



MULTIPLE CHOICE

1.1 The Doppler effect is used in medicine to ...

- A detect cancer.
- B determine the length of an artery.
- C monitor the heartbeat of a foetus.
- D monitor the growth rate of a foetus.

1.2 Which ONE of the statements below about the Doppler effect is CORRECT?

- A The Doppler effect is only applicable to sound waves.
- B The Doppler effect can be used to explain the expanding universe.
- C Electrons are ejected from a metal surface by means of the Doppler effect.
- D A stationary listener hears a lower pitch of the sound from a siren of an approaching vehicle because of the Doppler effect.

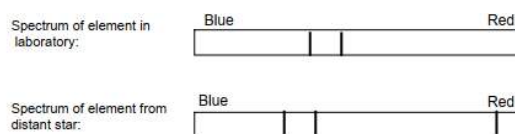
1.3 A sound source is moving relative to a stationary observer. As the sound source moves away from the observer, its frequency appears to decrease because the...

- A wavelength between the source and observer decreases.
- B wavelength between the source and observer increases.
- C wavelength between the source and observer remains unchanged.
- D loudness between the source and observer increases.

1.4 The siren of a stationary train delivers sound waves of frequency 800 Hz. The train starts moving in such a way that the WAVELENGTH of the sound waves that reach a stationary listener, INCREASES. The frequency that the stationary listener hears, could possibly be ...

- A 850 Hz
- B 800 Hz
- C 750 Hz
- D 1 000 Hz (2)

1.5 Astronomers obtained the following spectral lines of an element:



This observation confirms that the ...

- A star is moving towards the earth.
- B star is moving away from the earth.
- C universe enlarges.
- D star is undergoing no relative movement. (2)

1.6 The wavelengths of light emitted by a distant star appear shorter when observed from Earth. From this we can conclude that the star is ...

- A moving towards Earth and the light is blue shifted.
- B moving towards Earth and the light is red shifted.
- C moving away from Earth and the light is red shifted.
- D moving away from Earth and the light is blue shifted.

1.7 An observer moves away from a stationary source. The pitch heard by the observer appears to change because the ...

- A loudness of the source appears to increase.
- B frequency of the source appears to increase.
- C frequency of the source appears to decrease.

D wavelength of the source appears to decrease.

1.8 A stationary observer is listening to the sound coming from a sound source. The listener hears a sound of a lower pitch when compared to that produced by the source. What can you conclude about the source from this observation?

- A The source is at rest.
- B The source is moving towards the listener.
- C The source is moving away from the listener.
- D There is an obstacle between the source and the listener.

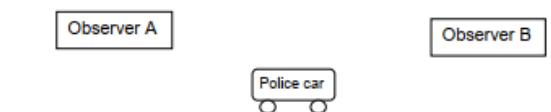
LONG QUESTIONS

QUESTION 6 (2018 MARCH DBE)

A police car is moving at a constant speed on a straight horizontal road. The siren of the car emits sound of constant frequency.

EACH of two observers, A and B, standing some distance apart on the same side of the road, records the frequency of the detected sound.

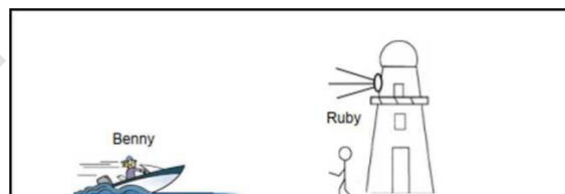
Observer A records a frequency of 690 Hz and observer B records a frequency of 610 Hz.



- 6.1 State the Doppler Effect in words. (2)
 - 6.2 In which direction is the car moving? Choose from TOWARDS A or AWAY FROM A. Give a reason for the answer. (2)
 - 6.3 Determine the speed of the police car. Take the speed of sound in air as 340 m.s^{-1} . (6)
 - 6.4 Name ONE application of the Doppler effect. (2)
- [11]

QUESTION 8 (E.C JUNE 2018)

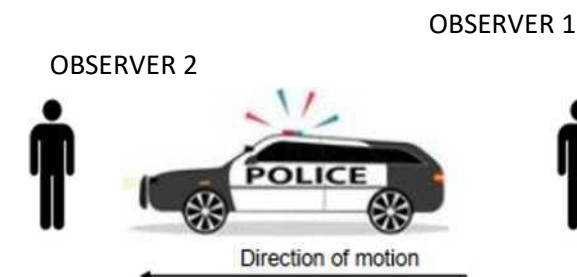
Benny is driving his speedboat at a constant speed towards a lighthouse. The fog horn from the lighthouse blows with a frequency of 180 Hz. The apparent frequency of sound heard by Benny is 188 Hz. Ruby, his friend, stands in front of the lighthouse, as shown in the diagram below. Use the speed of sound in the air as 340 m.s^{-1} .



- 8.1 State the Doppler effect in words. (2)
- 8.2 Explain why Ruby perceives the same frequency of 180 Hz. (2)
- 8.3 How would the wavelength of the sound wave produced by the fog horn change if the frequency of the sound wave is lower than 180 Hz? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)
- 8.4 Give a reason for your answer in QUESTION 8.3. (2)
- 8.5 Calculate the speed of the boat as it approaches the lighthouse. (5)
- 8.6 Ruby runs in the direction of the boat at a constant speed of 5 m.s^{-1} . Show, by calculations, that the frequency Ruby now hears, is lower than 180 Hz. (4)

QUESTION 6 (EC 2018 TRIALS)

6.1 In the diagram below, a police car with its siren blaring, stationed between two stationary observers.



6.1.1 How does the frequency detected by observer 1 compare to the frequency detected by observer 2 while the car is stationary?

Choose from, GREATER THAN, LESS THAN or EQUAL TO. Give a reason for the answer. (2)

6.1.2 The police car starts to move in the direction indicated by the arrow in the diagram. How does the frequency detected by observer 1 compare to the frequency detected by observer 2?

Choose from: GREATER THAN, LESS THAN or EQUAL TO. (1)

6.1.3 Draw a diagram to support the answer in QUESTION 6.1.2. (3)

6.1.4 NAME the phenomenon described in QUESTIONS 6.1.1 and 6.1.2 above. (1)

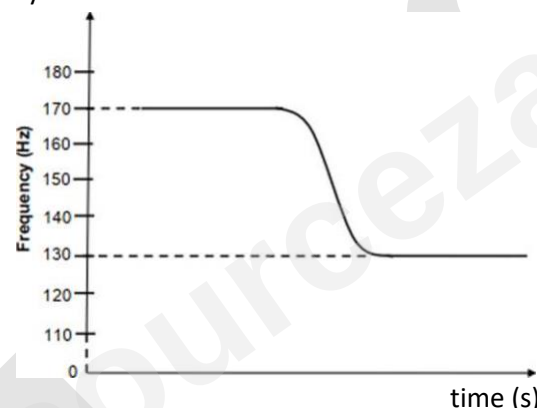
Observer 1 registers a frequency of 1 730 Hz as the police car approaches at a constant velocity of 25 m.s⁻¹. Take the velocity of sound in air as 340 m.s⁻¹.

6.1.5 Calculate the frequency of the siren. (5)

QUESTION 6 (DBE 2017 NOV)

A police car moving at a constant velocity with its siren on, passes a stationary listener.

The graph below shows the changes in the frequency of the sound of the siren detected by the listener.



6.1 State the Doppler Effect in words. (2)

6.2 Write down the frequency of the sound detected by the listener as the police car:

6.2.1 Approaches the listener (1)

6.2.2 Moves away from the listener (1)

6.3 Calculate the speed of the police car.

Take the speed of sound in air to be 340 m.s⁻¹.

(6)

[10]

QUESTION 6 (2017 E. C TRIALS)

An ambulance moves away from an accident scene at a constant speed with its siren producing sound waves at a frequency of 890 Hz. A detector at the scene measures 90% of the frequency of sound waves produced by the siren as the ambulance moves away.

6.1 What phenomenon is being described above? (1)

6.2 Explain, in terms of wave motion, why the detector measures 90% of the frequency of sound waves emitted by the ambulance. (2)

Assume that the speed of sound in air is 340 m.s⁻¹

6.3 Calculate the speed of the ambulance. (5)

6.4 What is the use of the Doppler flow meter in the medical field? (1)

6.5 The diagram below shows spectral lines for a nearby star and a distant star as observed from Earth.



- 6.5.1 Is the nearby star moving towards or away from Earth? (2)
- 6.52 Compare the motion of the nearby star and the distant star as observed from Earth. Which ONE of them is moving faster? (2)
- [12]**

QUESTION 6 (DBE MARCH 2017)

6.1 A sound source is moving at constant velocity past a stationary observer. The frequency detected as the source approaches the observer is 2 600 Hz. The frequency detected as the source moves away from the observer is 1 750 Hz.

Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$.

- 6.1.1 Name the phenomenon that describes the apparent change in frequency detected by the observer. (1)
- 6.1.2 State ONE practical application of the phenomenon in QUESTION 6.1.1 in the field of medicine. (1)
- 6.1.3 Calculate the speed of the moving source. (6)
- 6.1.4 Will the observed frequency INCREASE, DECREASE or REMAN THE SAME if the velocity of the source increased as it:

- (a) Moves towards the observer (1)
- (b) Moves away from the observer (1)
- 6.2 Spectral lines of star X at an observatory are observed to be red shifted.
- 6.2.1 Explain the term red shifted in terms of wavelength. (2)
- 6.2.2 Will the frequency of the light observed from the star INCREASE, DECREASE or REMAN THE SAME? (1)
- [13]**

2013 MARCH

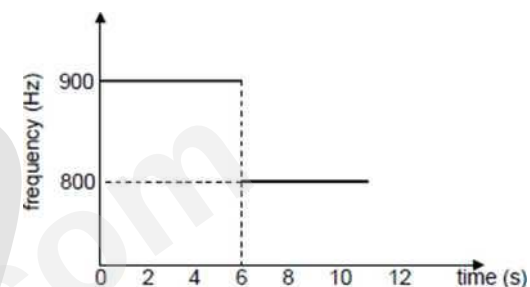
QUESTION 6 (Start on a new page.)

The siren of a stationary ambulance emits sound waves at a frequency of 850 Hz.

An observer, travelling in a car at a constant speed in a straight line, begins measuring the frequency of the sound waves emitted by the siren when he is at a distance x from the ambulance.

The observer continues measuring the frequency as he approaches, passes and moves away from the ambulance.

The results obtained are shown in the graph below.



- 6.1 The observed frequency suddenly changes at $t = 6 \text{ s}$. Give a reason for this sudden change in observed frequency.
- 6.2 Calculate the:
- 6.2.1 Speed of the car
- (Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$.)
- 6.2.2 Distance x between the car and the ambulance when the observer BEGINS measuring the frequency

2013 NOV

QUESTION 6

An ambulance approaches a stationary observer at a constant speed of $10,6 \text{ m}\cdot\text{s}^{-1}$, while its siren produces sound at a constant frequency of 954,3 Hz. The stationary observer measures the frequency of the sound as 985 Hz.

- 6.1 Name the medical instrument that makes use of the Doppler effect. (1)

6.2 Calculate the velocity of sound. (6)

6.3 How would the wavelength of the sound wave produced by the siren of the ambulance change if the frequency of the wave were higher than 954.3 Hz?

Write down only INCREASES, DECREASES or STAYS THE SAME. (1)

6.4 Give a reason for the answer to QUESTION 6.3. (2)

QUESTION 6 (NOV DBE 2014.)

6.1 The siren of a stationary ambulance emits a note of frequency 1 130 Hz. When the ambulance moves at a constant speed, a stationary observer detects a frequency that is 70 Hz higher than that emitted by the siren.

6.1.1 State the Doppler effect in words.

6.1.2 Is the ambulance moving towards or away from the observer?

Give a reason for the answer.

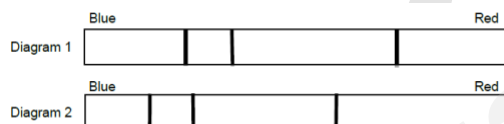
6.1.3 Calculate the speed at which the ambulance is travelling. Take the speed of sound in air as 343 m s^{-1} .

6.2 A study of spectral lines obtained from various stars can provide valuable information about the movement of the stars.

The two diagrams below represent different spectral lines of an element.

Diagram 1 represents the spectrum of the element in a laboratory on Earth.

Diagram 2 represents the spectrum of the same element from a distant star.



Is the star moving towards or away from the Earth? Explain the answer by referring to the shifts in the spectral lines in the two diagrams above. (2) [11]

QUESTION 6 2014 MARCH

A sound source on a car produces sound waves of frequency 850 Hz. A stationary

observer measures the emitted frequency using a detector which can measure a maximum frequency of 800 Hz. He finds that the detector only registers a reading whilst the car is moving. (Ignore the effects of wind.)

6.1 Must the car move TOWARDS or AWAY from the observer for the detector to register a reading?

Explain the answer by referring to frequency or wavelength. (3)

6.2 Calculate the minimum speed at which the car must move for the detector to Register the maximum reading. Take the speed of sound in air as 340 m s^{-1} . (5)

6.3 State ONE use of the Doppler effect in medicine. (1) [9]

Sept 2014 EASTERN CAPE

QUESTION 6 (Start on a new page.)

An ambulance approaches an accident scene at a constant velocity. The siren of the ambulance emits sound waves with a constant, unknown frequency. A detector at the scene measures the frequency as 1,07 times the frequency of the siren.

6.1 State the DOPPLER EFFECT for sound in words.

6.2 Calculate the speed at which the ambulance approaches the accident scene. Use the speed of sound in air as 340 m s^{-1} .

6.3 Explain, in terms of wave motion, why the frequency detected by the detector is higher than the frequency of the source.

6.4 State TWO uses of the Doppler flow meter in humans.

6.5 A line in a hydrogen spectrum has a frequency of $7,55 \times 10^{14}$ Hz when measured in a laboratory. The same line in the light of a star has a frequency of $7,23 \times 10^{14}$ Hz. Is this star moving TOWARDS or AWAY from the Earth? Explain your answer.

JUNE 2014 COMMON

QUESTION 6

An ambulance with its siren on, is moving at a constant speed of $37,5 \text{ m.s}^{-1}$, towards an accident scene. A police officer, seated in his stationary car at the accident scene holds a detector in his hands. The detector can measure a maximum frequency of 580 Hz. Ignore the effects of wind when answering the following questions.

6.1 Calculate the frequency of the sound waves produced by the sound source in the ambulance so that the detector registers a maximum reading. Take the speed of sound in air as 340 m.s^{-1} . (4)

6.2 The phenomenon observed here, is the Doppler effect. Define the Doppler effect. (2)

6.3 The speed of the ambulance is increased to $41,5 \text{ m.s}^{-1}$. Will the detector now

register a reading? Give a reason for your answer. (3)

6.4 How will the frequency of the sound wave observed by the driver in the ambulance compare to that emitted by the siren in the ambulance. (Write down LESS THAN, EQUAL TO or GREATER THAN).

Give a reason for your answer. (2)

6.5 How is Doppler effect noticed with

6.5.1 soundwaves? (1)

6.5.2 lightwaves? (1)

6.6 Describe ONE positive impact of the Doppler effect in medicine. (3)

2015 MARCH

QUESTION 6 (Start on a new page.)

The Doppler effect is applicable to both sound and light waves. It also has very important applications in our everyday lives.

6.1 A hooter on a stationary train emits sound with a frequency of 520 Hz, as detected by a person standing on the platform. Assume that the speed of sound is 340 m.s^{-1} in still air.

Calculate the:

6.1.1 Wavelength of the sound detected by the person (2)

6.1.2 Wavelength of the sound detected by the person when the train moves towards him/her at a constant speed of 15 m.s^{-1} with the hooter still emitting sound (6)

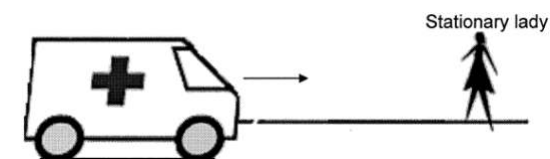
6.2 Explain why the wavelength calculated in QUESTION 6.1.1 differs from that obtained in QUESTION 6.1.2. (2)

6.3 Use your knowledge of the Doppler effect to explain red shifts. (2) [12]

QUESTION 8 2008 NOV

An ambulance travelling down a road at constant speed emits sound waves from its siren. A lady stands on the side of the road with a detector which registers soundwaves at a frequency of 445 Hz as the ambulance approaches her.

After passing her, and moving away at the same constant speed, sound waves of frequency 380 Hz are registered.



Assume that the speed of sound in air is 343 m s^{-1} .

8.1 Name the phenomenon that describes the change in the frequency observed by the lady.

8.2 Calculate:

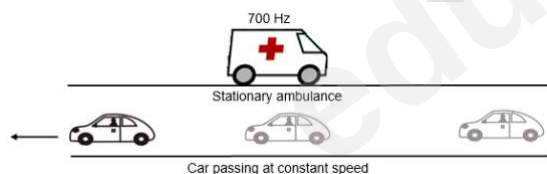
8.2.1 The speed at which the ambulance is moving

8.2.2 The frequency at which the siren emits the sound waves

QUESTION 8 2008 add. Exemplar

The sketch below shows a stationary ambulance. The siren of the ambulance emits sound waves of frequency 700 Hz .

The driver of a car approaching the ambulance and passing it at constant speed, observes the frequency of the emitted sound waves to change by 80 Hz .



8.1 Name and state the wave phenomenon illustrated above. (3)

8.2 Take the speed of sound in air as 340 m s^{-1} and calculate the speed at which the car passes the ambulance. (6)

[8]

4.2 QUESTION 6 (NOV. 2012)

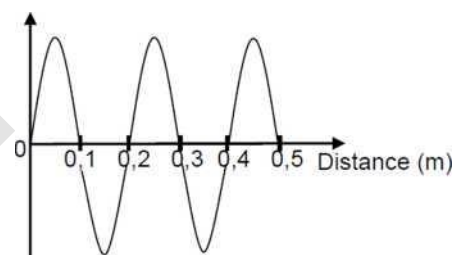
A bird flies directly towards a stationary birdwatcher at constant velocity. The bird constantly emits sound waves at a frequency of $1\,650 \text{ Hz}$. The birdwatcher hears a change in pitch as the bird comes closer to him.

6.1 Write down the property of sound that is related to pitch. (1)

6.2 Give a reason why the birdwatcher observes a change in pitch as the bird approaches him. (1)

The air pressure versus distance graph below represents the waves detected by the birdwatcher as the bird comes closer to him. The speed of sound in air is 340 m s^{-1} .

Air pressure



From the graph, write down the wavelength of the detected waves. Calculate the:

6.4.1 Frequency of the waves detected by the birdwatcher

6.4.2 Magnitude of the velocity at which the bird flies

4.8 QUESTION 7 (MAR. 2010)

An ambulance with its siren on, moves away at constant velocity from a person standing next to the road. The person measures a frequency which is 90% of the frequency of the sound emitted by the siren of the ambulance.

7.1 Name the phenomenon observed.

7.2 If the speed of sound in air is 340 m s^{-1} , calculate the speed of the ambulance.

4.10 QUESTION 6 (MAR. 2011)

The whistle of a train emits sound waves of frequency $2\,000 \text{ Hz}$. A stationary listener measures the frequency of these emitted sound waves as $2\,080 \text{ Hz}$. The speed of sound in air is 340 m s^{-1} .

6.1 Name the phenomenon responsible for the observed change in frequency. (1)

6.2 Is the train moving AWAY FROM or TOWARDS the stationary listener? (1)

6.3 Calculate the speed of the train. (4)

6.4 Will the frequency observed by a passenger, sitting in the train, be GREATER THAN, EQUAL TO or SMALLER THAN 2 000 Hz? Explain the answer. (2)

[8]

QUESTION 6 (EXEMPLAR 2014)

The siren of a stationary police car emits sound waves of wavelength 0,55 m.

With its siren on, the police car now approaches a stationary listener at constant velocity on a straight road. Assume that the speed of sound in air is 345 m s^{-1} .

6.1 Will the wavelength of the sound waves observed by the listener be GREATER THAN, SMALLER THAN or EQUAL TO 0,55 m? (1)

6.2 Name the phenomenon observed in QUESTION 6.1. (1)

6.3 Calculate the frequency of the sound waves observed by the listener if the car approaches him at a speed of 120 km h^{-1} . (7)

6.4 How will the answer in QUESTION 6.3 change if the police car moves away from the listener at 120 km h^{-1} ? Write down only INCREASES, DECREASES or REMAINS THE SAME.

QUESTION 6 (2014 MARCH)

A sound source on a car produces sound waves of frequency 850 Hz. A stationary observer measures the emitted frequency using a detector which can measure a maximum frequency of 800 Hz. He finds that the detector only registers a reading whilst the car is moving. (Ignore the effects of wind.)

6.1 Must the car move TOWARDS or AWAY from the observer for the detector to register a reading?

Explain the answer by referring to frequency or wavelength. (3)

6.2 Calculate the minimum speed at which the car must move for the detector to register the maximum reading.

Take the speed of sound in air as 340 m s^{-1} . (5)

6.3 State ONE use of the Doppler effect in medicine. (1)