Quiz C16.2

The Doppler effect HL

1. The shift in the wavelength of light emitted by a galaxy is measured on Earth. The shift allows the determination of

A the speed of the galaxy.
B the velocity of the galaxy.
C the component of the velocity along the line of sight.
D the component of the velocity at right angles to the line of sight.

2. A train approaches a stationary observer. The speed of the train is 40 m s^{-1} and the speed of sound is 340 m s^{-1}. The train emits sound of frequency 5.00×10^2 Hz. What is the frequency heard by the observer?

A 559 Hz **B** 567 Hz **C** 447 Hz **D** 441 Hz

3. An observer approaches a stationary source of sound with speed 30 m s^{-1} and the speed of sound is 330 m s^{-1}. The source emits sound of frequency 6.00×10^2 Hz. What is the frequency measured by the observer?

A 660 Hz **B** 655 Hz **C** 550 Hz **D** 545 Hz

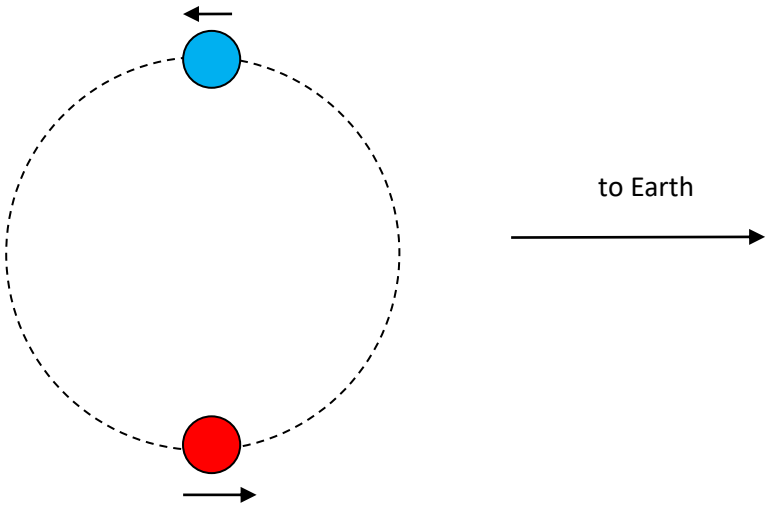
4. A train moves away from a stationary observer. The speed of sound is *c* and speed of the train is $\frac{c}{10}$. The train emits sound of wavelength 4.0 m. What is the wavelength measured by the observer?

A $\frac{22}{5}$ m **B** $\frac{18}{5}$ m **C** $\frac{40}{11}$ m **D** $\frac{40}{9}$ m

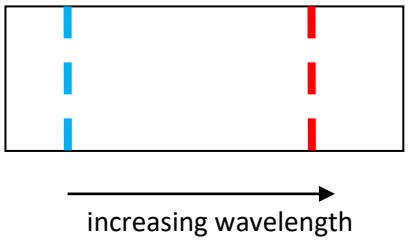
5. An observer approaches a stationary source of sound. The speed of sound is *c* and speed of the observer is $\frac{c}{5}$. The source emits sound of wavelength 5.0 m. What is the wavelength measured by the observer?

A 6.0 m **B** 5.0 m **C** 4.0 m **D** 3.0 m

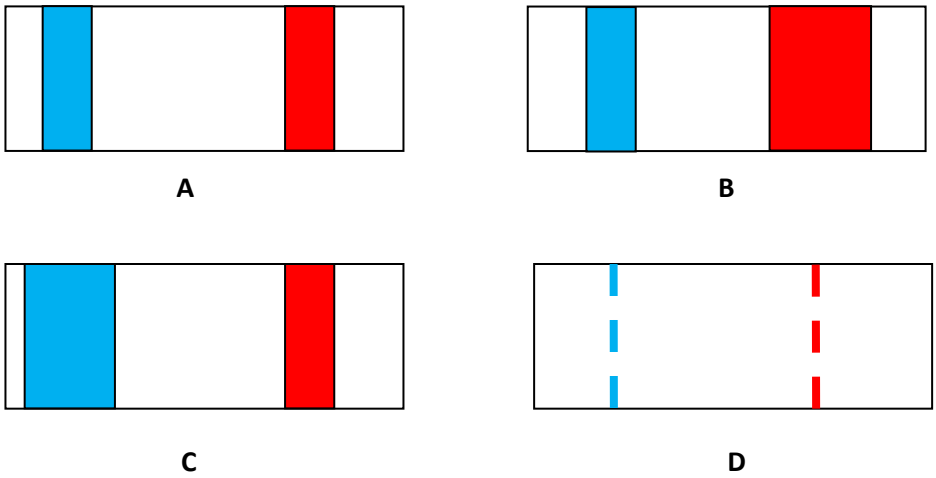
6. Two stars orbit the same centre in the same circular orbit. One star emits blue light and the other red.



The diagram below shows, at the star positions shown, the spectrum of the two stars on a wavelength scale according to an observer at the centre of the orbit.



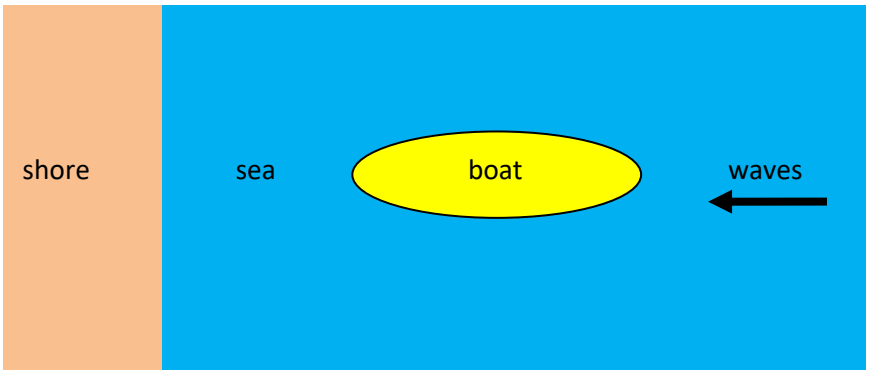
What is the spectrum observed on Earth in the course of a full revolution of the stars?



7. Sound of frequency f is emitted by a source that moves towards a stationary observer with a speed $\frac{c}{10}$ where c is the speed of sound. What is the frequency heard by the stationary observer according to the approximate Doppler formula and the exact Doppler formula?

	Approximate formula	Exact formula
A	$\frac{9f}{10}$	$\frac{10f}{9}$
B	$\frac{9f}{10}$	$\frac{9f}{10}$
C	$\frac{11f}{10}$	$\frac{10f}{9}$
D	$\frac{11f}{10}$	$\frac{9f}{10}$

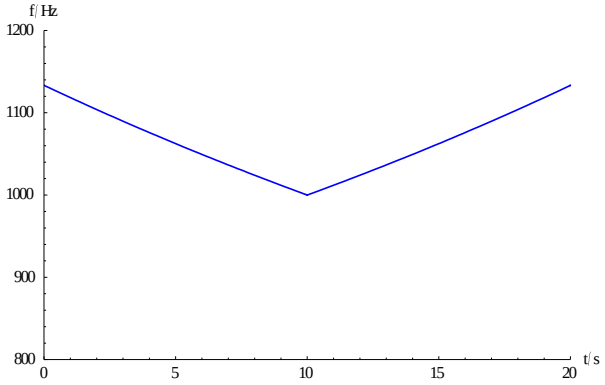
8. Observers on the shore measure a frequency of 4.0 Hz for water waves approaching the shore. Observers on a boat measure a frequency 3.0 Hz. The speed of the water waves relative to the shore is 4.0 m s^{-1}.



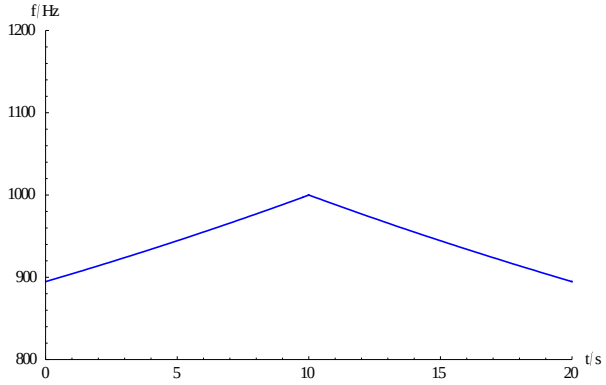
What is the velocity of the boat?

	Magnitude	Direction
A	1.0 m s^{-1}	Away from the shore
B	1.0 m s^{-1}	Towards the shore
C	1.3 m s^{-1}	Away from the shore
D	1.3 m s^{-1}	Towards the shore

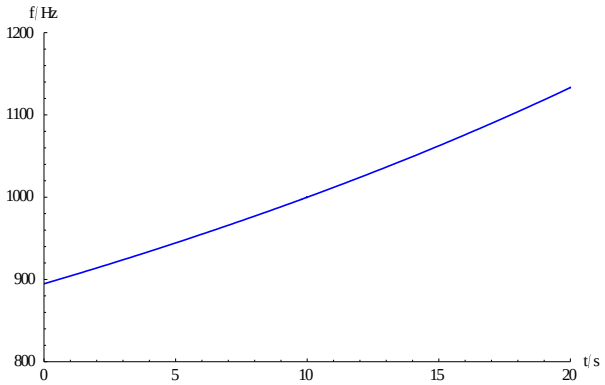
9. A decelerating train approaches a train station, comes to rest at t = 10 s at the train station and then immediately accelerates away. The train horn emits sound of frequency 1000 Hz. What is the variation with time of the frequency heard by an observer at the train station.



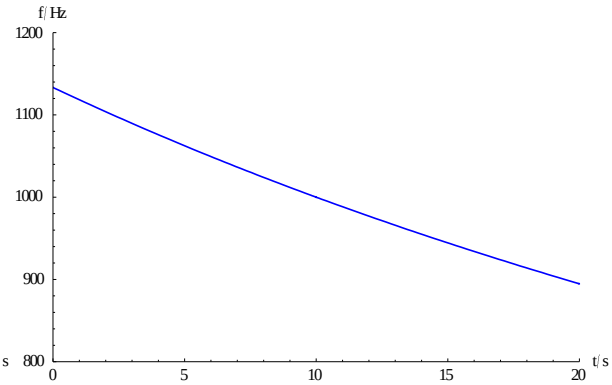
A



B



C



D

10. Ultrasound of frequency f is emitted from a stationary source towards an approaching car. The ultrasound is reflected by the car and arrives at the source. The speed of the car is v and the speed of ultrasound is c. Which expression gives the frequency shift at the source (i.e. frequency received minus frequency emitted)?

A $\frac{2vf}{c-v}$ **B** $\frac{2vf}{c+v}$ **C** $\frac{2cf}{c-v}$ **D** $\frac{2cf}{c+v}$

Quiz C16.2 Answers	
1	C
2	B
3	B
4	A
5	B
6	B
7	C
8	B
9	D
10	A