SUBJECT and GRADE	**Physical Sciences Grade 12**
TERM 2	*Week 3&4*
TOPIC	Doppler Effect
AIMS OF LESSON	Introducing the concept of the Doppler Effect and explaining the applications of the Doppler Effect with sound and ultrasound as well as with light. Problems will be solved using the Doppler Effect equation that will be introduced in this topic.
INTRODUCTION	• Concepts such as frequency, wavelength, wave speed, sound waves (longitudinal waves) and electromagnetic spectrum should already be familiar to learners from Waves, Sound and Light that were discussed in grade 10. It was also discussed that pitch of sound waves was directly related to frequency of sound waves. Learners should already be familiar with using the formulae v = fλ or T = $\frac{1}{f}$ from grade 10. • With the Doppler Effect we can explain certain phenomena such as red shifts and blue shifts as well as helping us explain why we can conclude that the universe is expanding.
CONCEPTS AND SKILLS	• State the Doppler Effect in words. (as per Examination guideline page 11 and Mind the Gap (MTG) page 84) The Doppler Effect with sound and ultrasound • Explain (using appropriate illustrations) the change in pitch observed when a source moves toward or away from a listener. (MTG page 84) • Solve problems using the equation $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ when EITHER the source or the listener is moving. (MTG page 85) • State applications of the Doppler Effect with ultrasound. (MTG page 88) The Doppler Effect with light – red shifts in the universe (evidence for the expanding universe) • Explain red shifts and blue shifts using the Doppler Effect. (MTG page 88) • Use the Doppler Effect to explain why we conclude that the universe is expanding. (MTG page 88) *Key points to consider when studying this topic:* • The Doppler Effect is the change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. When the pitch is high, the frequency is high and vice versa. When a source of sound is moving towards a stationary listener the pitch will be high and when it moves away from the stationary listener the pitch will be low.

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Remember that either the source of sound or the listener observing the sound will move and not both at the same time.
You should be able to perform calculations based on the formulae $f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ and v = fλ or T = $\frac{1}{f}$.
The speed of sound in air (v) is 340 m.s^{-1} unless stated otherwise.
Highlight and study definitions from the examination guidelines (page 11).
Common mistakes made: Learners do not state the definition of the Doppler Effect as per examination guidelines, learners do not convert to SI units.
When performing Doppler Effect calculations, it is important to write the correct formula from the datasheet as is and only manipulate the formula afterwards. Solve the problem by determining the unknown value. Sometimes it could be expected to solve two equations simultaneously to determine the answer.
Remember when interpreting graphs of frequency versus time that where there is a change in the curve that is when the apparent change in frequency occurs.

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<tr><td>ACTIVITIES/ ASSESSMENT</td><td colspan="2">Learners are referred to Doppler Effect activities/assessment that they can complete/do in their Physical Sciences textbooks or Study guides.
Informal assessment activities in Mind the Gap:
• Calculations based on using the Doppler Effect formula: Activity 1-2 (page 85-87)</td></tr>
<tr><td>CONSOLIDATION</td><td colspan="2">In this topic the concept of the Doppler Effect was introduced and the applications of the Doppler Effect were discussed. Learners should have engaged in a variety of problems involving the change in frequency when a sound source emitting sound and listener is moving relative to each other. We looked at the applications of the Doppler Effect with sound and ultrasound as well as with light. At the end of this lesson learners should have a better understanding of red shifts and blue shifts and should be able to explain why we can conclude that the universe is expanding.</td></tr>
<tr><td rowspan="2">RESOURCES</td><td>Paper based resources</td><td>Digital resources</td></tr>
<tr><td>Learners are referred to the:
• Doppler Effect topic in the textbook or study guides (e.g. Answer Series) that learners will have on hand.
• Examination Guideline (page 11)
• Mind the Gap books (pages 81-89)
• Past NSC Examination papers (refer to question 6)</td><td>Refer to the relevant digital resources:
• WCED ePortal https://wcedeportal.co.za
• Past NSC Examination papers (refer to question 6) https://wcedonline.westerncape.gov.za/grade-12-question-papers
• Telematics https://wcedonline.westercape.gov.za/edumedia/revision-dvds-telematics
• Mind the Gap https://wcedonline.westercape.gov.za/mind-gap
• HeyScience App for Physical Sciences on Play Store</td></tr>
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