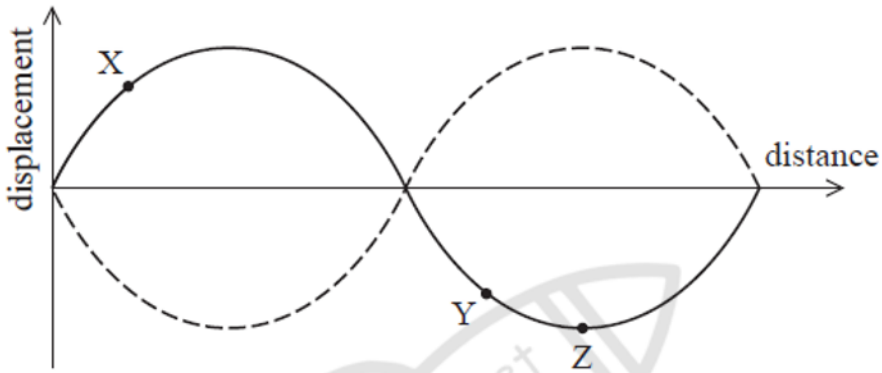
Questions

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows how the displacement varies with distance along a stationary wave at two instants of time.



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

☒ **A** Points X and Z are in antiphase with each other.

☒ **B** Points Y and Z have the same amplitude of vibration.

☒ **C** Points Y and Z have the same frequency of vibration.

☒ **D** Point Z is an antinode.

(Total for question = 1 mark)

Q2.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A string is stretched between two fixed points and set into oscillation.

The frequency of the vibrating string is **not** dependent on

☒ **A** the amplitude of the string's vibration.

☒ **B** the length of the string.

☒ **C** the mass per unit length of the string.

☒ **D** the tension in the string.

(Total for question = 1 mark)

Q3.

A loudspeaker produces a sound wave in air.

(a) Diagram 1 shows air molecules before the sound wave passes.

Diagram 1

At a particular instant as the sound wave passes, the air molecules are displaced as shown in Diagram 2.

Diagram 2

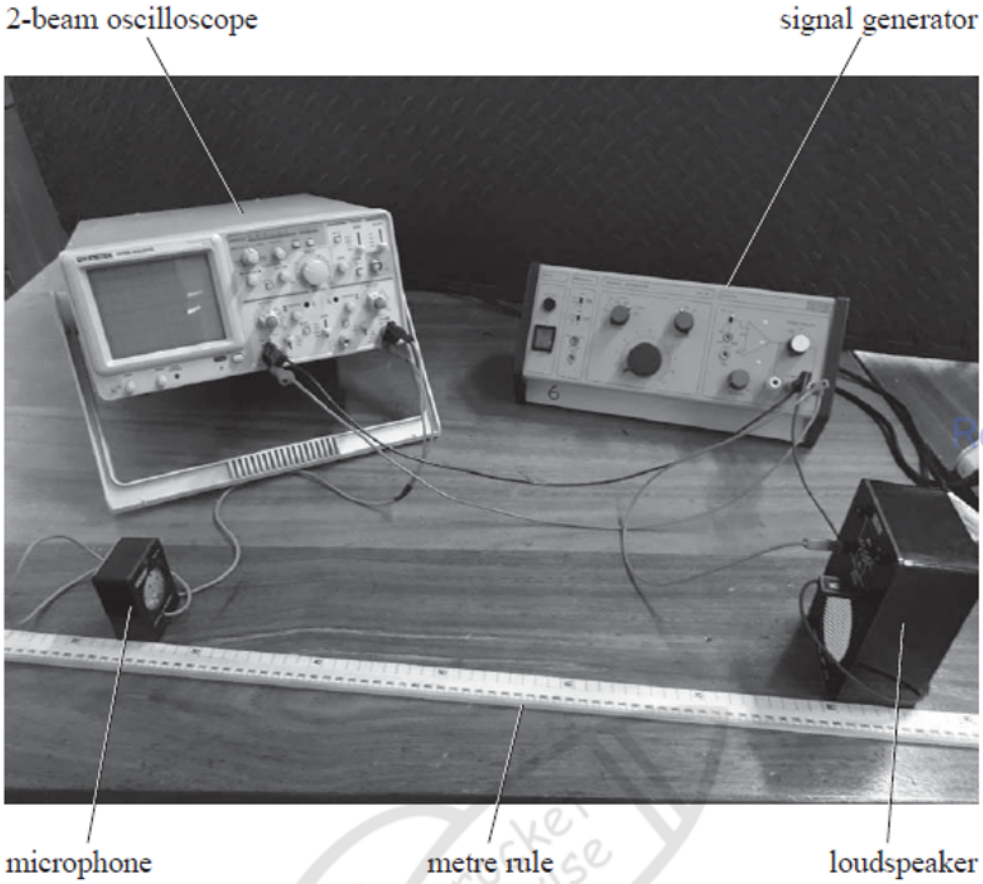
(i) Label a point on Diagram 2 where the pressure of the air is a minimum.

(1)

(ii) Sketch a graph of displacement against distance for the air particles between A and B at this instant on the axes below.

(2)

(b) The speed of sound can be determined using the apparatus shown.



When the loudspeaker is switched on, two traces are produced on the oscilloscope, one directly from the signal generator and the other from the microphone.

(i) Describe how a value for the speed of sound in air can be determined.

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(ii) Describe how the oscilloscope display can be used to demonstrate that the two traces have

the same frequency.

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(iii) A frequency of 15.0 kHz was used. A student suggested that the experiment would give a more accurate result for the speed of sound if a frequency of 4.0 kHz was used.

Evaluate the student's suggestion. You should use a calculation in your answer.

speed of sound in air = 340 m s^{-1}

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(Total for question = 13 marks)

Q4.

An Aeolian harp is a stringed musical instrument that is 'played' by the wind. An Aeolian harp is shown in the photograph.

(Source: *www.youtube.com*)

As air passes the strings, it forces them to vibrate, creating stationary waves on the strings.

(a) Explain how stationary waves are formed on the strings.

(2)

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(b) When the strings of an Aeolian harp vibrate, the frequency f of the string vibrations is given by the equation

$$f = \frac{Ku}{d}$$

where u is the speed of the moving air, d is the diameter of the string and K is a constant.

(i) Show that the constant K has no units.

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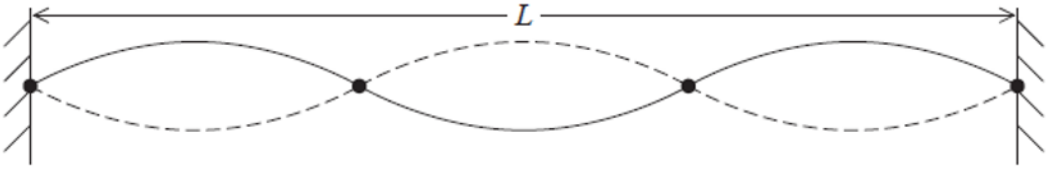
(ii) A stationary wave is produced on a string of length L as shown.



(Source: *hep.physics.indiana.edu*)

Calculate the speed of the air required to produce this stationary wave.

length of string = 0.33 m
diameter of string = 0.15 mm
tension in string = 63 N
mass per unit length of string = 0.58×10^{-3} kg m^{-1}
$K = 0.20$

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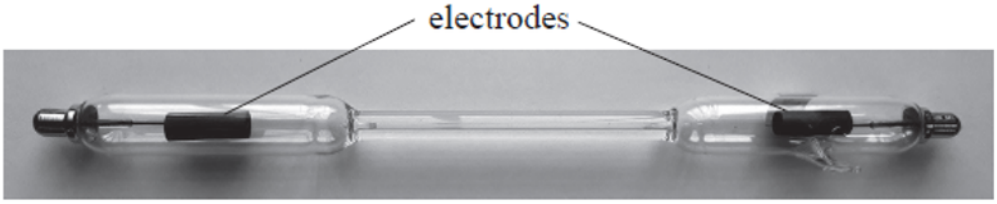
Speed of the air = ...

(Total for question = 9 marks)

Q5.

In 1857, Heinrich Geissler invented the first gas discharge tube. A sodium gas discharge tube is shown.



When a high potential difference is applied between the electrodes, electrons move through the sodium gas in the tube. The electrons collide with the sodium atoms. The tube then gives out visible light with a wavelength of 589 nm.

(a) Describe the process by which visible light is emitted from the sodium atoms.

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(b) Calculate the energy, in eV, of a photon of visible light with a wavelength of 589 nm.

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Photon energy = ... eV

(c) Light from the tube was directed through a diffraction grating, labelled as having

300 lines per mm. The diffraction pattern produced was displayed on a flat screen. The student measured the distance *s* between the central maximum and the first-order maximum on the screen. He also measured the distance *D* from the diffraction grating to the screen.

Determine whether the labelling of the diffraction grating as having 300 lines per mm was correct.

$s = 0.234$ m
$D = 1.30$ m

λ = 589 nm

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(Total for question = 9 marks)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

When a guitar string is plucked, a sound of constant frequency is heard.

The wave produced on the vibrating guitar string is

☒ **A** longitudinal and progressive.

☒ **B** longitudinal and stationary.

☒ **C** transverse and progressive.

☒ **D** transverse and stationary.

(Total for question = 1 mark)

Q7.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Waves can be represented on graphs of displacement against distance and displacement against time.

Which of the following properties can only be determined by combining information from both graphs?

☒ **A** amplitude

☒ **B** frequency

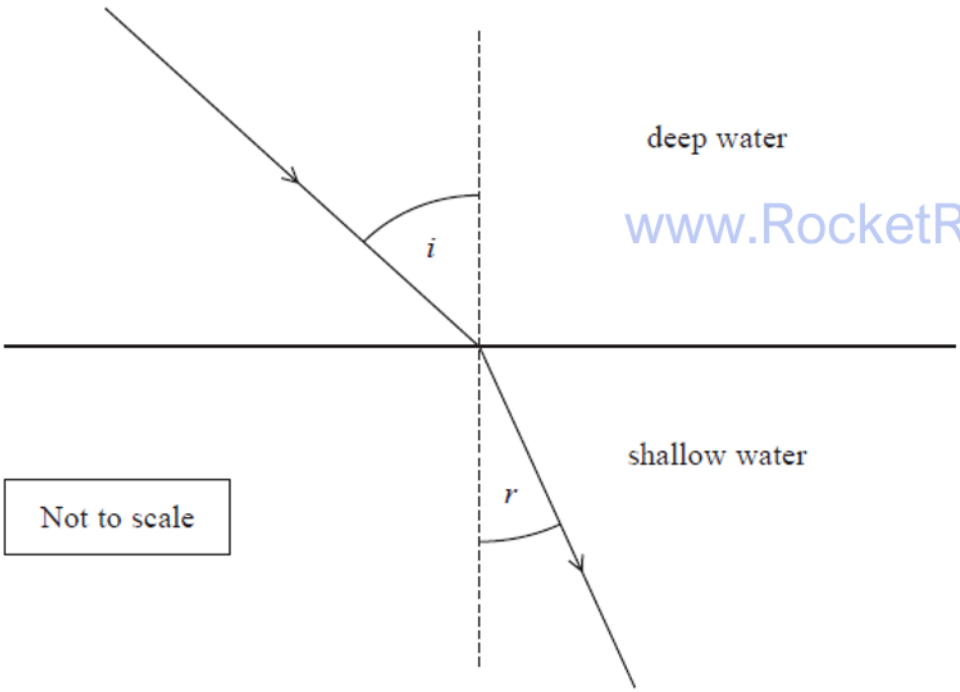
☒ **C** speed

☒ **D** wavelength

(Total for question = 1 mark)

Q8.

A water wave approaches a boundary between deep water and shallow water and is refracted. The diagram shows how the direction of travel of the wave changes.



(a) Explain why the wave is refracted as shown, as it travels from deep water into shallow water. You may add to the diagram.

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(b) When waves travel across the surface of water, their speed v is dependent on the depth d of the water and the wavelength λ of the waves.

For waves travelling in deep water, where $d > \frac{\lambda}{2}, v = \sqrt{\frac{g\lambda}{2\pi}}$

For waves travelling in shallow water, $v = \sqrt{(gd)}$

(i) Calculate the angle of refraction r.

wavelength of waves in deep water = 15 m
depth of deep water = 10 m
depth of shallow water = 0.50 m
angle of incidence = 40°

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r = ...

(ii) In 1933, the crew of the US Navy ship USS Rampo took measurements from one of the largest waves ever recorded. The wavelength of the wave was 342 m and the time period was 14.8 s.

Show that the depth of the water where the crew measured the wave was greater than 170 m.

(3)

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(Total for question = 10 marks)

Q9.

Waves may be longitudinal or transverse.

Which of the following statements is correct?

☒ **A** All transverse waves travel at the same speed.

☒ **B** All transverse waves have vibrations that are parallel to the direction of wave travel.

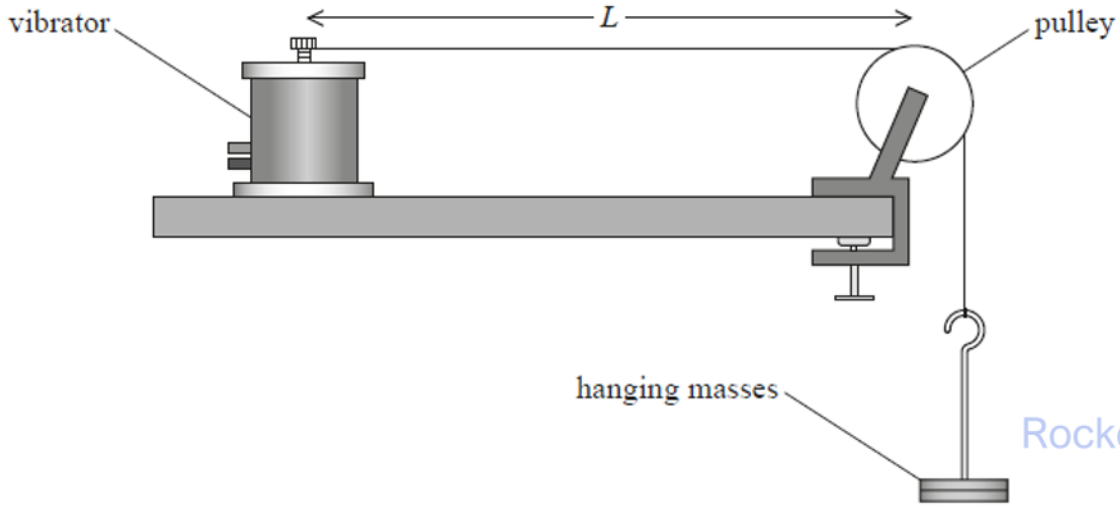
☒ **C** Both transverse and longitudinal waves can be refracted.

☒ **D** No transverse waves can travel through liquids.

(Total for question = 1 mark)

Q10.

A student investigated how the frequency of vibration of a string varies with the tension in the string. The student connected masses to one end of the string and attached the other end to a vibrator as shown.



(Source: http://www.schoolphysics.co.uk/age16-19/Sound/text/Vibrating_strings/index.html)

A signal generator was connected to the vibrator. The signal generator was adjusted until a stationary wave was produced on the string. The stationary wave had nodes at both ends of the vibrating length of the string, *L*, and an antinode in the middle.

(a) Explain how nodes and antinodes are created on a string.

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(b) The student changed the weight *W* applied to the string and adjusted the frequency *f* of the signal generator until the same stationary wave was set up on the string.

The student plotted a graph of f^2 against *W*.

Explain why the graph was a straight line through the origin.

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(c) Describe a method that can be used to confirm that the frequency value stated on the signal generator is correct.

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(d) When W is 80.0 N, f is 659 Hz.

Calculate the mass per unit length of the string.

length L = 0.328 m

(3)

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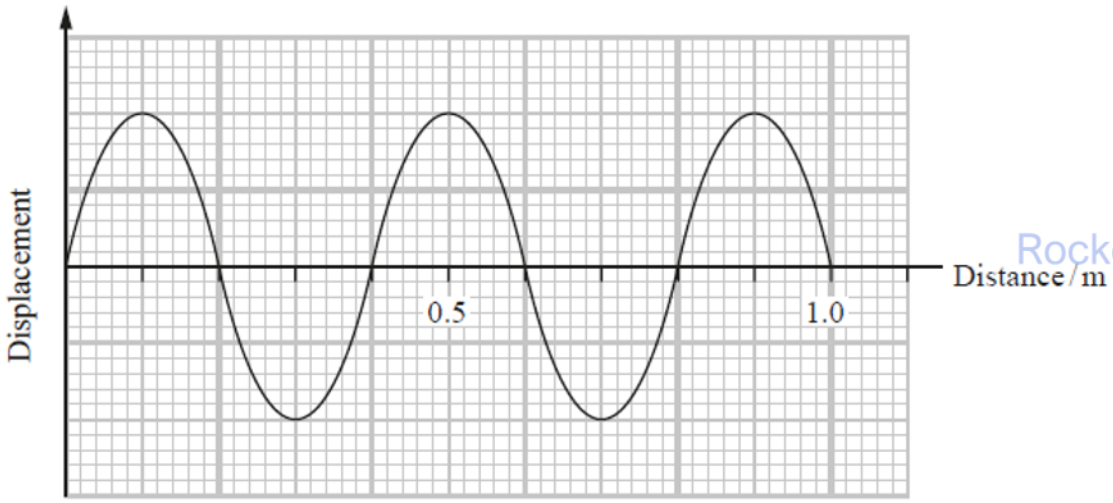
Mass per unit length = ...

(Total for question = 13 marks)

Q11.

Active Noise Reduction (ANR) is a system used to reduce unwanted noise. In ANR a second sound wave is produced that cancels the first. ANR is used in aircraft to reduce the noise heard from the engine.

(a) On a particular flight, the noise from the engine has a frequency of 0.85 kHz. The graph shows a possible second wave.



Determine whether this wave could be suitable to cancel the noise from the engine.

speed of sound in air = 340 m s^{-1}

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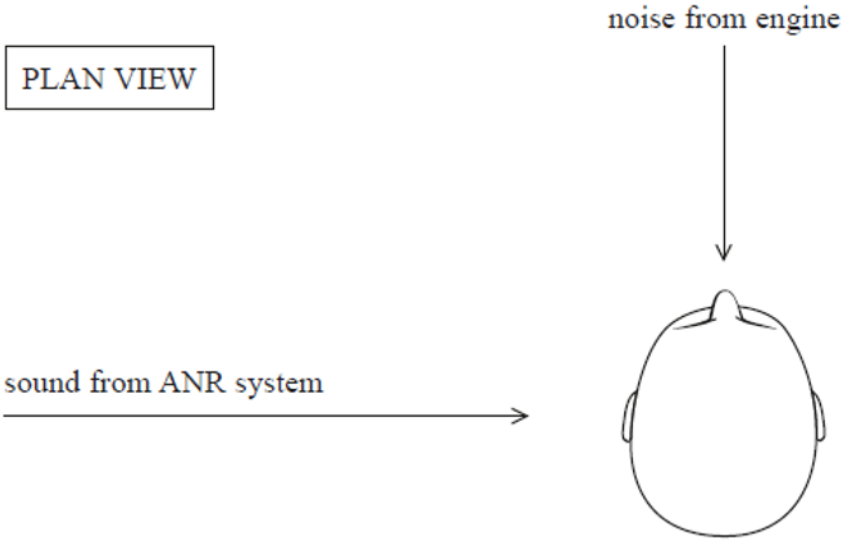
*(b) For a particular passenger in an aircraft, the noise from the engine travels as a wave towards the passenger from the front. An ANR system creates a second sound wave that is directed towards the passenger from the side, as shown.



Explain how this can lead to the sound being cancelled for one ear but louder for the other ear.

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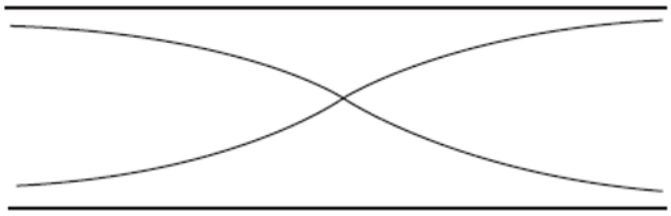
(Total for question = 9 marks)

Q12.

A recorder is a musical instrument with a mouthpiece at one end, as shown.

(a) When a musician blows into the mouthpiece, a stationary wave is produced in the air column inside the recorder.

(i) The stationary wave has antinodes at both ends of the air column as shown.



Calculate the frequency of the sound produced by this stationary wave.

speed of sound in air = 330 m s^{-1}
length of recorder = 23.6 cm

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Frequency = ...

(ii) The recorder is made from three separate sections that slide together as shown.

A musician plays the recorder and produces the same frequency sound as in (i).
The temperature of the air increases. As the temperature of the air increases, the speed of sound also increases.

Explain how the musician can adjust the recorder to produce the same frequency sound as in (i).

(3)

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(b) On a violin, a stationary wave is created when a string is plucked. A violin string has a fixed length but the tension can be adjusted.

When a string is plucked, it produces a sound with a frequency of 432 Hz. This string is adjusted to produce a sound of frequency 440 Hz.

Calculate the percentage increase in the tension in the string.

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Percentage increase = ...

(Total for question = 9 marks)

Q13.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A wave has amplitude A, period T, and wavelength λ.

Which of the following can be used to calculate the speed of the wave?

☒ **A** AT

☒ **B** $\frac{A}{T}$

☒ **C** λT

☒ **D** $\frac{\lambda}{T}$

(Total for question = 1 mark)

Q14.

Ultraviolet light of wavelength 20.0 nm is incident on a metal surface. The metal has a work function of 3.68 eV. Electrons are released by the photoelectric effect.

(a) Calculate the maximum speed of the electrons as they are released from the metal surface.

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Maximum speed = ...

(b) A student suggests that if the wavelength and intensity of the light used are both increased, the maximum speed of the electrons released from the metal surface also increases.

Explain whether the student's suggestion is correct.

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(Total for question = 9 marks)

Q15.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Which of the following statements is correct for minimum displacement of the particles in a longitudinal wave?

☒ **A** Minimum displacement occurs at compressions only.

☒ **B** Minimum displacement occurs at rarefactions only.

☒ **C** Minimum displacement occurs at compressions and rarefactions.

☒ **D** Minimum displacement occurs at neither compressions nor rarefactions.

(Total for question = 1 mark)

Q16.

ICESat-2 is a satellite launched into space by NASA in 2018. One purpose of the satellite is to measure the thickness of ice on the Earth's surface. The satellite is powered using solar panels. A laser in the satellite produces a beam of photons, which travel to the Earth and back.

(a) Calculate the intensity of solar radiation as it reaches ICESat-2.

distance from the Sun to ICESat-2 = 1.50×10^{11} m
power of the Sun = 3.83×10^{26} W

(3)

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Intensity of solar radiation = ...

(b) The laser emits light with a wavelength of 532 nm. Calculate the energy, in J, of each photon.

(3)

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Energy of photon = ... J

(c) The photons released by the laser are directed towards the Earth. The mean time for these photons to return to the satellite is 3.20 ms.

(i) Calculate the height that ICESat-2 orbits above the surface of the Earth.

(2)

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Height above Earth = ...

(ii) When photons arriving at the satellite are detected, only those with a wavelength of exactly 532 nm are used in the analysis of the results.

Suggest why.

(1)

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(d) At one point, ICESat-2 passes over a flat ice sheet. The ice sheet is 1000 m above sea level.

Explain how the measurements taken by ICESat-2 can be used to show that the ice sheet has a flat surface and is higher than sea level.

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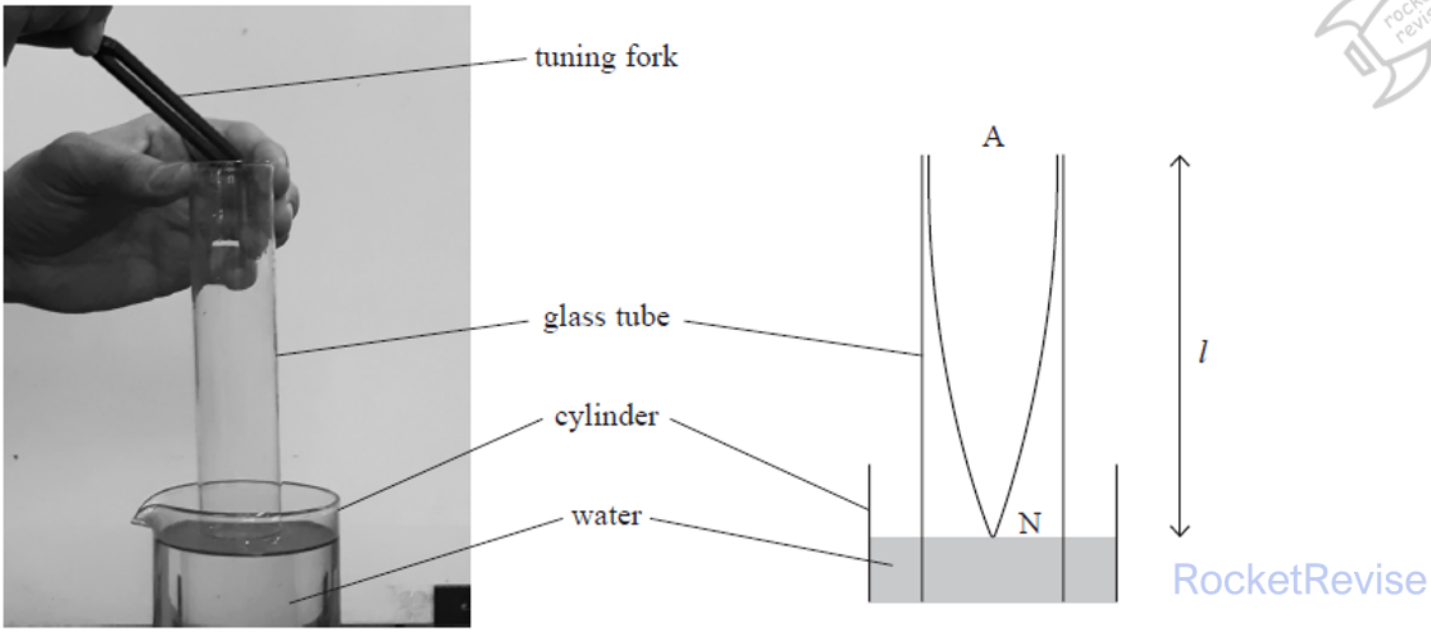
(Total for question = 11 marks)

Q17.

In an experiment to determine the speed of sound in air, a student held a vibrating tuning fork above a glass tube. The air column in the tube could be adjusted by raising or lowering the tube into a cylinder containing water. When the length of the air column was *l*, a stationary wave with one node and one antinode was produced as shown. This caused a sound to be heard.



(a) Explain how the stationary wave was formed in this experiment.

(2)

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(b) (i) A sound was heard when *l* was 19.3 cm.

Determine a value for the speed of sound in air.

frequency of tuning fork = 440 Hz

(3)

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Speed of sound in air = ...

(ii) The antinode is slightly further from the water than the end of the glass tube.

Explain how this would affect the accuracy of your calculated value for the speed of sound.

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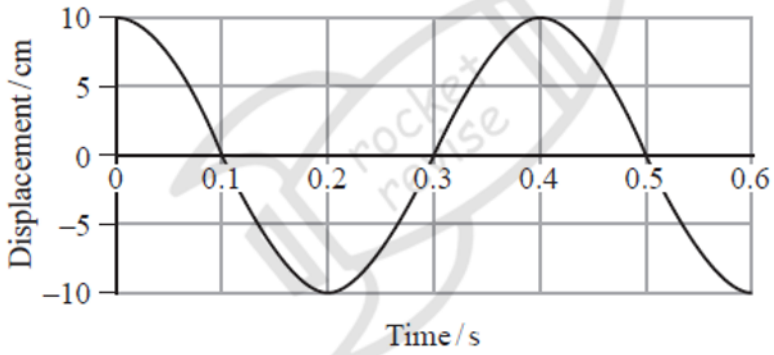
(Total for question = 7 marks)

Q18.

A graph of displacement against time for a point on a transverse progressive wave is shown.



Which of the following statements is correct?

☒ **A** The amplitude of the wave is 20 cm.

☒ **B** The frequency of the wave is 2.5 Hz.

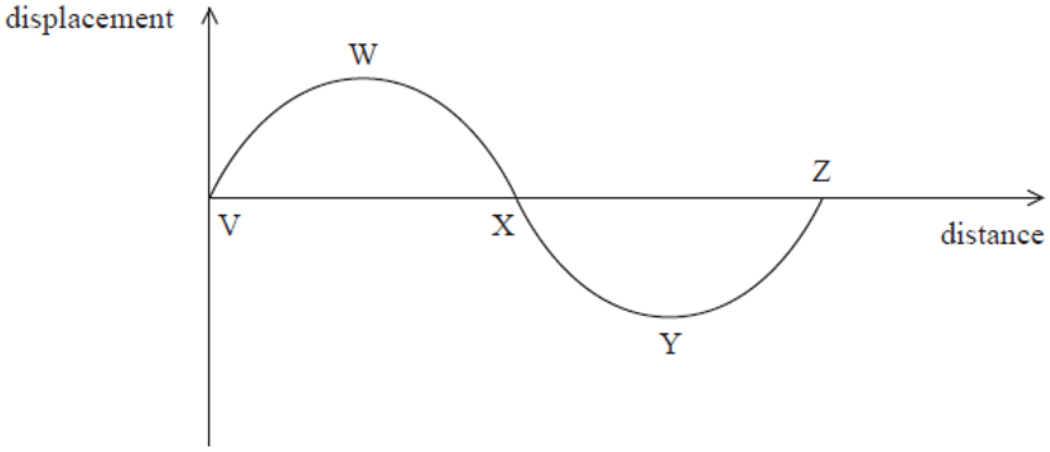
☒ **C** The period of the wave is 0.2 s.

☒ **D** The wavelength of the wave is 0.4 m.

(Total for question = 1 mark)

Q19.

A sound wave travels through air. The diagram represents the displacement of air particles along the wave at an instant in time.



There is a compression at position V.

At which position is there also a compression?

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

(Total for question = 1 mark)

Q20.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A moving electron has a de Broglie wavelength of 656 nm.

Which of the following could be used to determine the speed of the electron?

☒ **A** $\frac{6.63\times10^{-34}}{(656\times10^{-9})(9.11\times10^{-31})}$

☒ **B** $\frac{(656\times10^{-9})(9.11\times10^{-31})}{6.63\times10^{-34}}$

☒ **C** $\frac{(656\times10^{-9})(6.63\times10^{-34})}{9.11\times10^{-31}}$

☒ **D** $\frac{9.11\times10^{-31}}{(656\times10^{-9})(6.63\times10^{-34})}$

(Total for question = 1 mark)

Q21.

A student used two sources, A and B, of electromagnetic radiation to investigate the photoelectric effect. Radiation from A has a photon energy of 2.0 eV.

(a) The radiation from B has a wavelength of 280 nm.

Show that this radiation has a photon energy of about 4.4 eV.

(4)

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*(b) The student used the two sources of radiation to investigate the photoelectric effect for two different metals, copper and zinc.

The following statements were made by the student.

When radiation of photon energy 2.0 eV from source A is directed towards either of the metal plates no electrons are released, even when the intensity of the radiation is increased.

When radiation of photon energy 4.4 eV from source B is directed towards the copper plate, no electrons are released. However, when the radiation is directed towards the zinc plate, electrons are released. As the intensity of radiation is increased, electrons are released at a greater rate.

Explain the conclusions that can be made from these statements.

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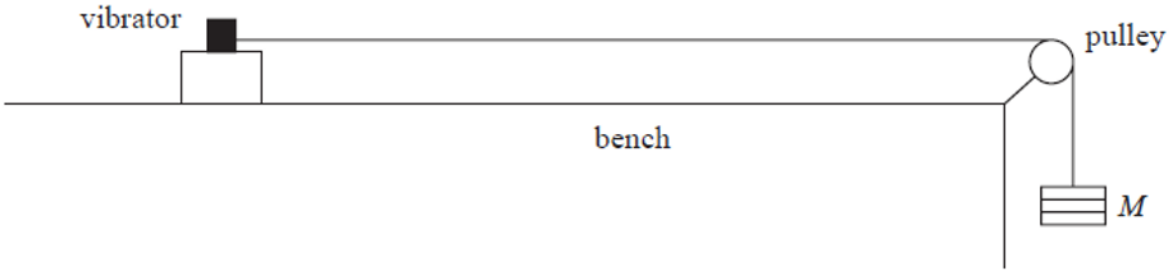
(Total for question = 10 marks)

Q22.

A student investigated stationary waves on a stretched string. The string was attached to a vibrator and a mass M, as shown.



(a) Explain how a stationary wave forms on the string.

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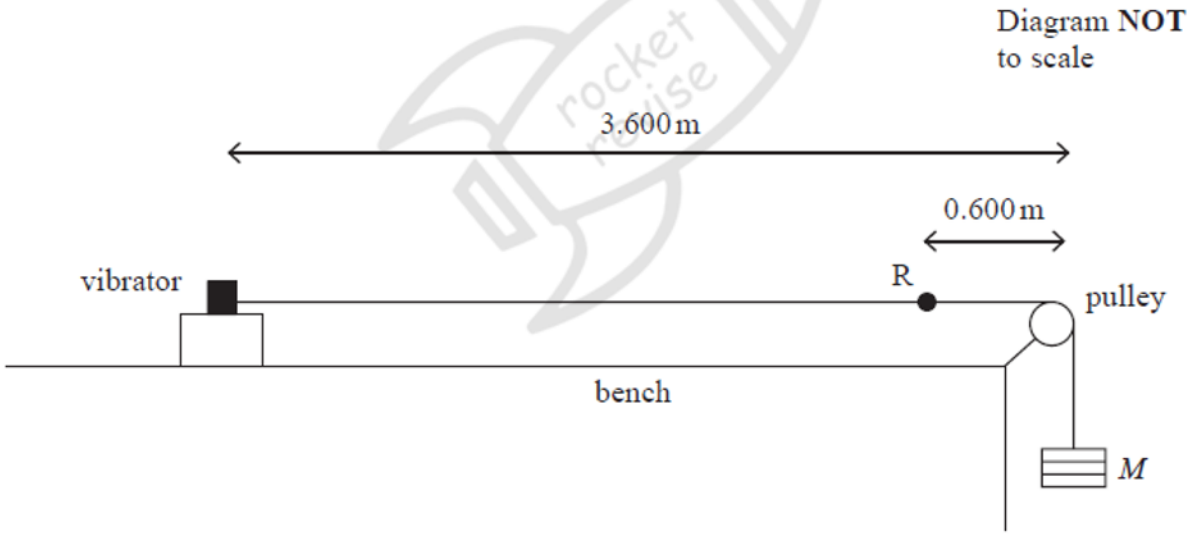
(b) The frequency of the stationary wave was 30.0 Hz. The distance between the vibrator and the pulley was 3.600 m. Point R is 0.600 m from the pulley, as shown.



Determine whether there was a node at point R.

M = 0.300 kg

mass per unit length of string = 2.27×10^{-3} kg m^{-1}

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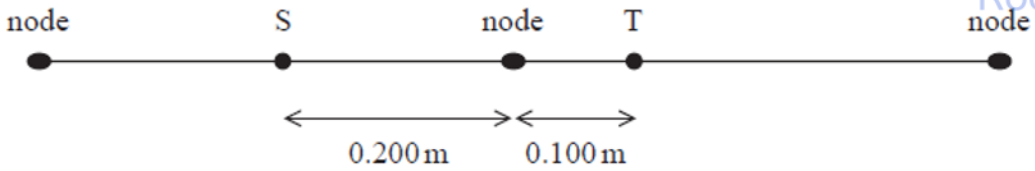
(c) The mass *M* was changed and the frequency of the vibrator was adjusted, so that a different stationary wave formed on the string. Adjacent nodes were separated by 0.400 m. The diagram shows two points, S and T, on the string at an instant when the string was straight.



(i) Explain the phase relationship between points S and T.

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(ii) Explain how the amplitude of vibration of the string at point S compares with the amplitude of vibration of the string at point T.

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(Total for question = 12 marks)

Q23.

When an earthquake occurs, two types of wave travel through the Earth. The two types of wave are P-waves (longitudinal) and S-waves (transverse).

(a) The velocities of P-waves and S-waves as they travel through the Earth are related to the density ρ of the material they are travelling through.

The velocity v_p of P-waves and the velocity v_s of S-waves are given by the following equations:

$$v_p = \sqrt{\frac{K + \frac{4}{3}G}{\rho}} \qquad v_s = \sqrt{\frac{G}{\rho}}$$

where K and G are constants for a particular material below the Earth's surface.

(i) The density of one material is 2700 kg m^{-3}.

Calculate v_p and v_s in this material.

K = 7.55 × 10^{10} Pa

G = 2.61 × 10^{10} Pa

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v_p = ...

v_s = ...

(ii) The Earth contains layers of liquid. The value of G for liquids is 0.

Explain whether S-waves can travel through liquids.

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(b) During a single earthquake, S-waves can be produced by more than one source. If two coherent S-waves meet, interference can take place.

(i) Explain what is meant by coherent.

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(ii) A scientist created a model to predict the effect of two coherent S-waves at different distances from the source. The model predicted the amplitude of the S-waves at positions A and B shown on the diagram.

The amplitude of the waves at position A was zero. The amplitude of the waves at position B was greater than zero.

Explain why the amplitude of the waves at position A was zero.

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(Total for question = 11 marks)

Q24.

Ultraviolet light is incident on a zinc plate. If the photon energy is greater than the work function of the zinc, electrons are released.

(a) State what is meant by work function.

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(b) The ultraviolet (UV) section of the electromagnetic spectrum can be split into three parts, known as UVA, UVB and UVC. The range of wavelengths of these parts is given in the table.

	UVC	UVB	UVA
Range of wavelength / nm	200–280	280–320	320–400

The minimum de Broglie wavelength of the released electrons is 1.50×10^{-9} m.

Deduce whether the ultraviolet light incident upon the zinc plate is UVA, UVB or UVC.

work function of zinc = 4.30 eV

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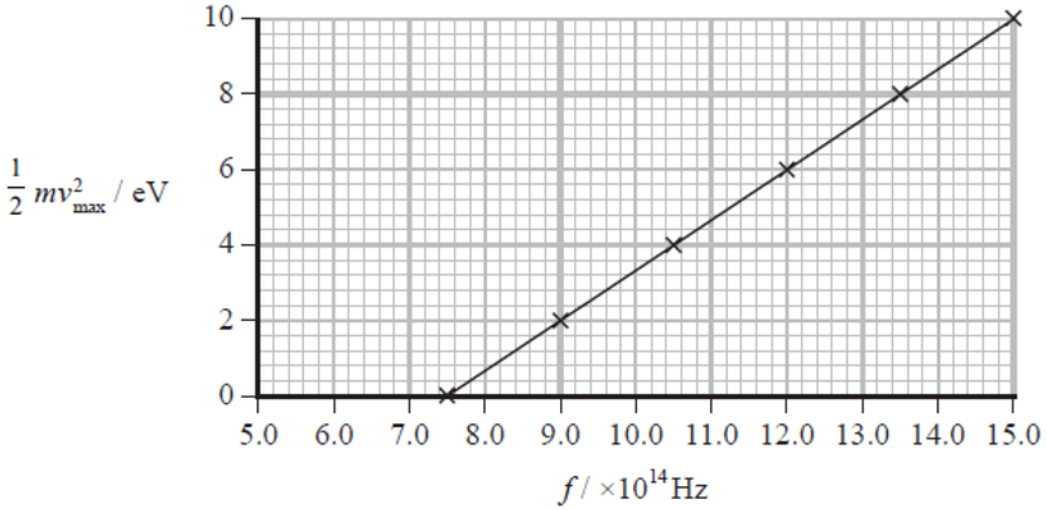
(c) A student used a zinc plate and UV light of different frequencies in an experiment. The student's graph of maximum kinetic energy of the released electrons against the frequency of the incident UV light is shown.



Einstein's photoelectric equation applies to this situation.

$$hf = \phi + \frac{1}{2}mv^2_{max}$$

Describe **two** ways that the graph is not consistent with the values known for a zinc plate. Your answer should include calculations.

work function of zinc = 4.30 eV

(4)

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(Total for question = 11 marks)

Q25.

Light is a transverse wave.

(a) Describe the difference between transverse waves and longitudinal waves.

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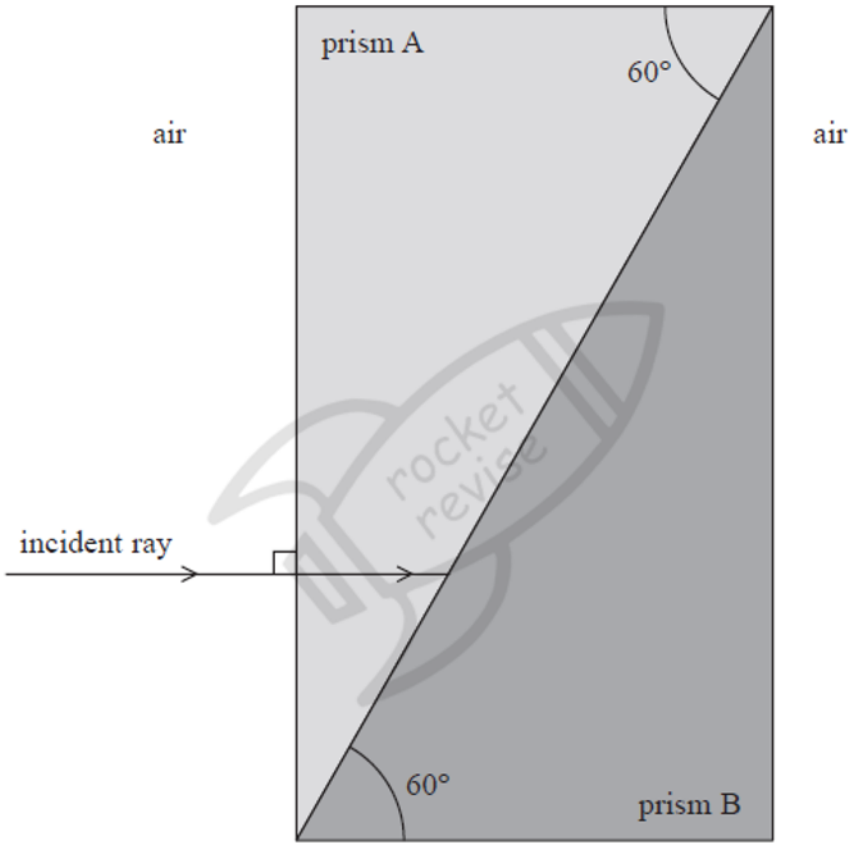
(b) Two prisms, A and B, made from different types of glass are placed in contact as shown. An incident ray of light enters prism A.



(i) State why the incident ray of light does not change direction as it enters prism A.

(1)

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(ii) The refractive index of the glass in prism B is greater than the refractive index of the glass in prism A. When the ray of light reaches the boundary between the prisms, some light is reflected and some is refracted.

Complete the diagram to show the two paths taken by the reflected and refracted light until they have returned to the air.

(4)

(iii) Calculate the angle of refraction as this ray of light travels across the boundary between

prism A and prism B.

refractive index of glass in prism A = 1.40
refractive index of glass in prism B = 1.55

(3)

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Angle of refraction = ...

(c) The light emerging from prism B is observed through a polarising filter. The polarising filter is rotated gradually, and the light transmitted by the filter varies in intensity.

Explain how this observation demonstrates that light waves are transverse.

(2)

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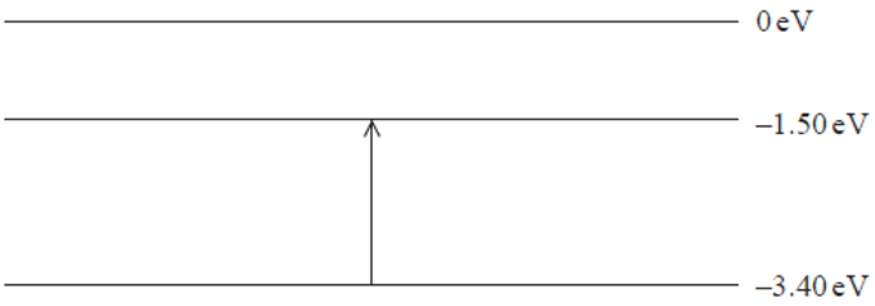
(Total for question = 12 marks)

Q26.

Sirius A is the brightest star in the night sky and is mostly composed of hydrogen.

(a) When light from Sirius A passes through the hydrogen in the outer layers of the star, some light is absorbed. This causes electrons in the hydrogen to be excited. The diagram shows an electron being excited from the –3.40 eV level to the –1.50 eV level.



Ground state —— –13.6 eV

The wavelengths of the different colours of visible light are shown in the table below.

violet	blue	green	yellow	orange	red
380–450 nm	450–495 nm	495–570 nm	570–590 nm	590–620 nm	620–750 nm

Deduce the colour of the visible light that caused the electron transition shown in the diagram.

(4)

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(b) A light year is the distance travelled by light in one year.

Sirius A is 8.60 light years from Earth. The intensity of radiation from Sirius A received on Earth is 1.17×10^{-7} Wm^{-2}.

Calculate the power of Sirius A.

(4)

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Power of Sirius A = ...

(c) When hydrogen gas is excited in the laboratory, only certain wavelengths of light are emitted.

Explain why.

(2)

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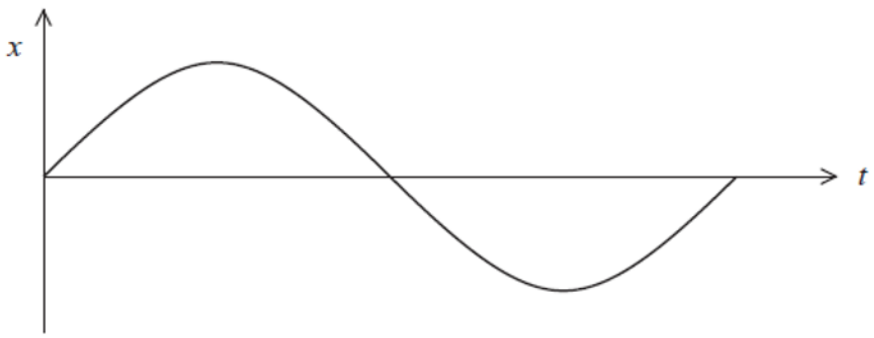
(Total for question = 10 marks)

Q27.

Answer the question with a cross in the box you think is correct (☒). If you change your mind, put a line through the box (☒) and then mark your new answer with a cross (☒).

The graph shows how the displacement x of particles in a wave varies with time t. The speed of the wave is not known.



Which of the following can **not** be determined from a graph of displacement against time for the particles in a wave?

☒ **A** amplitude

☒ **B** frequency

☒ **C** period

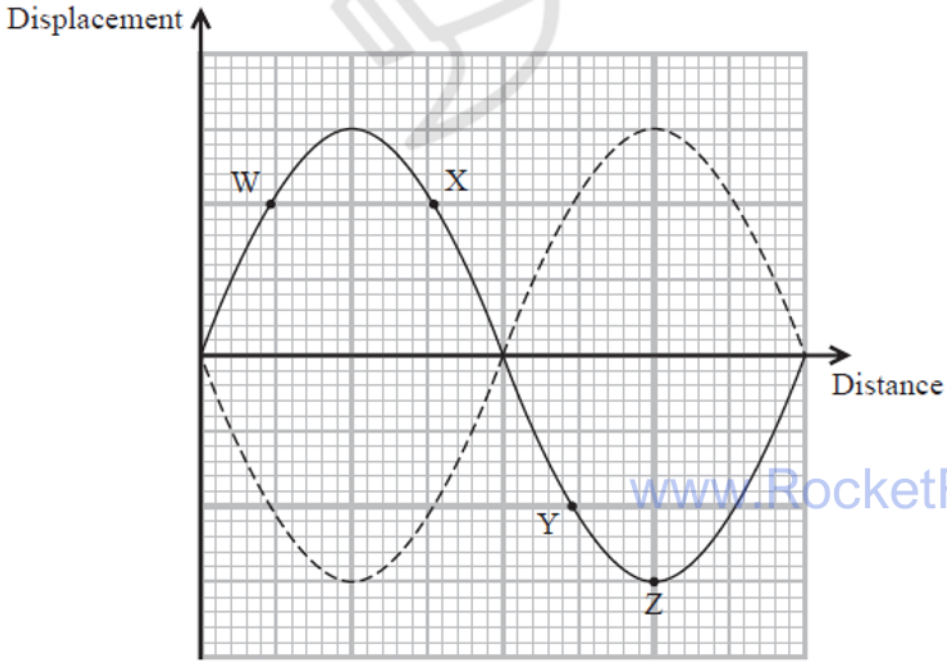
☒ **D** wavelength

(Total for question = 1 mark)

Q28.

Select one answer from A to D and put a cross in the box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows how the displacement varies with distance along a stationary wave at two instants of time.



Which of the following statements is correct?

☒ **A** Points W and X are in antiphase.

☒ **B** Points W and Y are in phase.

☒ **C** Points X and Y are in phase.

☒ **D** Points X and Z are in antiphase.

(Total for question = 1 mark)

Q29.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Two students are discussing longitudinal waves.

Student 1 states that at the centre of a compression the displacement of molecules is zero.

Student 2 states that at the centre of a rarefaction the displacement of molecules is zero.

Which of the students' statements are correct?

☒ **A** Both

☒ **B** Neither

☒ **C** Only student 1

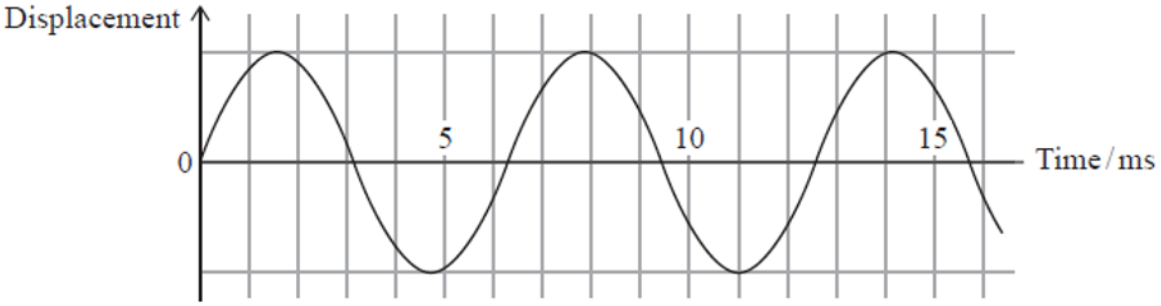
☒ **D** Only student 2

(Total for question = 1 mark)

Q30.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The graph shows how displacement varies with time for a particular point as a wave passes.



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

☒ **A** The time period can be determined directly from the graph.

☒ **B** The wavelength can be determined directly from the graph.

☒ **C** The wave could be longitudinal.

☒ **D** The wave could be transverse.

(Total for question = 1 mark)

Q31.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

When longitudinal waves pass through a material, compressions and rarefactions are formed.

Which of the following statements is correct?

☒ **A** Compressions are points where the displacement of particles is a maximum.

☒ **B** Compressions are points where the pressure is a minimum.

☒ **C** Rarefactions are points where the displacement of particles is a minimum.

☒ **D** Rarefactions are points where the pressure is a minimum.

(Total for question = 1 mark)

Q32.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The time period of a wave decreases.

Which of the following properties of the wave increases?

☒ **A** amplitude

☒ **B** frequency

☒ **C** speed

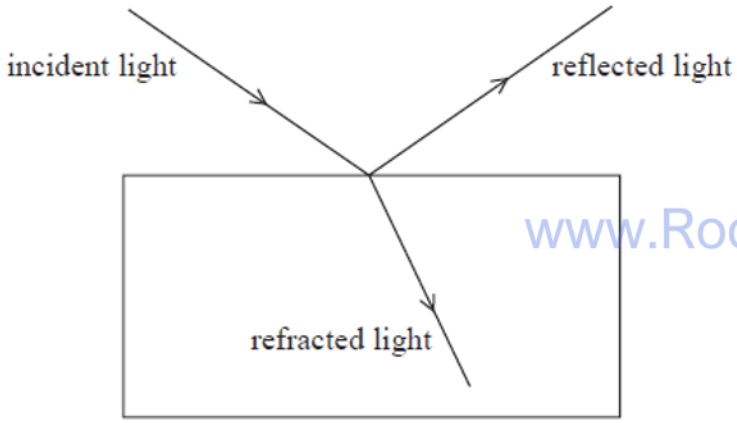
☒ **D** wavelength

(Total for question = 1 mark)

Q33.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Monochromatic light is incident on a rectangular glass block. Some of the light is reflected and some of the light is refracted, as shown.



Which of the following properties does **not** decrease when the light is refracted?

☒ **A** frequency

☒ **B** intensity

☒ **C** speed

☒ **D** wavelength

(Total for question = 1 mark)

Q34.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Monochromatic light travels through air and enters a glass block.

Which of the following quantities does **not** change as light enters the glass block?

☒ **A** amplitude

☒ **B** frequency

☒ **C** speed

☒ **D** wavelength

(Total for question = 1 mark)

Q35.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Which of the following pairs of quantities could be used to calculate the speed of a wave?

☒ **A** amplitude and frequency

☒ **B** amplitude and wavelength

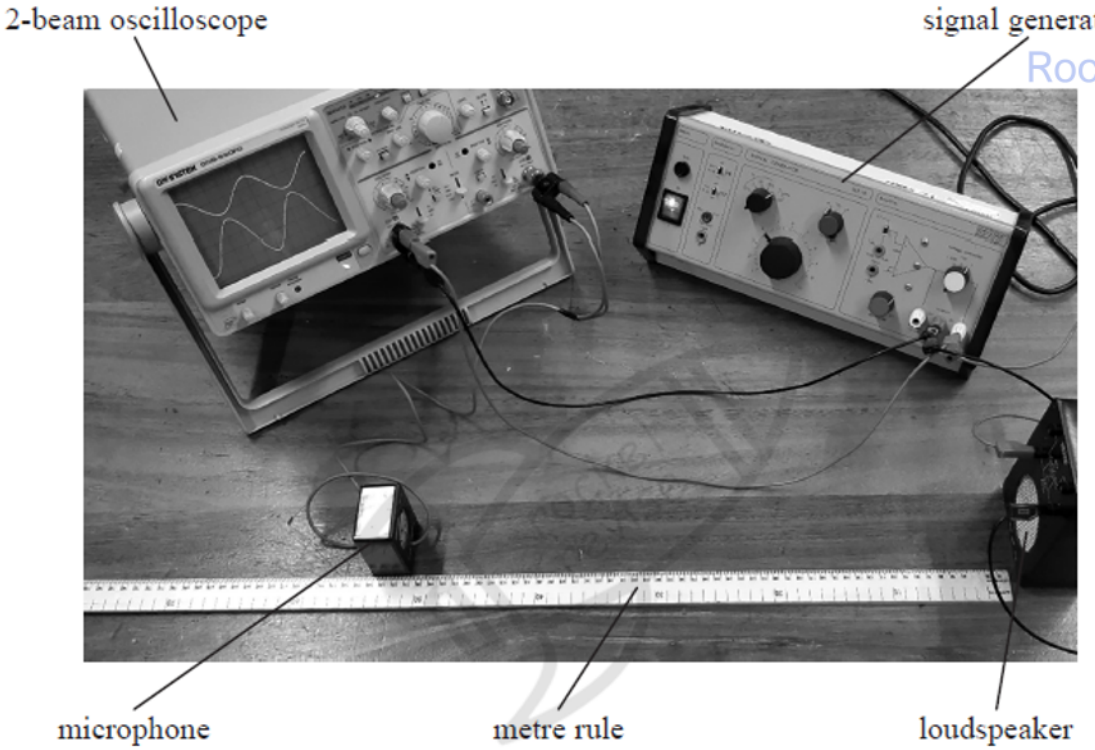
☒ **C** period and frequency

☒ **D** period and wavelength

(Total for question = 1 mark)

Q36.

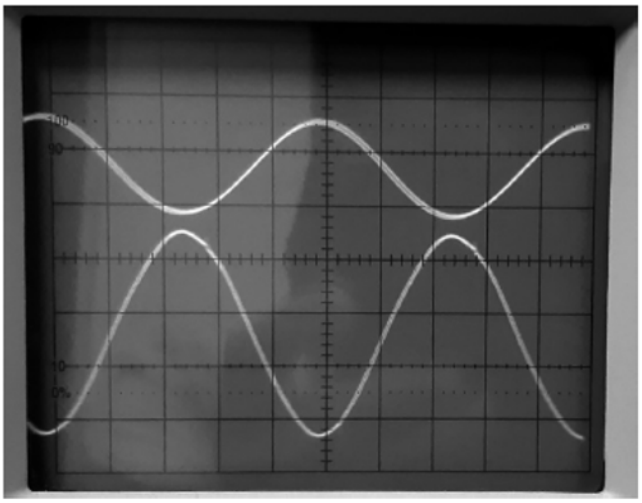
A student used the apparatus shown in Photograph 1 to determine the speed of sound in air.



Photograph 1

The student switched on the signal generator. The oscilloscope showed one trace from the signal generator and another trace from the microphone.

Initially the peaks of one trace were directly above the troughs of the other trace, as shown in Photograph 2.



Photograph 2

The horizontal axis of the oscilloscope screen represents time. The number of milliseconds per division on the horizontal scale is known.

(a) Explain how the apparatus shown in Photograph 1 could be used to determine the speed of sound in air.

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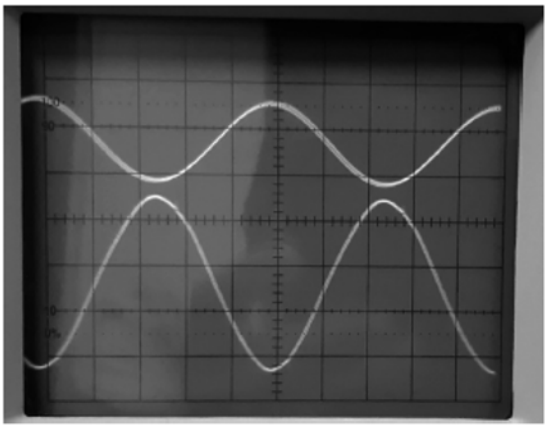
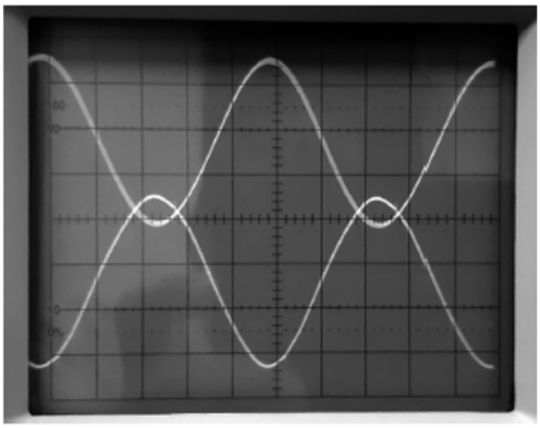
(b) The student changed the position of the microphone. The traces on the oscilloscope screen before and after changing the position of the microphone are shown in Photograph 2 and Photograph 3.



Photograph 2



Photograph 3

Explain what change the student made to the position of the microphone between Photograph 2 and Photograph 3.

(3)

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(Total for question = 8 marks)