IGCSE (EDEXCEL) Physics : Doppler effect

Q1. Diagram 2 shows the boat moving towards an observer.

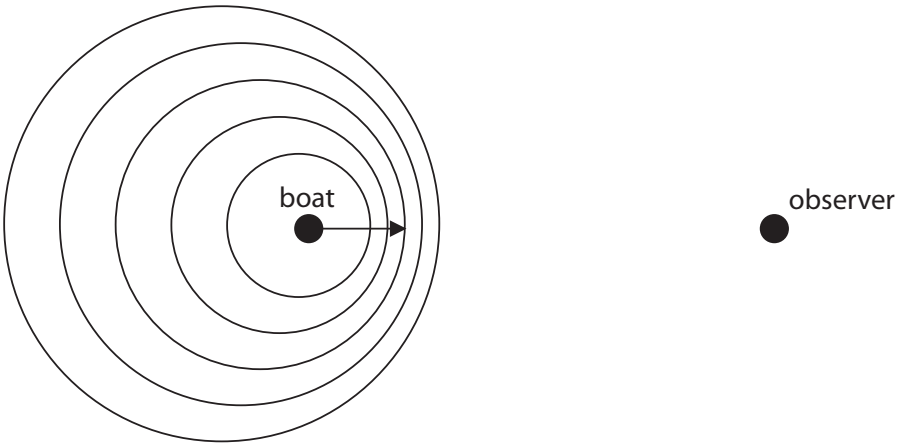


Diagram 2

Explain why the frequency of the water waves measured by the observer is larger than the frequency of the water waves created by the boat.

(3)

Q2. A toy produces continuous waves when floating on the surface of a pool of water. The waves spread out as circular wavefronts.

Diagram 1 shows the wavefronts produced when the toy is not moving, as viewed from above.
Diagram 2 shows the wavefronts produced when the toy is moving across the surface of the pool of water.

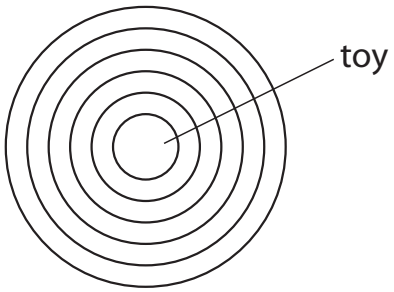


Diagram 1

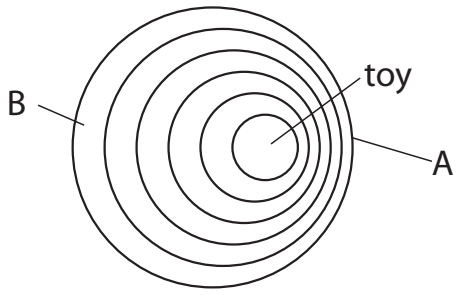


Diagram 2

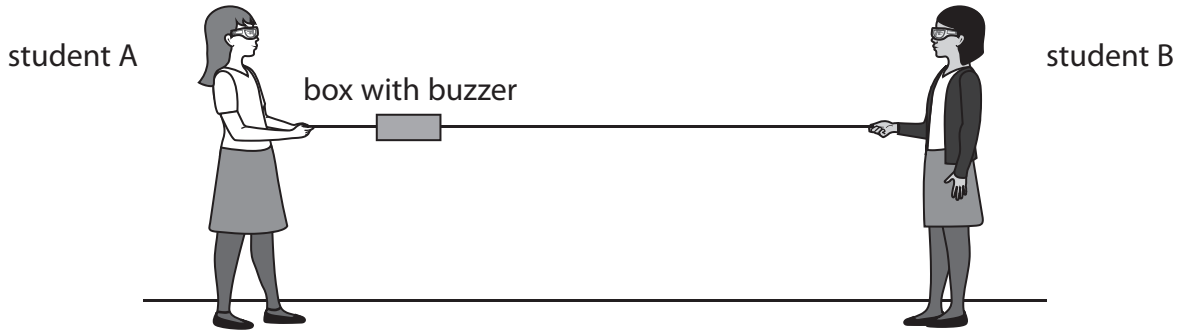
(a) Draw an arrow on diagram 2 to show the direction the toy is moving.

(1)

(b) Explain how the frequency of the waves at point A is different to the frequency of the waves at point B.

(4)

Q3. The diagram shows two students holding a piece of string with a box attached. The box has a buzzer inside and can move along the string.



The buzzer in the box emits a loud sound of constant frequency.
The box moves away from student A at a constant speed. Explain why the sound heard by student A has a different frequency to the sound emitted by the buzzer.

(5)

Q4. A radar speed gun is used to measure the speed of the moving car.
The radar speed gun emits radio waves towards the moving car. The moving car reflects the radio waves back to a detector on the gun. The detected radio waves have a different frequency from the emitted radio waves. This change in frequency is used to measure the speed of the moving car.

Explain this change in frequency when the car is moving towards the radar speed gun.

(4)

Q5. Diagram 1 shows two identical buzzers connected with springs.

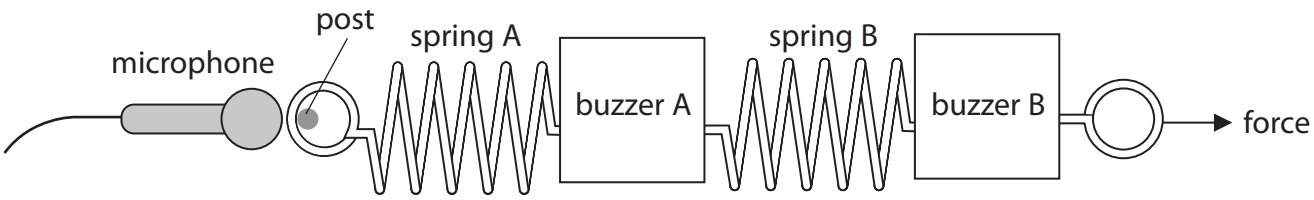


Diagram 1

A student connects the microphone to an oscilloscope to measure the frequency of sound from the two buzzers while the force acts on the arrangement.
Explain the difference in the measured frequencies of sound from buzzer A compared to buzzer B.

(3)

Q6. This question is about using radio waves to track an aeroplane.

aeroplane

aerial at airport

(a) Radio waves are emitted from an aerial at an airport, and are then reflected back to the aerial from an aeroplane. The time taken between emitting the radio waves and receiving the waves back at the aerial is 1.9 milliseconds.

Show that the aeroplane is approximately 300 km away from the aerial.
[speed of radio waves = 3.0 × 105 km/s]

(3)

(b) As the aeroplane travels away from the airport, it sends a signal to the airport using radio waves with a wavelength of 1.2 m. When the signal is received at the airport, the wavelength is 1.1×10^{-6} m longer than when it is emitted by the aeroplane.

Calculate the speed of the aeroplane using the formula

$$\frac{\text{change of wavelength}}{\text{wavelength}} = \frac{\text{speed of aeroplane}}{\text{speed of radio wave}}$$

[speed of radio waves = 3.0×10^{8} m/s]

(3)

speed of aeroplane = _____ m/s

Q7. This question is about satellites and their orbits.

(a) (i) State a difference between an artificial satellite's orbit and a planet's orbit.

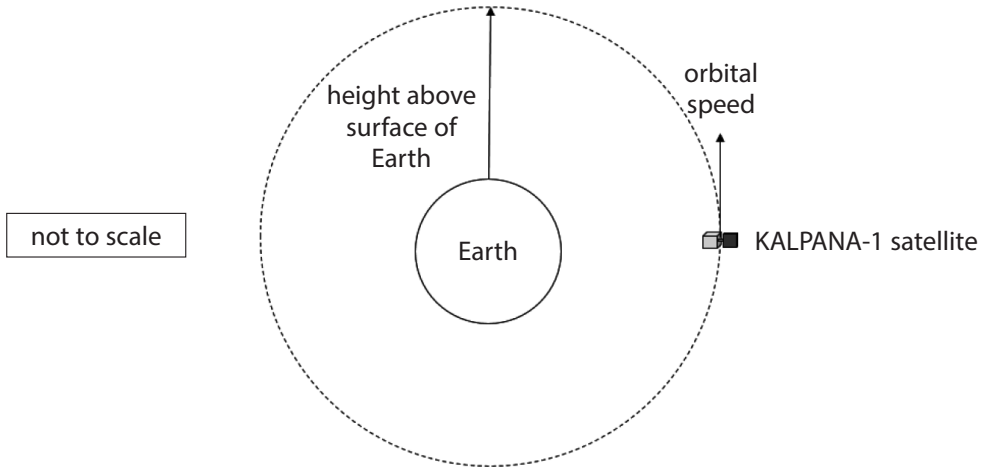
(1)

(ii) State a similarity between an artificial satellite's orbit and a moon's orbit.

(1)

(b) KALPANA-1 was an artificial satellite used to monitor the weather.

(i) The diagram shows the orbit of the satellite.



KALPANA-1 has an orbital speed of 3.1 km/s and completes one orbit in 24 hours.
Calculate the height of KALPANA-1's orbit above the Earth's surface.
[radius of Earth = 6400 km]

(4)

height above surface = _____ km

(ii) The Doppler effect occurs when there is relative motion between the source of waves and the observer of the waves.

Explain how the Doppler effect causes a change in the observed frequency of the waves.

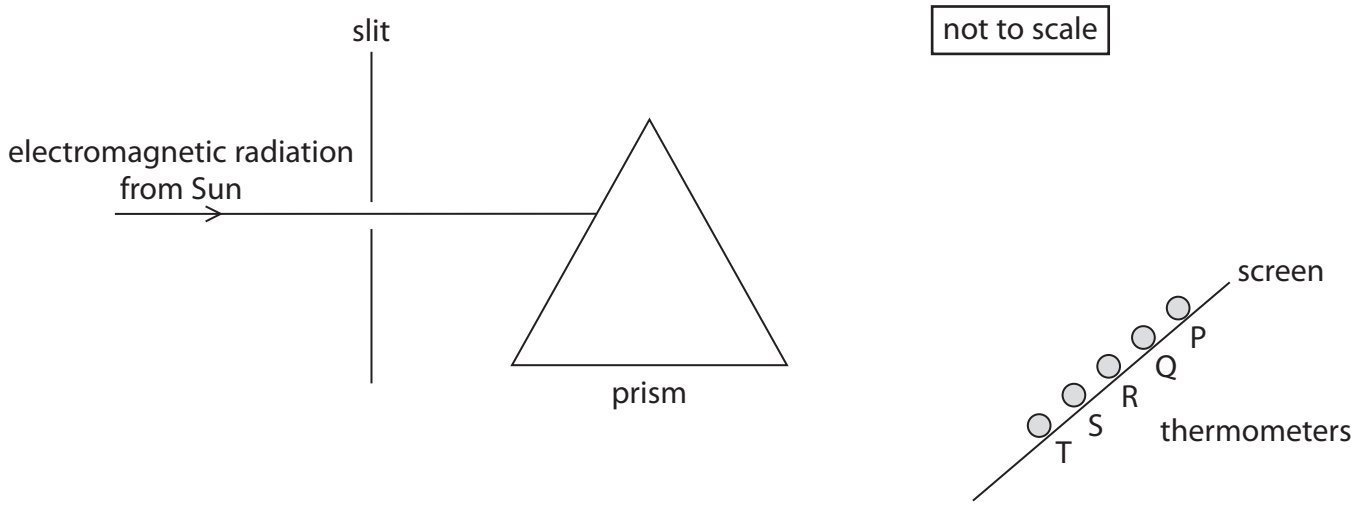
(3)

(iii) Suggest why the radio waves from KALPANA-1 detected on the Earth's surface are not affected by the Doppler effect.

(2)

Q8. The diagram shows the apparatus used to demonstrate the existence of electromagnetic radiation just beyond the visible spectrum.

Electromagnetic radiation from the Sun passes through a slit and a prism.
The electromagnetic radiation refracts through the prism onto the screen.
Five thermometers are placed in front of the screen.



Complete the table to show the missing parts of the electromagnetic spectrum.

Thermometer	Part of electromagnetic spectrum
P	
Q	red light
R	
S	violet light
T	