3. Waves

3.4 Sound

Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 The horn on a ship makes a sound. The captain on the ship hears an echo from a cliff 4.0 s later.

The speed of sound is 340 m / s.

How far away is the cliff from the ship?

A 170 m **B** 340 m **C** 680 m **D** 1400 m

2 Sound waves may cause an echo.

What happens to sound waves to cause an echo and what is the nature of sound waves?

	what an echo is caused by	nature of sound waves
A	reflection	longitudinal
B	reflection	transverse
C	refraction	longitudinal
D	refraction	transverse

3 The table shows data for the hearing ranges of different animals.

Which animal has the most similar hearing range to a human?

	animal	hearing range / Hz
A	turtle	20–1000
B	mouse	1000–1 000 000
C	moth	20 000–300 000
D	elephant	16–12 000

4 Which description of ultrasound is correct?

A longitudinal waves with a frequency greater than 20 000 Hz

B longitudinal waves with a frequency less than 20 Hz

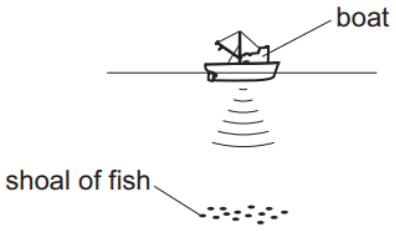
C transverse waves with a frequency greater than 20 000 Hz

D transverse waves with a frequency less than 20 Hz

5 How does the direction of vibration of a longitudinal wave compare to its direction of propagation and which wave example is longitudinal?

	direction of vibration compared to direction of propagation	wave example
A	at right angles	ultrasound waves
B	at right angles	ultraviolet waves
C	parallel	ultrasound waves
D	parallel	ultraviolet waves

6 A pulse of sound is produced at the bottom of a boat. The sound travels through the water and is reflected from a shoal of fish. The sound reaches the boat again 1.2 s after it is produced. The speed of sound in the water is 1500 m / s.



How far below the bottom of the boat is the shoal of fish?

A 450 m **B** 900 m **C** 1800 m **D** 3600 m

7 The frequency of a sound wave increases from 31 000 Hz to 32 000 Hz.

What is the nature of the wave and how does it sound to a human with normal hearing?

A It is a longitudinal wave with a decreasing pitch.

B It is a transverse wave with an increasing pitch.

C It is a longitudinal wave that cannot be heard by a human with normal hearing.

D It is a transverse wave that cannot be heard by a human with normal hearing.

8 Dogs can hear sounds in the range from 100 Hz to 45 kHz.

Which statement is correct?

A Any sound a dog can hear can also be heard by a human.

B Any sound a human can hear can also be heard by a dog.

C Dogs can hear some low frequency sounds that are silent for humans.

D Dogs can hear some high frequency sounds that are silent for humans.

9 Which statement about a sound that can be heard by a person with normal hearing is correct?

A The sound is a longitudinal wave with a frequency between 2.0 Hz and 20 Hz.

B The sound is a longitudinal wave with a frequency between 20 Hz and 20 000 Hz.

C The sound is a transverse wave with a frequency between 2.0 Hz and 2000 Hz.

D The sound is a transverse wave with a frequency between 2.0 Hz and 20 MHz.

10 Student X fires a starting pistol which produces smoke and sound. Student Y is standing 100 m away and sees the smoke the instant it is produced. The speed of sound in air is 340 m/s.

What is the time delay between student Y seeing the smoke and hearing the sound?

A 0.29 s **B** 0.59 s **C** 1.7 s **D** 3.4 s

11 A boy shouts and hears the echo from a tall building 2.2 s later.

The speed of sound in air is 330 m/s.

How far away from the boy is the building?

A 150 m **B** 300 m **C** 360 m **D** 730 m

12 An observer stands at the finish line of a 100 m race. He wants to time the winner's run. He starts his stop-watch as soon as he sees the smoke from the starting gun instead of when he hears the bang.

What is the reason for doing this?

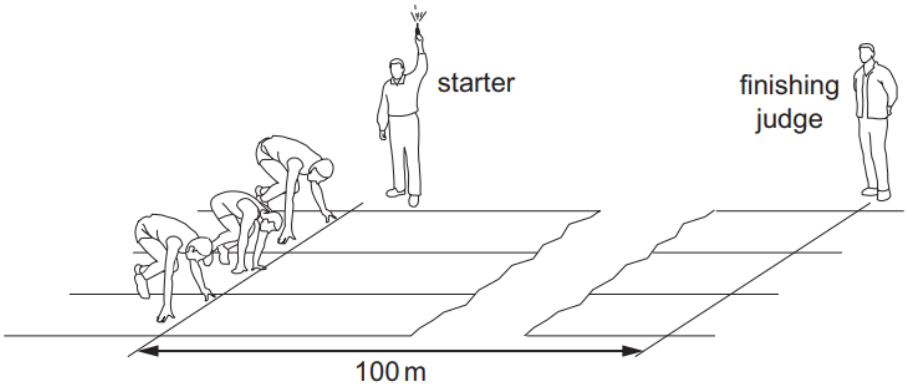
A Light travels much faster than sound.

B There is a risk he might respond to an echo from a wall.

C Humans react slower to sound than to light.

D Humans react more quickly to sound than to light.

13 A 100 m race is started by firing a gun. The gun makes a bang and a puff of smoke at the same time.



When does the finishing judge see the smoke and when does he hear the bang?

	sees the smoke	hears the bang
A	almost immediately	almost immediately
B	almost immediately	after about 0.3 s
C	after about 0.3 s	almost immediately
D	after about 0.3 s	after about 0.3 s

14 Which row gives the correct description of a sound wave?

	action of wave	type of wave
A	transfers energy without transferring matter	longitudinal
B	transfers energy without transferring matter	transverse
C	transfers matter without transferring energy	longitudinal
D	transfers matter without transferring energy	transverse

15 What is ultrasound?

A sound waves that are so loud that they damage human hearing

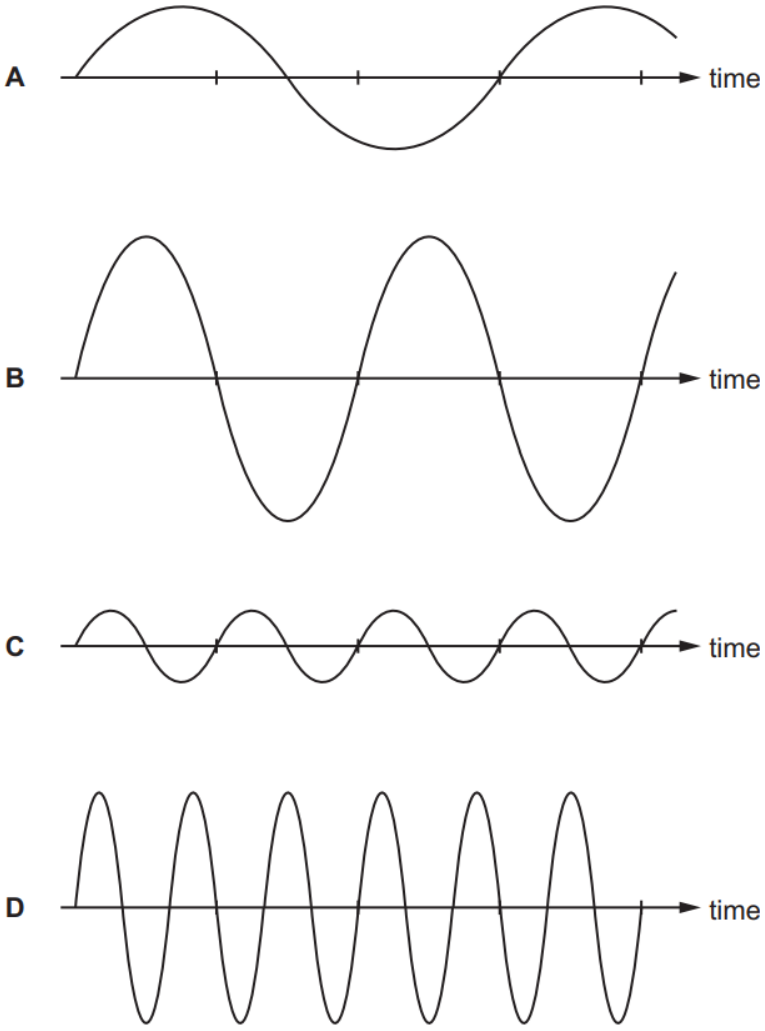
B sound waves that are too high-pitched for humans to hear

C sound waves that are too low-pitched for humans to hear

D sound waves that are too quiet for humans to hear

16 The diagrams represent the waves produced by four sources of sound. The scales are the same for all the diagrams.

Which sound has the highest frequency?



17 Sound is a transfer of energy from an oscillating source.

Which statement describes how sound energy is transferred?

A a longitudinal wave with the oscillation parallel to the direction in which energy is transferred

B a longitudinal wave with the oscillation perpendicular to the direction in which energy is transferred

C a transverse wave with the oscillation parallel to the direction in which energy is transferred

D a transverse wave with the oscillation perpendicular to the direction in which energy is transferred

18 A police car with its siren sounding is stationary in heavy traffic. A pedestrian notices that, although the loudness of the sound produced does not change, the pitch varies.

Which row describes the amplitude and the frequency of the sound?

	amplitude	frequency
A	constant	constant
B	constant	varying
C	varying	constant
D	varying	varying

19 A dolphin sends out a sound wave. An echo returns 0.010 s later from a fish which is 7.5 m from the dolphin.

What is the speed of the sound wave in water?

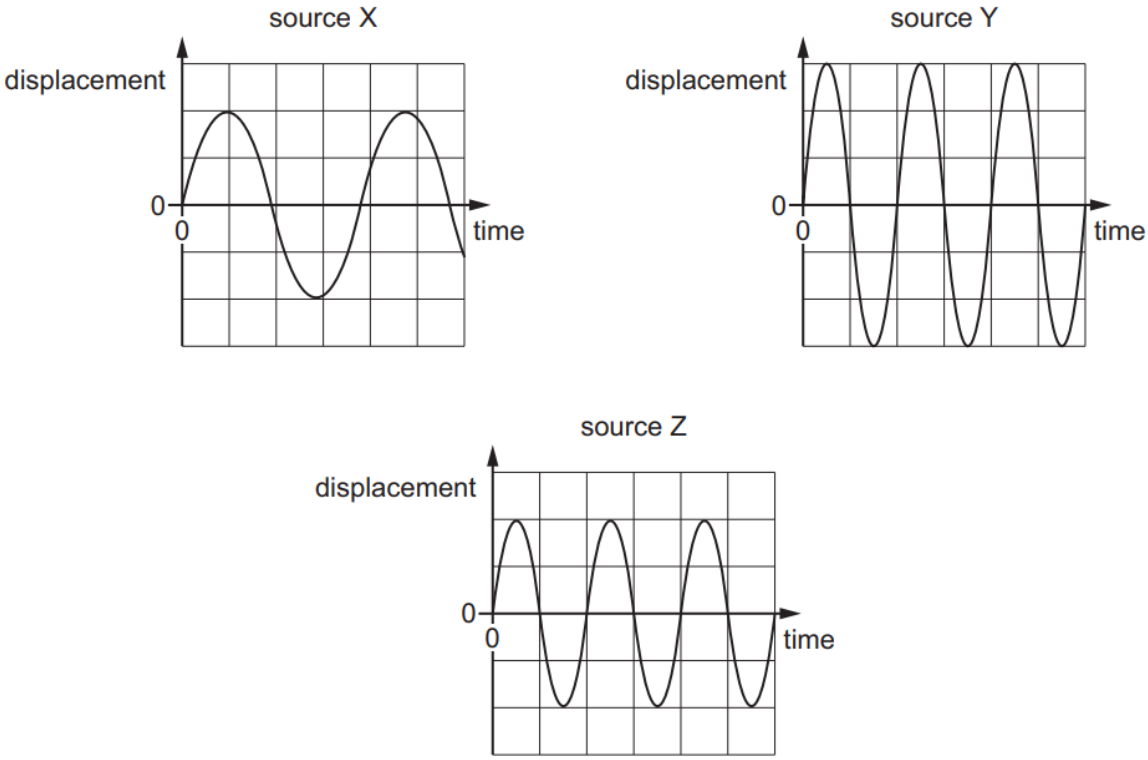
A 0.075 m/s **B** 0.15 m/s **C** 750 m/s **D** 1500 m/s

20 A man hears a starting pistol fire 1.5 seconds after he sees a puff of smoke from the pistol. The sound and the smoke are made at the same time. The starting pistol is 450 metres away from the man.

What is the speed of sound calculated from this observation?

A 150 m/s **B** 300 m/s **C** 330 m/s **D** 625 m/s

21 The graphs show the displacement of particles in sound waves from three sources X, Y and Z. The scales on the graphs are all identical.



Which sources are producing sound waves with the same pitch?

A X and Y only **B** Y and Z only **C** X and Z only **D** X, Y and Z

22 Ultrasound is used in a hospital to scan a patient. Ultrasound refracts at the boundary between muscle and bone because it travels at a greater speed in bone.

Which change takes place when the ultrasound travels from muscle into bone?

A The frequency of the wave decreases.

B The frequency of the wave increases.

C The wavelength of the wave decreases.

D The wavelength of the wave increases.

23 Which range is approximately correct for the audio frequencies that can be detected by a healthy human ear?

A 2 Hz to 2000 Hz

B 2 Hz to 20 000 Hz

C 20 Hz to 2000 Hz

D 20 Hz to 20 000 Hz

24 A woman hears the first note produced by a clarinet.

She then hears a second note that has a higher pitch and is quieter.

Which row compares the frequency and the amplitude of the two notes?

	first note	second note
A	higher frequency	larger amplitude
B	higher frequency	smaller amplitude
C	lower frequency	larger amplitude
D	lower frequency	smaller amplitude

25 Which statement about ultrasound is correct?

A Ultrasound must have greater amplitude than audible sound.

B Ultrasound must have greater frequency than audible sound.

C Ultrasound must have lower amplitude than audible sound.

D Ultrasound must have lower frequency than audible sound.

26 A dolphin has a range of audible frequencies of 150 Hz–150 kHz.

Which range of frequencies can be heard both by humans with good hearing and by dolphins?

A 20 Hz–150 Hz

B 20 Hz–150 kHz

C 20 kHz–150 kHz

D 150 Hz–20 kHz

27 A siren is emitting a sound. As time passes, the sound becomes louder and higher pitched.

What is happening to the amplitude and to the frequency of the emitted sound wave?

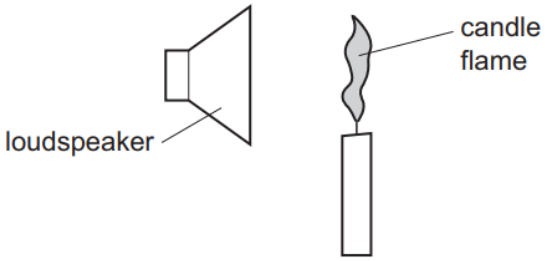
	amplitude	frequency
A	decreasing	decreasing
B	decreasing	increasing
C	increasing	decreasing
D	increasing	increasing

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

28 A candle flame is placed in front of a loudspeaker.

The loudspeaker produces a sound wave that causes air particles to vibrate. The vibrating air particles make the candle flame vibrate in the same direction as the air particles.



Which row shows the direction of vibration of the candle flame and the nature of sound waves?

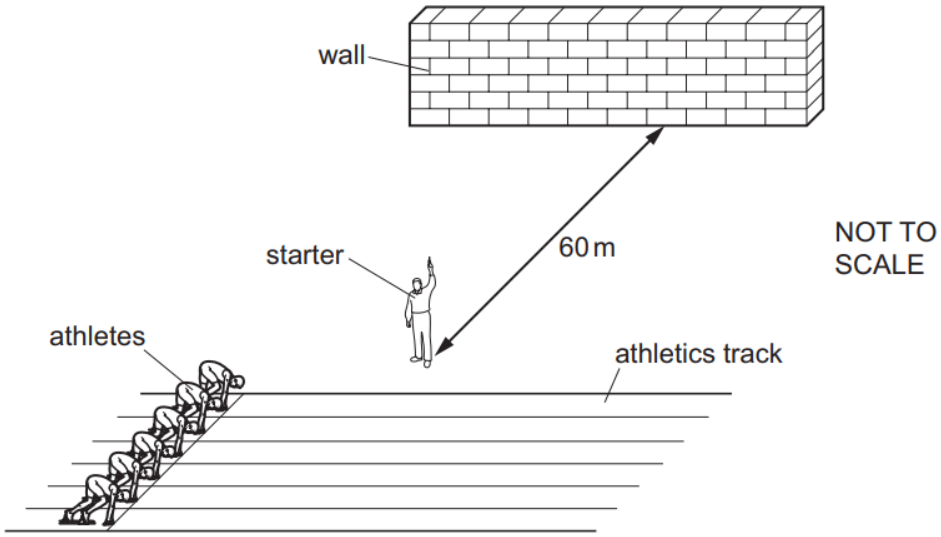
	direction of vibration	nature of sound waves
A	↕	longitudinal
B	↕	transverse
C	↔	longitudinal
D	↔	transverse

29 What is the approximate value of the speed of sound in air at normal temperature?

A 340 m/s **B** 34 000 m/s **C** 340 km/s **D** 3.0×10^8 m/s

30 The starter in an athletics race fires the starting pistol. There is a wall 60 m from the starter.

Take the speed of sound as 330 m/s.



How long after firing the pistol does the starter hear the echo of the sound from the wall?

A 0.18 s **B** 0.36 s **C** 2.8 s **D** 5.5 s

31 A sound wave travels at 330 m/s. The distance between the centre of a compression and the centre of the nearest rarefaction in the sound wave is 2.5 cm.

What is the frequency of the sound wave?

A 66 Hz **B** 130 Hz **C** 6600 Hz **D** 13 000 Hz

32 The element mercury exists as a solid, a liquid or a gas. **(extended only)**

Which row gives a possible set of values of the speeds of sound through mercury?

	speed of sound in frozen mercury / m/s	speed of sound in liquid mercury / m/s	speed of sound in mercury vapour / m/s
A	250	1500	2500
B	250	2500	1500
C	1500	250	2500
D	2500	1500	250

33 A sound wave travels from air into water.

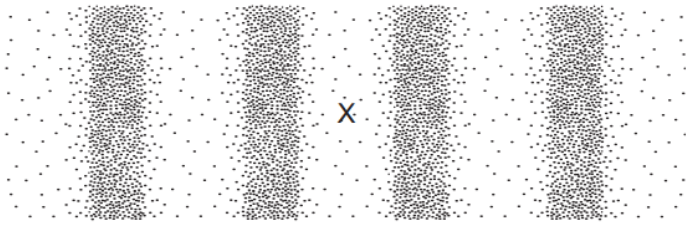
Which row describes what happens to the frequency and the wavelength of the wave?

	frequency	wavelength
A	decreases	increases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	increases

34 Which row gives typical values for the speed of sound in a solid and in a gas? **(extended only)**

	speed of sound in a solid m/s	speed of sound in a gas m/s
A	3	30
B	30	3
C	300	3000
D	3000	300

35 The diagram shows the air molecules in part of a sound wave at a particular moment in time.



Which statement is **not** correct?

A Earlier, there was compression at X.

B Later, there will be a rarefaction at X.

C This part of the wave is travelling horizontally across the page.

D This part of the wave is travelling towards the top of the page.

36 The speed of sound in air is 330 m/s. **(extended only)**

How do the speeds of sound in concrete and water compare with this speed?

	speed in concrete	speed in water
A	greater	greater
B	greater	less
C	less	greater
D	less	less

37 A sound wave is created by a loudspeaker that vibrates backwards and forwards 96 000 times per minute.

The speed of sound is 320 m/s.

What is the wavelength of the sound wave?

A 0.20 m **B** 5.0 m **C** 300 m **D** 18 000 m

38 A sound wave is travelling outwards from a loudspeaker into the surrounding air. **(extended only)**

Here are three statements.

1 The air pressure is lower at a rarefaction compared with undisturbed air.

2 The density of the air is less at a compression compared with undisturbed air.

3 The distance from a compression to a rarefaction equals half a wavelength.

Which statements about the sound wave are correct?

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

39 Sound travels through air as a series of compressions and rarefactions. **(extended only)**

Which statement correctly compares a compression with a rarefaction?

A In a compression the wavelength is longer than in a rarefaction.

B In a compression the wavelength is shorter than in a rarefaction.

C In a compression the density of the air is greater than in a rarefaction.

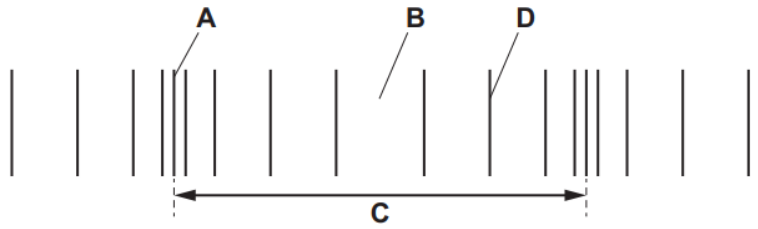
D In a compression the density of the air is lower than in a rarefaction.

40 Which row gives possible values for the speed of sound? **(extended only)**

	speed in gas m/s	speed in liquid m/s	speed in solid m/s
A	972	1450	3560
B	972	3560	1450
C	1450	3560	972
D	3560	972	1450

41 A student draws a diagram to illustrate the different sections of a longitudinal wave.

Which labelled section is a rarefaction?



42 A sheet of ice floats on water. A source of sound S is positioned at the edge of the ice sheet.

Four microphones are placed equal distances from S. **(extended only)**

Which microphone detects the sound from S first?