2020 Sec 4 Physics Notes Answers
Chapter 11 General Wave Properties

11.1 Describing wave motion

- energy

11.12 Vibrations in springs

- transverse
- longitudinal

11.13 Waves in a ripple tank

Example 11.1
- Answer: A

11.2 Wave terms

- distance, per second.
- number
- time
- distance, crests, troughs
- magnitude, maximum
- line

11.21 Wave equation

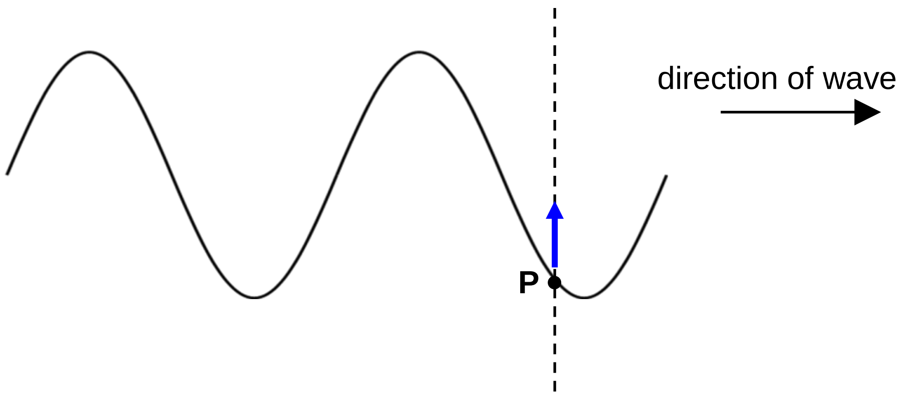
Example 11.2

(a) $v = f\lambda$
$= (6.0)(0.500)$
$= 3.0 \text{ m s}^{-1}$

(b) $\lambda = v / f$
$= (3.0) / (2.5)$
$= 1.2 \text{ m}$

11.22 Motion of waves and particles

Example 11.3



Also see video at *http://www.showme.com/sh/?h=EyApfHs*

11.3 Longitudinal and transverse waves

11.31 Longitudinal waves

- parallel
- Explore the properties of longitudinal waves and corresponding graphs using the simulation at *http://ngsir.netfirms.com/englishhtm/Lwave.htm*

11.32 Transverse waves

- perpendicular
- Explore the properties of transverse waves and corresponding graphs using the simulation at *http://ngsir.netfirms.com/englishhtm/TwaveA.htm*

Note: The above simulations are Java applets and may not run on iPads

11.33 Classification of waves

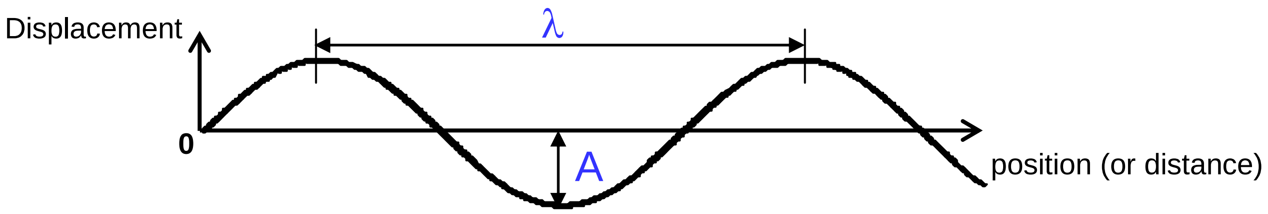
	Nature of vibrations	**Type of waves**
Examples of waves	*Mechanical or electromagnetic (EM)?*	*Transverse or longitudinal?*
• Along a rope (or string)	Mechanical	Transverse
• Along a spring (e.g. a slinky spring)	Mechanical	Transverse or longitudinal
• Water waves (e.g. in a ripple tank)	Mechanical	Transverse
• Sound waves	Mechanical	Longitudinal

• Electromagnetic waves	Electomagnetic	Transverse
• Earthquake waves	Mechanical	Transverse (secondary seismic wave or S waves) Longitudinal (primary seismic wave or P waves)

11.34 Displacement-position graph

Note: Revisit simulations used in sections 11.31 and 11.32.

- On the graph below, label clearly the amplitude A and wavelength λ.



Example 11.4

(a) Based on the displacement-position graph above, is it possible to determine whether it is for a transverse wave or a longitudinal wave? Explain your answer.

No, displacement-position graph is just a representation of the displacement of the particles with their position as the waves pass through them.

(b) What is the direction of motion of the particles in the displacement-position graph for

(i) longitudinal waves?

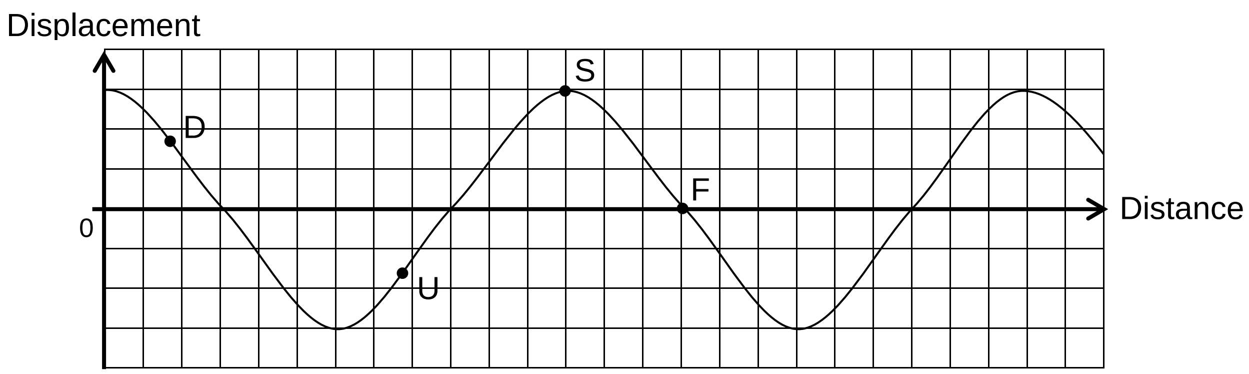
Direction of motion of particles is parallel to the direction of the wave.

(ii) transverse waves?

Direction of motion of particles is perpendicular to the direction of the wave.

Example 11.5
(a) 5.0 cm
(b) 20.0 cm

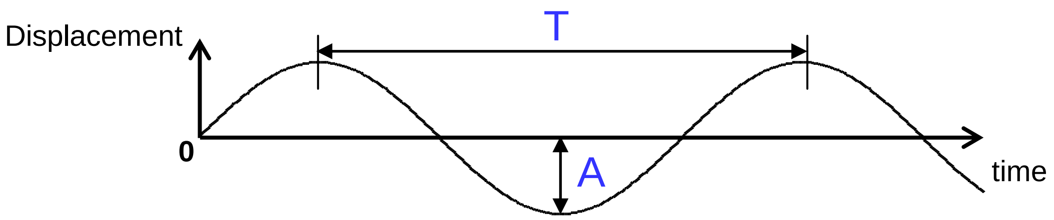
Example 11.6



Accept other reasonable answers

11.35 Displacement-time graph

- On the graph below, label clearly the amplitude A and period T.



Example 11.7

(a) longitudinal waves?

Direction of motion of particles is parallel to the direction of the wave.

(b) transverse waves?

Direction of motion of particles is perpendicular to the direction of the wave.

How do the answers above compare to that of the displacement-position graph?

- Same answers

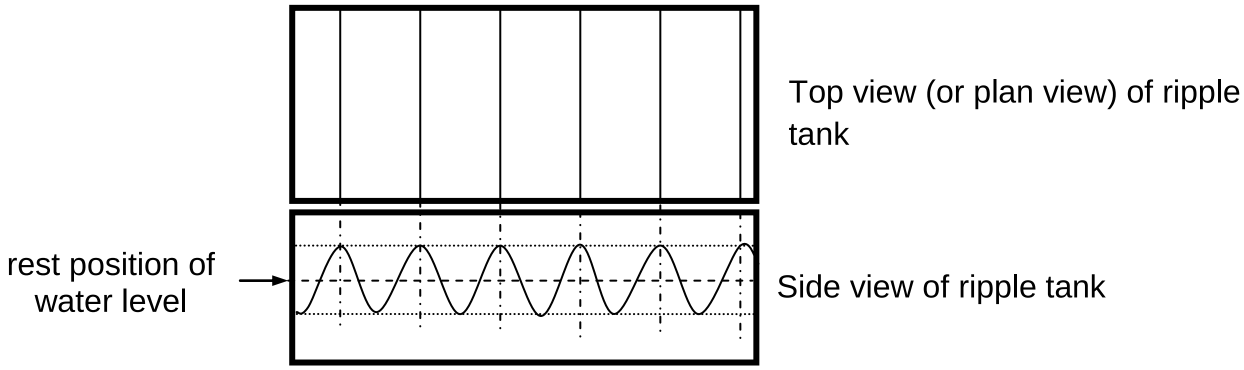
Example 11.8

(i) True (ii) False (iii) True (iv) True

11.4 Reflection and refraction of plane waves

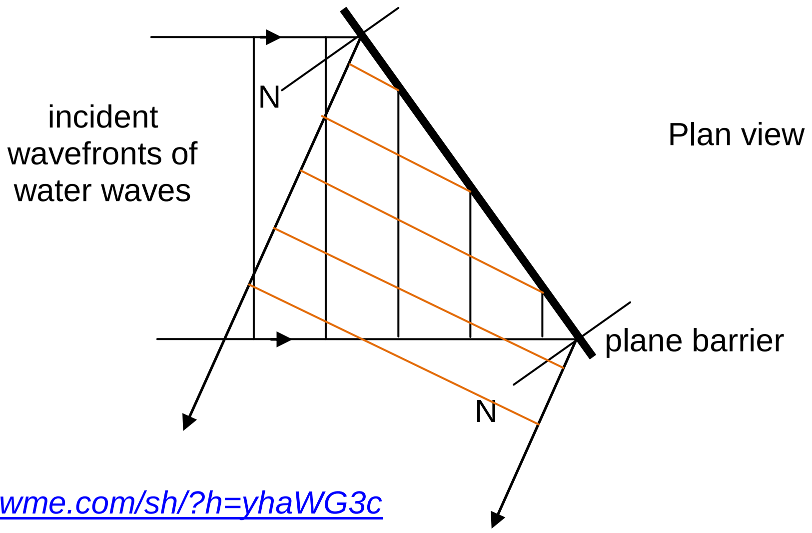
11.41 Reflection of plane wavefronts

- Draw the side view of the ripple tank to show the wave profiles.



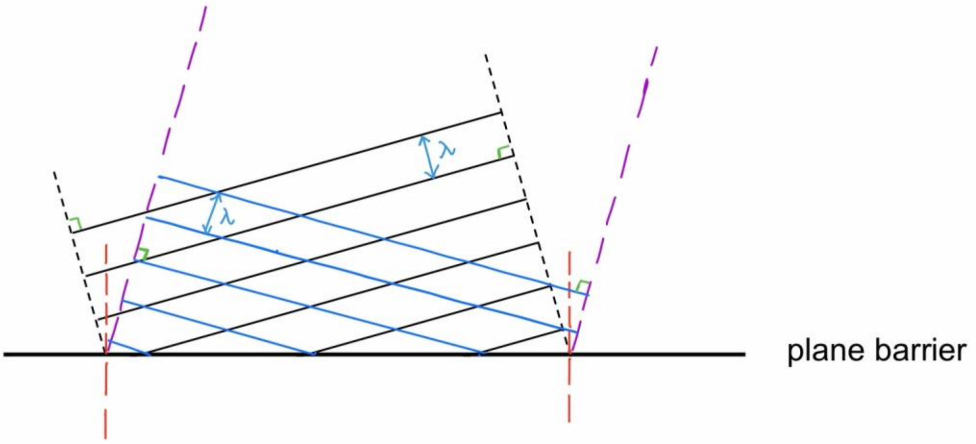
Also see video at *http://www.showme.com/sh/?h=oqBa49o*

- **Reflected plane wavefronts**



Also see video at *http://www.showme.com/sh/?h=yhaWG3c*

Optional exercise

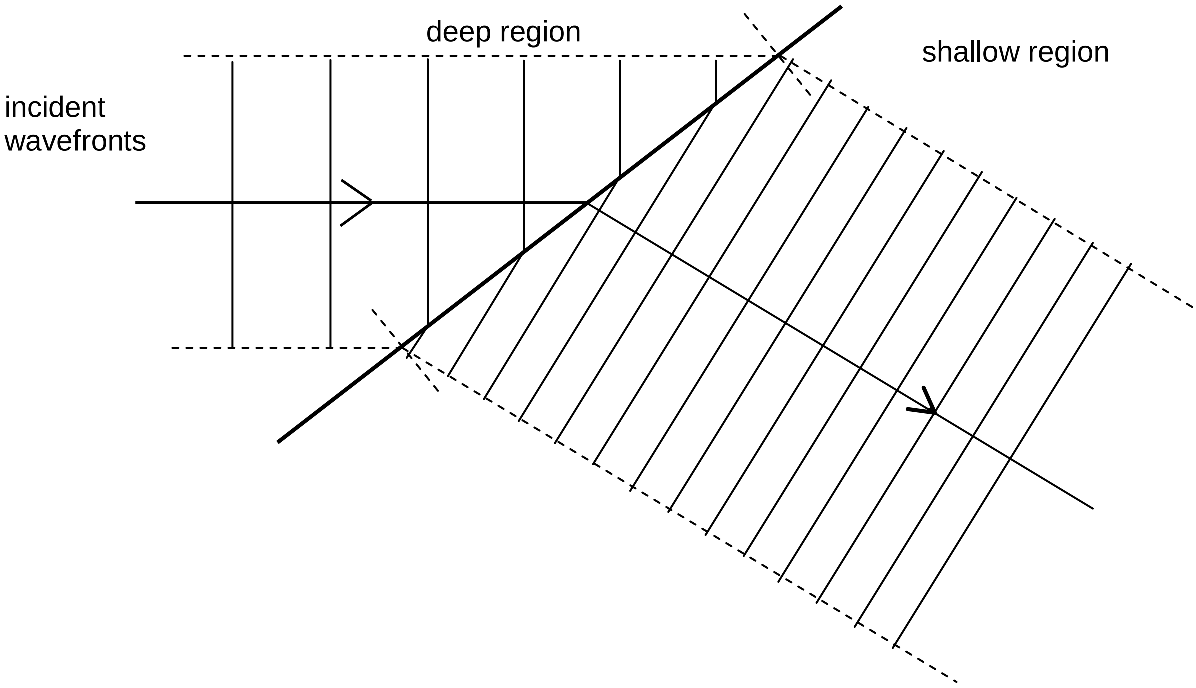


angle of incidence = ...16° ± 1°...; angle of reflection = ...16° ± 1°...

11.42 Refraction of plane wavefronts

	Visible Light	Water Waves	Visible Light	Water Waves
Medium	air → glass (increase in refractive index)	deep → shallow (decrease in depth of water)	glass → air	shallow → deep
change in direction of waves (bending)	towards the normal	towards the normal	away from the normal	away from the normal
wave speed v	decreases	decreases	increases	increases
frequency f	constant	constant	constant	constant
wavelength λ	decreases	decreases	increases	increases

- **Refracted plane wavefronts**



Also see video at *http://www.showme.com/sh/?h=QeedBrs*

Example 11.9

(a) 52^o

(b) 20^o

(c) 1.3 cm

(d) 0.6 cm

(e) 2.2

Discussion

1. True or false? Justify your answer.

(a) False: $v = f \times \lambda$

(b) False: A slinky can be used to produce both transverse & longitudinal waves