particles do not vibrate	all the particles vibrate in phase with each other

(Total 1 mark)

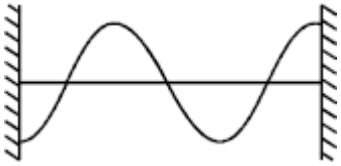
19.



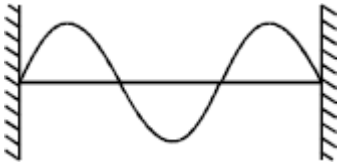
frequency of vibration = 50 Hz

The diagram above shows a stationary wave on a stretched string at a time $t = 0$. Which one of the diagrams, **A** to **D**, correctly shows the position of the string at a time $t = 0.010$ s?

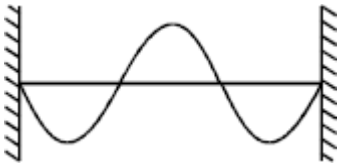
A



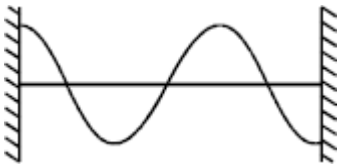
B



C



D



(Total 1 mark)

20. Which one of the following statements about stationary waves is true?

A Particles between adjacent nodes all have the same amplitude.

B Particles between adjacent nodes are out of phase with each other.

C Particles immediately on either side of a node are moving in opposite directions.

D There is minimum disturbance of the medium at an antinode.

(Total 1 mark)