Wave Properties and Stationary Waves (MCQ Only)

Q1.

A string is held under tension. When it is plucked it vibrates with a frequency *f*.

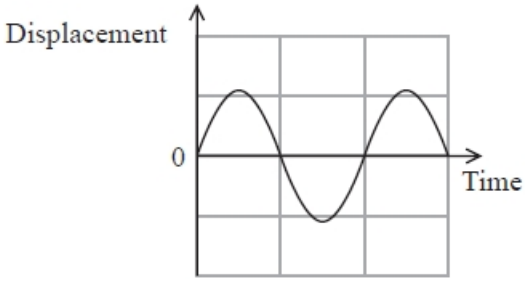
Which of the following would result in a lower value for *f* ?

- ☒ **A** decreasing the cross-sectional area of the string
- ☒ **B** decreasing the density of the material of the string
- ☒ **C** increasing the length of the string
- ☒ **D** increasing the tension

(Total for question = 1 mark)

Q2.

A displacement-time graph is shown for a particle in a transverse wave.



Which property of the wave **cannot** be determined directly from the displacement-time graph?

- ☒ **A** amplitude
- ☒ **B** frequency
- ☒ **C** time period
- ☒ **D** wavelength

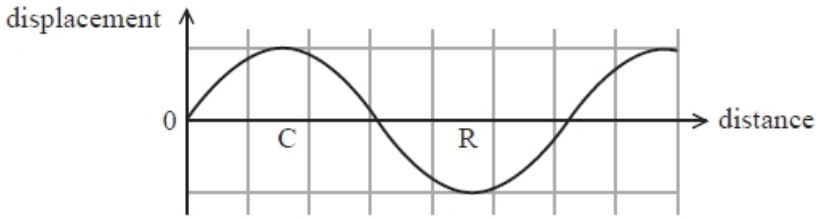
(Total for question = 1 mark)

Q3.

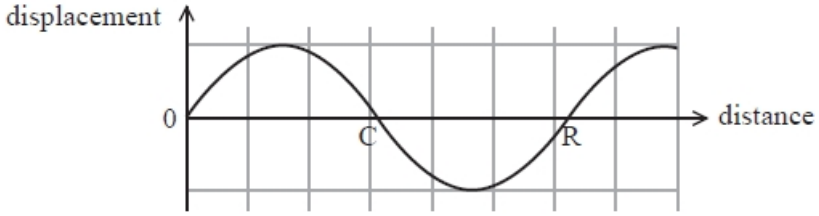
A longitudinal wave is represented on a displacement-distance graph. A positive displacement on the graph indicates a displacement to the right.

Which graph shows the correct labelling of possible positions of a compression, C, and a rarefaction, R?

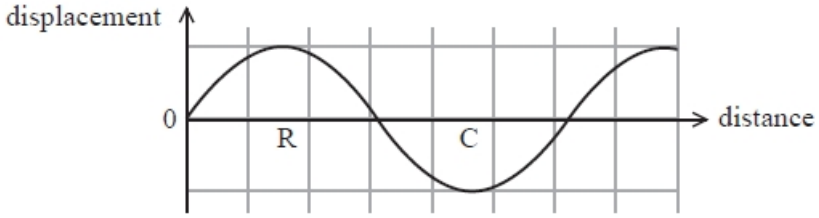
A



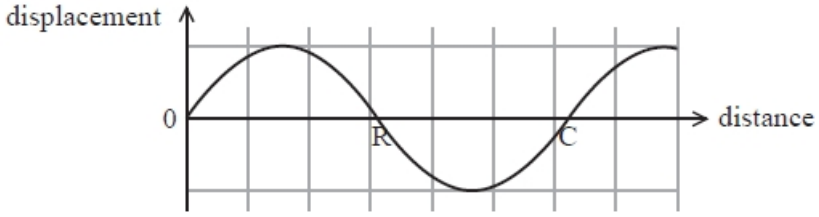
B



C



D



- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

(Total for question = 1 mark)

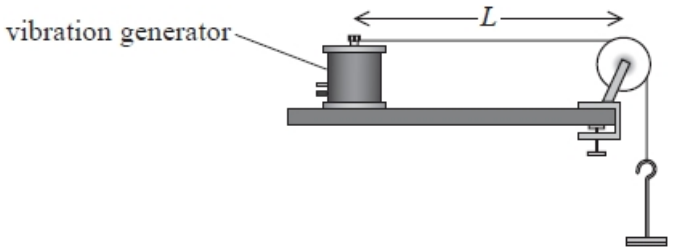
Q4.

The speed v of a transverse wave on a string is given by

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

where μ is the mass per unit length of the string and T is the tension in the string.

A fixed length L of string is connected to a vibration generator and held under tension T as shown. The frequency of the vibration generator is varied until, at a frequency f, a standing wave with one antinode is observed. T is increased and the procedure is repeated.



Which of the following describes the variation in f as T increases?

☒ **A** decreases linearly

☒ **B** decreases non-linearly

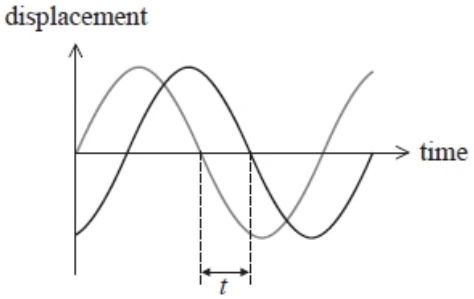
☒ **C** increases linearly

☒ **D** increases non-linearly

(Total for question = 1 mark)

Q5.

Displacement-time graphs are shown for two waves, each of frequency f and period T.



The phase difference in radians between the two waves is given by

(1)

☒ **A** $\frac{2\pi t}{T}$

☒ **B** $\frac{\pi t}{T}$

☒ **C** $\frac{2\pi t}{f}$

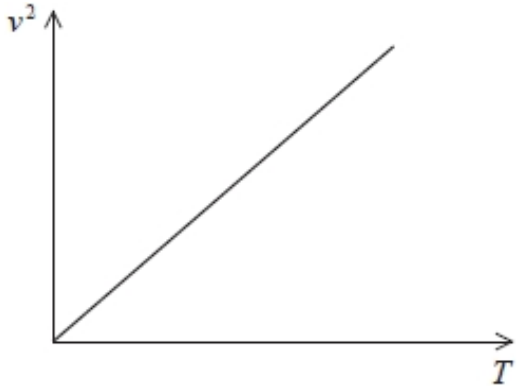
☒ **D** $\frac{\pi t}{f}$

(Total for question = 1 mark)

Q6.

This question refers to an experiment to investigate stationary waves on a string.

Corresponding values of v^2 against T are plotted. A straight line graph is obtained, as shown.



Which of the following expressions for the mass per unit length μ of the string is correct?

☒ **A** $\mu = \text{gradient}$

☒ **B** $\mu = \sqrt{\text{gradient}}$

☒ **C** $\mu = \frac{1}{\text{gradient}}$

☒ **D** $\mu = \frac{1}{\sqrt{\text{gradient}}}$

(Total for question = 1 mark)

Q7.

A beam of light from a torch with power *P* is shone onto a surface. The light is spread over a circular area with a radius *r*.

Which of the following gives the intensity of the light on the surface?

☒ **A** $P \times 4\pi r^2$

☒ **B** $\frac{P}{4\pi r^2}$

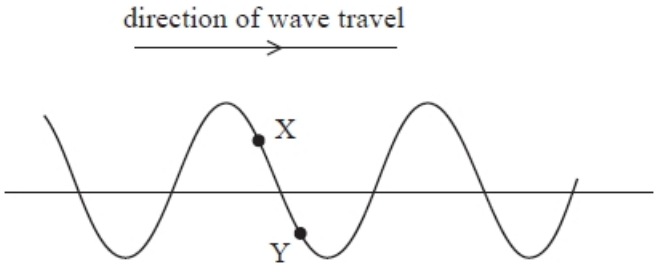
☒ **C** $P \times \pi r^2$

☒ **D** $\frac{P}{\pi r^2}$

(Total for question = 1 mark)

Q8.

The diagram shows the position of two particles, X and Y, on a transverse wave.
The wave is travelling from left to right.



Which of the following describes the directions in which the particles at X and Y are moving at the instant shown?

	Particle X	Particle Y
☒ **A**	down	down
☒ **B**	down	up
☒ **C**	up	down
☒ **D**	up	up

(Total for question = 1 mark)

Q9.

Which of the following wave properties demonstrates that electromagnetic waves must be transverse?

- ☒ **A** diffraction
- ☒ **B** interference
- ☒ **C** polarisation
- ☒ **D** refraction

(Total for question = 1 mark)

Q10.

Which of the following statements about standing waves is **not** true?

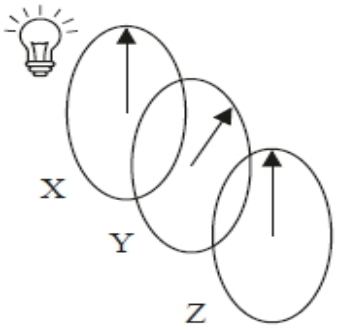
- ☒ **A** Particles between adjacent nodes oscillate with varying amplitudes.
- ☒ **B** Particles between adjacent nodes are moving in phase with each other.
- ☒ **C** Particles immediately either side of a node are moving in opposite directions.
- ☒ **D** Particles undergo no disturbance at an antinode.

(Total for question = 1 mark)

Q11.

Three polarising filters X, Y and Z, are placed in front of a source of unpolarised light. The planes of polarisation of the filters are initially parallel.

Filter Y is rotated by 45° as shown.



Filter Z is then rotated clockwise and the intensity of light emerging from Z is measured.

Which angle of rotation of Z will result in the lowest intensity of light?

☒ **A** 90°

☒ **B** 135°

☒ **C** 180°

☒ **D** 225°

(Total for question = 1 mark)

Q12.

The speed v of a transverse wave on a string is given by

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

where μ is the mass per unit length of the string and T is the tension in the string.

μ can be calculated from measurements of the mass and length of the string.

The percentage uncertainty in the measurement of mass is 0.4%.
The percentage uncertainty in the measurement of length is 0.05%.

Which of the following is the percentage uncertainty in the calculated value for μ?

☒ **A** 0.4 + 0.05

☒ **B** 0.4 − 0.05

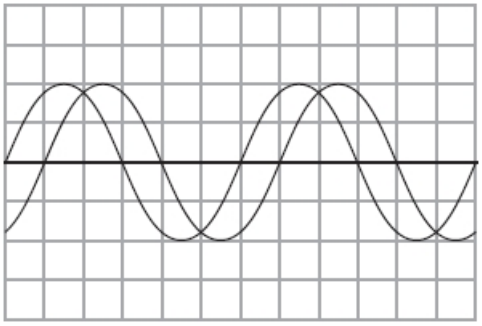
☒ **C** 0.4 × 0.05

☒ **D** 0.4 ÷ 0.05

(Total for question = 1 mark)

Q13.

A two-beam oscilloscope is used to display signals from two microphones as shown.



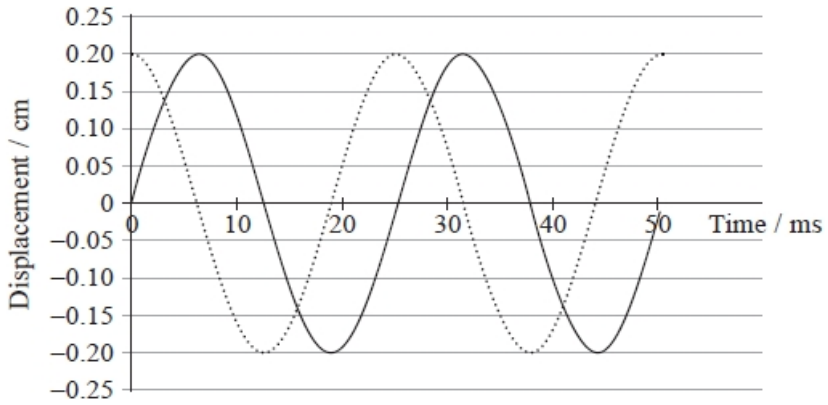
Which of the following could be the phase difference in radians between the traces?

- ☒ **A** $\frac{\pi}{6}$
- ☒ **B** $\frac{\pi}{4}$
- ☒ **C** $\frac{\pi}{3}$
- ☒ **D** $\frac{\pi}{2}$

(Total for question = 1 mark)

Q14.

The graph shows the variation of displacement with time for two waves.



What is the phase difference between these two waves?

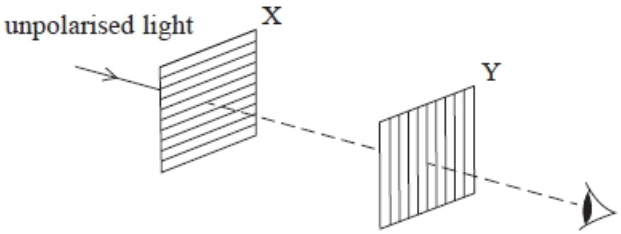
(1)

- ☒ **A** 6 ms
- ☒ **B** 0.20 cm
- ☒ **C** π radians
- ☒ **D** 90 degrees

(Total for question = 1 mark)

Q15.

A source of unpolarised light is viewed through two crossed polarising filters X and Y.



Which row in the table correctly describes the light emerging from the two filters?

(1)

	Light emerging from filter X	Light emerging from filter Y
☒ A	oscillates in every direction	oscillates in one direction
☒ B	oscillates in every direction	no light
☒ C	oscillates in one direction	oscillates in one direction
☒ D	oscillates in one direction	no light

(Total for question = 1 mark)

Q16.

Which of the following statements about waves is **not** correct?

☒ **A** An unpolarised wave may be polarised on reflection from a surface.

☒ **B** Longitudinal waves cannot be plane polarised.

☒ **C** The vibrations in an unpolarised wave are in many directions.

☒ **D** Transverse waves are always plane polarised.

(Total for question = 1 mark)

Q17.

This questions refers to an experiment to investigate stationary waves on a string.

A string of length *l*, fixed at both ends, is placed under tension *T* and plucked. The fundamental frequency *f* of the vibrating string is measured and the speed *v* of the wave on the string is calculated.

Which of the following gives the speed of the wave?

☒ **A** $v = 4fl$

☒ **B** $v = 2fl$

☒ **C** $v = fl$

☒ **D** $v = \frac{fl}{2}$

(Total for question = 1 mark)

Q18.

Two waves have the same amplitude and are travelling in the same medium.

The two waves can produce a standing wave if they

☒ **A** have different frequencies and travel in opposite directions.

☒ **B** have different frequencies and travel in the same direction.

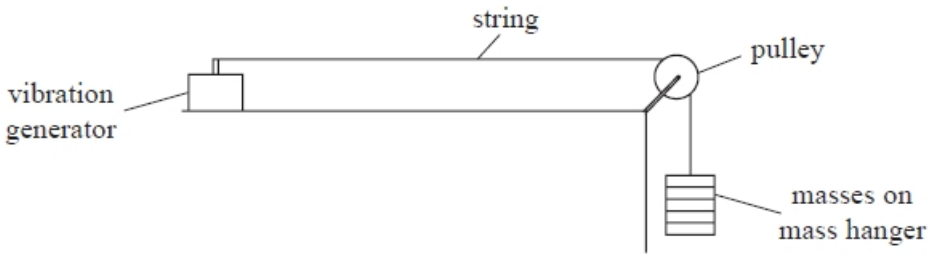
☒ **C** have the same frequency and travel in opposite directions.

☒ **D** have the same frequency and travel in the same direction.

(Total for question = 1 mark)

Q19.

The diagram represents an arrangement used to generate standing waves on a string.



A standing wave pattern with two nodes is obtained as shown.

Which of the following single changes could produce a standing wave pattern with three nodes?

☒ **A** decreasing the distance between the vibration generator and pulley

☒ **B** decreasing the frequency of the vibration generator

☒ **C** decreasing the mass on the mass hanger

☒ **D** decreasing the mass per unit length of the string

(Total for question = 1 mark)

Q20.

Which statement about sound is correct?

(1)

☒ **A** Sound can travel through a solid.
☒ **B** Sound can travel through a vacuum.
☒ **C** Sound waves can travel as polarised waves.
☒ **D** Sound waves travel in a direction perpendicular to the direction of the oscillations.

(Total for question = 1 mark)

Q21.

Which of the following is a correct statement about a stationary wave?

☒ **A** All points on the wave oscillate in phase.

☒ **B** A node is formed at a point of constructive interference.

☒ **C** Stationary waves can only be formed from transverse waves.

☒ **D** Two points $\frac{\lambda}{2}$ apart oscillate with the same amplitude.

(Total for question = 1 mark)

Q22.

Sound waves are produced by a vibrating guitar string.

Which row in the table correctly describes the waves produced?

(1)

	Guitar string	Sound
☒ A	transverse	transverse
☒ B	longitudinal	longitudinal
☒ C	longitudinal	transverse
☒ D	transverse	longitudinal

(Total for question = 1 mark)

Mark Scheme – Wave properties and Stationary Waves (MCQ Only)

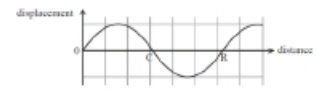
Q1.

Question Number	Answer	Mark
	C increasing the length of the string	1
	Incorrect Answers: A results in a higher value for f B results in a higher value for f D results in a higher value for f	

Q2.

Question Number	Answer	Mark
	D wavelength	1
	Incorrect Answers: A – determined from the maximum displacement on y-axis B – determined from 1/time for one cycle C – determined from the time for one cycle on x-axis	

Q3.

Question Number	Answer	Mark
	B 	1
	Incorrect Answers: A compression and rarefaction both occur at regions of 0 displacement C compression and rarefaction both occur at regions of 0 displacement D compression and rarefaction are labelled the wrong way round with respect to the direction of the positive displacement	

Q4.

Question Number	Answer	Mark
	D – increases non-linearly	1
	Incorrect Answers: A – incorrect as $f \propto \sqrt{T}$ B – incorrect as $f \propto \sqrt{T}$ C – incorrect as $f \propto \sqrt{T}$	

Q5.

Question Number	Answer	Mark
	A $\frac{2\pi t}{T}$	**1**
	Incorrect Answers: B – no factor of 2 C – incorrect substitution of f D – incorrect substitution of f and no factor of 2	

Q6.

Question Number	Answer	Mark
	C - $\mu = \frac{1}{\text{gradient}}$	**1**
	Incorrect Answers: A – incorrect use of $v = \sqrt{\frac{T}{\mu}}$ B – incorrect use of $v = \sqrt{\frac{T}{\mu}}$ D - incorrect use of $v = \sqrt{\frac{T}{\mu}}$	

Q7.

Question Number	Answer	Mark
	D – $\frac{P}{\pi r^2}$	**1**
	Incorrect Answers: A – Incorrect equations B – Incorrect equation for area of a circle C – Incorrect equation	

Q8.

Question Number	Answer	Mark
	D – both are moving up	**1**
	Incorrect Answers: A – incorrect answer B – incorrect answer C – incorrect answer	

Q9.

Question Number	Answer	Additional guidance	Mark
	C	(polarisation)	**(1)**

Q10.

Question Number	Answers	Additional Guidance	Mark
	D	particles undergo no disturbance at an antinode	**(1)**

Q11.

Question Number	Acceptable answer	Additional guidance	Mark
	B	The only correct answer is **B**: light leaving Y is polarised in its plane of polarisation and 135° is perpendicular to the plane of Y, so there will be maximum absorption by filter Z A is not correct because Z is not perpendicular to the plane of Y so some light is transmitted C is not correct because Z is not perpendicular to the plane of Y so some light is transmitted D is not correct because Z is not perpendicular to the plane of Y so some light is transmitted	1

Q12.

Question Number	Answer	Mark
	A 0.4 + 0.05	**1**
	Incorrect Answers: B – compound uncertainties by addition C – compound uncertainties by addition D – compound uncertainties by addition	

Q13.

Question Number	Answer	Mark
	C $\frac{\pi}{3}$	**1**
	Incorrect Answers: **A** – incorrect **B** – incorrect **D** – incorrect	

Q14.

Question Number	Acceptable answers	Additional guidance	Mark
	D 90 degrees		1

Q15.

Question Number	Acceptable answers	Additional guidance	Mark
	D oscillates in one direction, no light		1

Q16.

Question Number	Answer	Mark
	D Transverse waves are always plane polarised.	1
	Incorrect Answers: A – An unpolarised wave may be polarised on reflection from a surface. B – Longitudinal waves cannot be plane polarised. C – The vibrations in an unpolarised wave are in many directions.	

Q17.

Question Number	Answer	Mark
	B - $v = 2fl$	1
	Incorrect Answers: A – wavelength is $2l$ C - wavelength is $2l$ D - wavelength is $2l$	

Q18.

Question Number	Acceptable Answers	Additional Guidance	Mark
	C		1

Q19.

Question Number	Answer	Mark
	The only correct answer is C because decreasing the mass on the hanger decreases the tension in the string and, since $v = \sqrt{\frac{T}{\mu}}$, decreases the speed of waves on the string. $\lambda = v/f$ so the wavelength is shorter and a whole wavelength could fit in the original length A the wavelength at the original frequency is unchanged, so decreasing the length will not allow a whole wavelength B decreasing the frequency will increase the wavelength, since wave speed is unchanged, so this will not allow a whole wavelength D since $v = \sqrt{\frac{T}{\mu}}$, decreasing the mass per unit length will increase the wave speed, increasing the wavelength at the original frequency, so this will not allow a whole wavelength	1

Q20.

Question Number	Acceptable answers	Additional guidance	Mark
	A Sound can travel through a solid.		1

Q21.

Question Number	Answer	Mark
	D – Two points $\frac{\lambda}{2}$ apart oscillate with the same amplitude	1
	Incorrect Answers: A – Points on a wave do not all oscillate in phase B – A node is formed from destructive interference C – Stationary waves may also be formed from longitudinal waves	

Q22.

Question Number	Acceptable answers	Additional guidance	Mark
	D transverse, longitudinal		1