Review of Grade 11 Physics Part 2

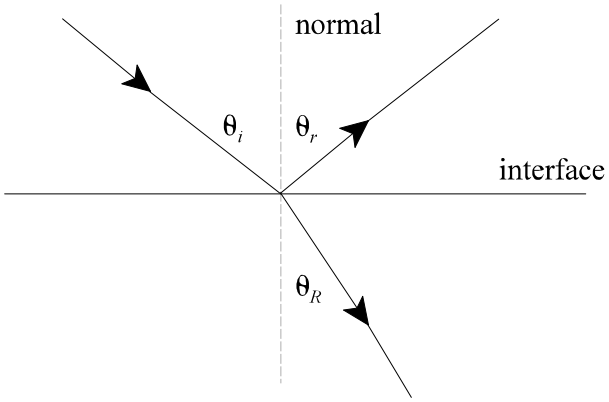
If you want to do well in Physics this semester, you will need to remember the Physics concepts you learned last year (and in previous years). This booklet contains 4 lessons that cover the essentials of the optics, waves, and electromagnetism units from grade 10-11. Tutorial assistance will be available after class if you need extra help.

The first two units of grade 12 will rely on an understanding of the following material.

Review Lesson 8:

Optics: Light and Refraction

Light is a form of energy that is visible to the human eye. Rays of light travel in straight lines under most circumstances; they converge, diverge, or remain parallel as they propagate through a uniform medium. The speed of light is $c = 3.00 \times 10^8$ m/s in a *vacuum*.



Law of reflection: $\theta_i = \theta_r$

Light refracts, or bends, as it passes from one medium to another with a different index of refraction because the light speeds up or slows down.

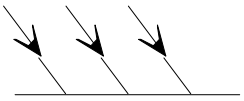
$n = \dfrac{c}{v}$ $n =$ index of refraction

$v =$ **speed of light in medium**

Snell's Law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

Total Internal Reflection occurs when $n_1 > n_2$ and $\theta_i > \theta_c$. $n_1 \sin\theta_C = n_2 \sin 90^\circ$

1. Parallel rays of light are incident upon a plane mirror, as in the figure below. Draw in the reflected rays.



2. Choose the correct alternatives in the following statements: "Rays of light travelling from air into glass at an oblique angle *speed up/slow down* when they reach the glass. The change in speed causes them to bend *away from/toward* the normal.

3. Light travels from air into diamond with an angle of incidence of 60.0°. The angle of refraction is 21.0°. (a) What is the index of refraction of the diamond? (b) Calculate the speed of light in diamond. (c) What would happen if light were to travel from the interior of the diamond to air at $\theta_i = 60.0^\circ$? (2.42, 1.24×10^8 m/s, $\theta_c = 24^\circ$)

4. Light is travelling from glass ($n = 1.51$) to air. What is the critical angle? Sketch what would happen if θ_i in glass is (a) less than the critical angle and (b) greater than the critical angle. ($\theta_c = 41^\circ$)

Waves

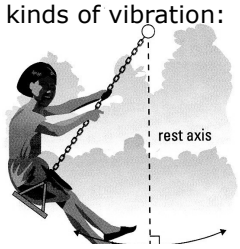
A wave is a disturbance that transfers energy over a distance. Waves require a medium, and it is the disturbance from some normal value of the medium that is transmitted, not the medium itself.

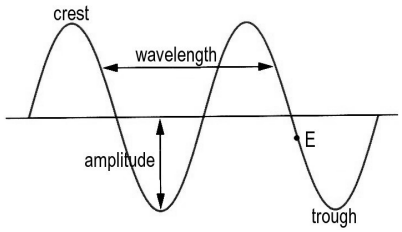
Universal wave equation: $v = \lambda f$ $\quad f = \frac{1}{T}$ **frequency** = # cycles/second (Hz)

Period = time req. for 1 cycle (s)

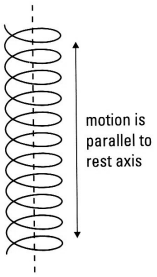
There are three kinds of vibration:

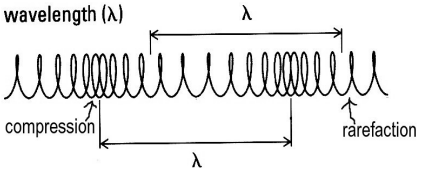
Transverse



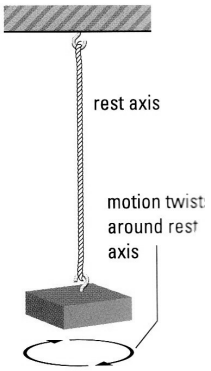


Longitudinal



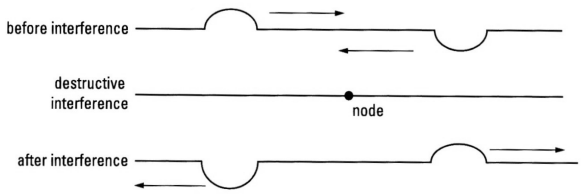


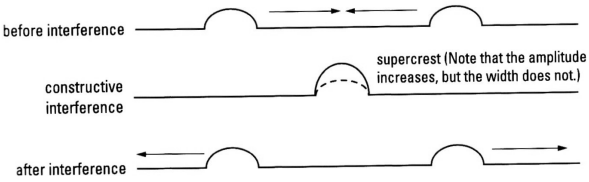
Torsional



Objects vibrate **in phase** if they have the same period and pass through the rest position at the same time. Waves **reflected** at a **free end** (where the medium is free to move) are not inverted, whereas waves reflected at a **fixed end** will be inverted. Waves travelling from a slow medium to a fast medium and vice versa will experience **partial reflection**.

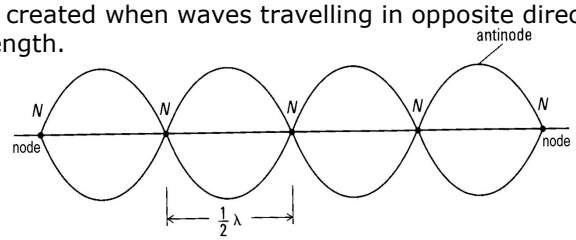
Wave interference occurs when two or more waves act simultaneously on the same particles of a medium. **Destructive interference** occurs when a crest meets a trough. **Constructive interference** occurs when waves build each other up.





Principle of superposition: At any point the resulting amplitude of two interfering waves is the algebraic sum of the displacement of the individual waves.

Standing waves are created when waves travelling in opposite directions have the same amplitude and wavelength.



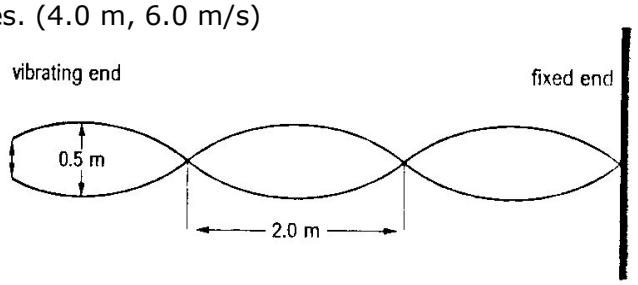
1. (a) In the diagram of the longitudinal wave above, label a point F that is in phase with point E. (b) If the wave is moving to the left, draw a vector to represent the instantaneous velocity of the particle in the medium at point E. (c) Calculate the period of the wave if it makes 10 vibrations in 2.0 s. (0.20 s)

2. A certain wave source has a frequency of 3.0 Hz. The waves have a speed of 5.0 m/s. What is the distance between adjacent troughs? (1.7 m)

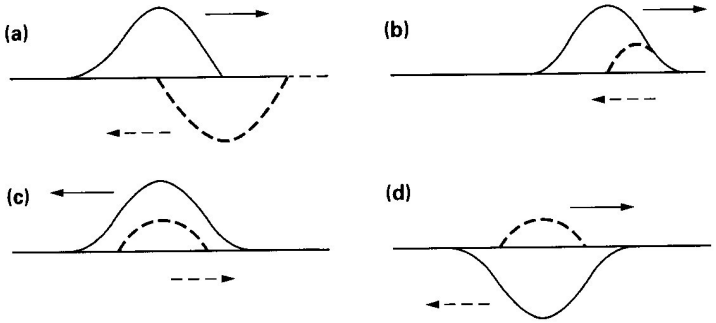
3. A crest of a water wave requires 5.2 s to travel between two points on a fishing pier located 19 m apart. It is noted in a series of waves that 20 crests pass the first point in 17 s. What is the wavelength of the waves? (3.1 m)

4. You send a wave down a string that is attached to a second string with unknown properties. The pulse returns to you inverted and with a smaller amplitude. (a) Is the speed faster or slower in the second string? (b) Is the wavelength smaller or larger in the second string?

5. In an experiment to find the speed of waves in a rope, a standing wave pattern is established as in the figure below. The vibrating end makes 90 complete vibrations in one minute. Calculate (a) the wavelength of the waves and (b) the speed of the waves. (4.0 m, 6.0 m/s)



6. Determine the resultant displacement of the particles of the medium at each instant, using the principle of superposition.



7. A standing wave interference pattern is produced in a rope by a vibrator with a frequency of 28 Hz. If the wavelength of the waves is 2.0×10^1 cm, what is the distance between successive nodes? (10 cm)

8. The distance between the second and fifth nodes in a standing wave is 6.0×10^1 cm. What is the wavelength of the waves? What is the speed of the waves, if the source has a frequency of 25 Hz? (40 cm, 10 cm/s)

9. The distance between adjacent nodes in the standing wave pattern in a piece of string is 25.0 cm. (a) What is the wavelength of the wave in the string? (b) If the frequency of the vibration is 200 Hz, calculate the speed of the wave. (50.0 cm, 1.00×10^4 cm/s)

Review lesson 10:

Electricity

Conventional current flow: the flow of positive charge, as opposed to electron flow.

Law of Electric Charges: opposite charges attract, similar charges repel, charged objects attract some neutral objects.

Law of Conservation of Charge: the total charge (the difference between the amounts of positive and negative charge) within an isolated system is conserved.

$Q = Ne$ (Q = quantity of charge (C), N = # of charges, $e = 1.60 \times 10^{-19}$ C)

Electric current $I = \frac{Q}{\Delta t}$, 1 A = 1 C/s

Electric potential difference (V) is the amount of work required per unit charge to move a positive charge from one point to another in the presence of an electric field. The electric potential difference between two points A and B is given by

$V = \frac{W}{Q}$, 1 V = 1 J/C

The electrical energy lost by a current through a potential difference for a time Δt is given by the equation $\Delta E = VI\Delta t$.

1. (a) Sketch a diagram of a Bohr-Rutherford model of the atom. For each particle in the atom, list the charge, its mass relative to other types of particles, and the magnitude of force acting on it. (b) Which particle is responsible for the conduction of electricity in solids?

2. (a) Explain the meaning of the term "elementary charge." (b) What is the charge on an electroscope with an excess of 3.0×10^{11} electrons? (c) An object has a positive charge of 0.30 C. How many electrons has the object lost? (-4.8×10^{-8} C, 1.9×10^{18})

3. Find the potential difference between two points if 10.0 kJ of work is required to move 2.5 C of charge between the two points. (4.0×10^{3} V)

4. Research physicists use high electric potential differences to accelerate particles they are studying. How much energy is given to a proton as it accelerates through an electric potential difference of 4.5×10^{7} V? The charge on a single proton is 1.6×10^{-19} C. (7.2×10^{-12} J).

5. Find the charge that passes through a device if a constant electric current of 0.30 A flows in it for 5.0 min. (90 C)

6. When the electric potential difference across a series of lights is 12.0 V, a current of 0.35 A flows through it. The lights are left on for 0.50 h. What is the energy used by the lights? (7.6×10^{3} J)

7. A bolt of lightning delivers 25 C of charge, releasing 1.2×10^{9} J of energy in 30.0 ms. (a) What is the power associated with the bolt? (b) What is the current? (c) What is the potential difference across the bolt of lightning? (4.0×10^{10} W, 8.3×10^{2} A, 4.8×10^{7} V)

Review lesson 11:

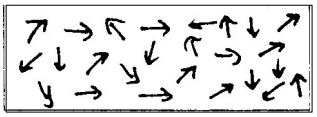
Electromagnetism

Laws of Magnetic Poles: opposite poles attract, similar poles repel, there is no monopole.

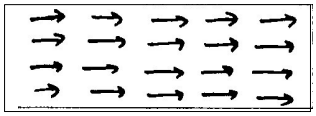
Magnetic field lines
A field is the area around a magnet in which a magnetic force can be detected.

- they are continuous and form closed curves running N to S outside the magnet and S to N inside the magnet
- lines of force never cross
- the number of field lines per unit area is proportional to the strength of the field

Magnetic Domains



Unmagnetised: domains point in many directions



Magnetised: domains line up

Electromagnetic Induction: A current creates a circular magnetic field perpendicular to its direction.

Right Hand Rule for Magnetic fields About a Straight Conductor
Thumb points in direction of current, fingers curl in direction of field

Right Hand Rule for Magnetic field about a Solenoid
Fingers curl in direction of current, thumb points toward north-seeking pole

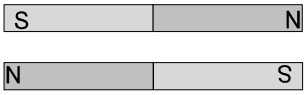
Right Hand Rule for the Motor Principle
Thumb points in direction of current, fingers point in direction of external magnetic field, palm pushes in direction of resulting force.

Generator effect and Lenz's Law: a changing magnetic field induces a current. The direction of the induced current is always such as to oppose the change in the circuit or the magnetic field that produces it.

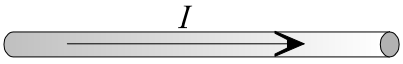
1. Sketch the magnetic field lines for the following:

(a) bar magnet

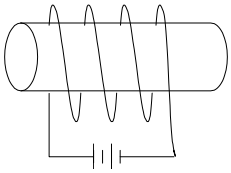
(b) two bar magnets



(c) a conductor with a current in it



(d) solenoid



2. Sketch the magnetic field lines for the two conductors below, and indicate the direction of the force felt on each.

3. Explain how to increase the magnitude of the magnetic field of the following: (a) a bar magnet, (b) a straight conductor with an electric current, and (c) an electromagnet.