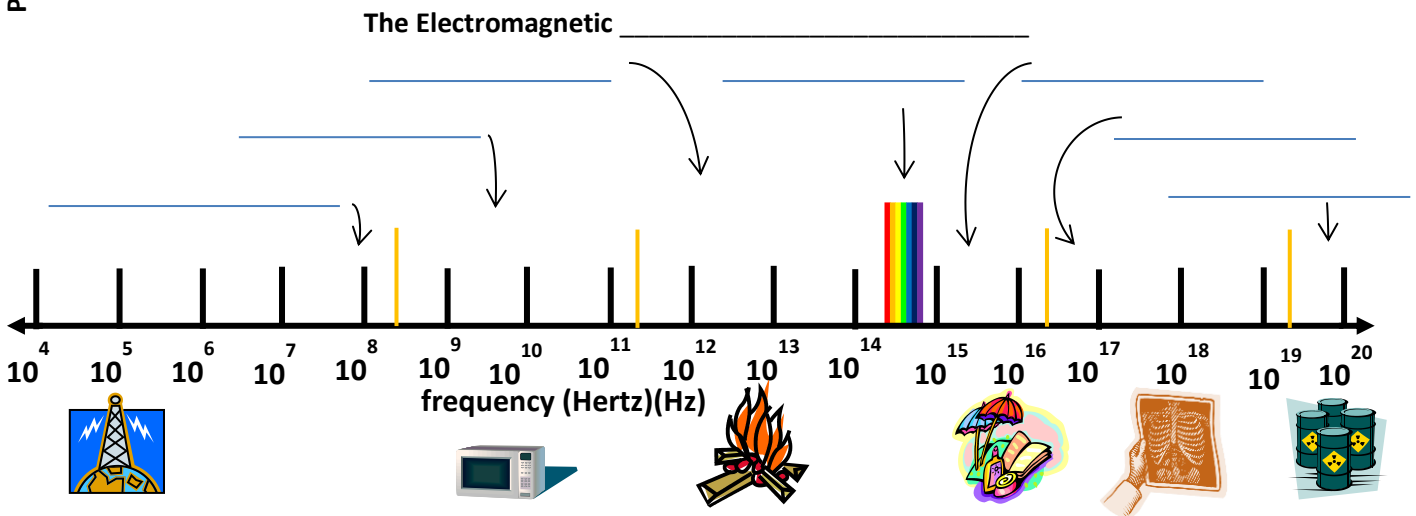


Part A 1. Fill in the diagram.



2. $10^4 =$ _____ $10^8 =$ _____

Part B 3. Electricity and magnetism are related. We know this because moving a magnet in a coil of wire produces _____ and an electric current flowing in a coil of wire produces _____.

4. In the 1860s, James Clerk Maxwell used the data of many experiments to come up with a set of equations which suggested to him that light is an _____-field wave combined with a _____-field wave.
5. Draw a “3D” electromagnetic wave showing the electric-field wave moving up and down and the magnetic-field wave moving “out of” the page and “into” the page.



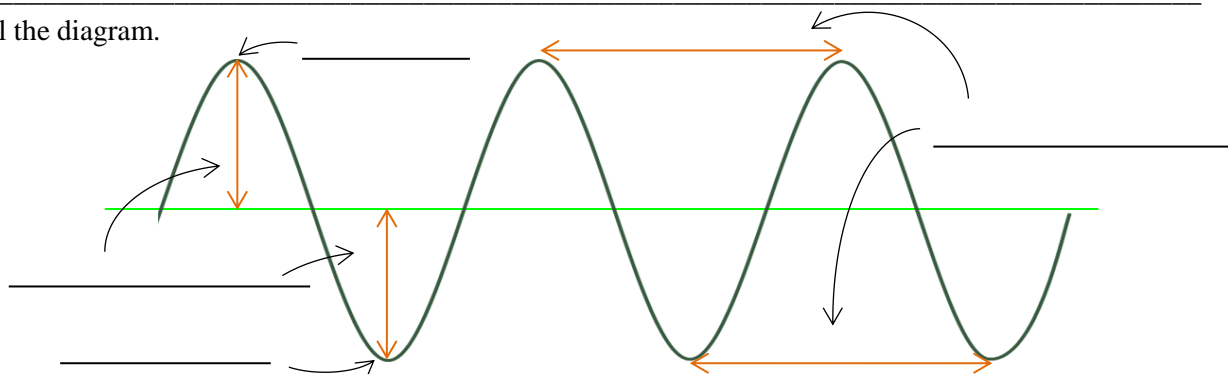
Part C 6. Name three types of waves (other than electromagnetic waves).

7. Using a simple slinky diagram, like the one shown at right, draw:
-
- (a) a transverse wave
- (b) a longitudinal wave

(c) Use arrows in your diagrams above to show (a) which way each loop moves and (b) in which direction the wave is moving.

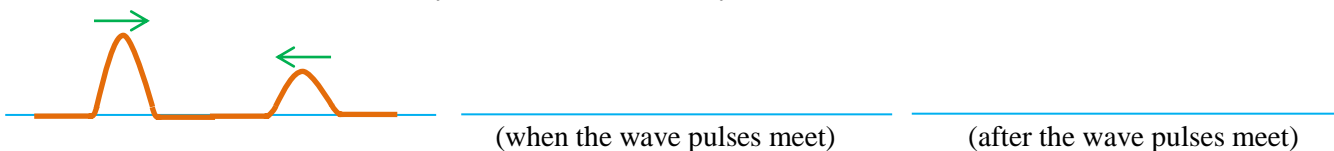
8. All waves, except electromagnetic waves, need a medium to travel through. What is a “medium”? Give two examples. _____

Label the diagram.



9. In the diagram of the wave above, $\lambda =$ _____ cm , while the amplitude = _____ cm.

10. Two wave pulses head towards each other on a slinky. Draw what the wave pulses will look like when the two waves meet, and what they will look like after they meet.



11. What is the frequency (f) of a wave? What is the unit for frequency?

speed = distance/time time = distance/speed speed_{light} = 300,000km/s speed_{sound} = 340m/s = 0.340km/s
 (your units for distance and speed must match: if you use km/s, your distance must be in km)

12. The length of the Earth’s equator is about 40,000km. Calculate the time it would take for a light beam **and** a sound wave to travel...

(a) around the world once.

Light

Sound

_____ seconds

_____ seconds
 _____ minutes ^(÷60)
 _____ hours ^(÷60)

(b) to the moon. (the Earth-Moon distance = 378,000km)

(earth size, moon size, and earth-moon distance are to scale in diagram)



Earth



Moon

Light

Sound

_____ seconds

_____ seconds
 _____ minutes
 _____ hours
 _____ days

13. Why do you often hear a thunder clap sometime after you see the lightning?

14. How does a change in frequency of a wave affect its speed? (Hint: TRICK QUESTION)

15. For any given type of wave, a lower frequency results in a _____ wavelength.

16. Fill in the table using the wave equation: wave speed = frequency x wavelength
 frequency = wave speed / wavelength wavelength = wave speed / frequency

Working-out space

Wave	Speed, s (m/s)	Frequency, f (Hz)	Wavelength, λ (m)
Sound in 15°C air		256	1.33
Sound in 30°C air	349	256	
He-Ne Laser beam	300,000,000		633 x 10 ⁻⁹ m
Nova FM's broadcast signal	300,000,000	100,300,000 (100.3MHz)	

17. Fill in the table.

Commonly Used Unit Prefixes				
Prefix	Letter	Standard Form	Meaning (in English)	Decimal/Numeric
pico-	p	10 ⁻¹²	1 trillionth	0.000 000 000 001
nano-		10 ⁻⁹	1 billionth	0.000 000 001
micro-	μ			0.000 001
milli-	m	10 ⁻³		
centi-	c	10 ⁻²	1 one hundredth	
(no prefix)	-	10 ⁰	1	1
kilo-	k			
mega-		10 ⁶		
giga-	G		billion	
tera-	T	10 ¹²		
peta-			quadrillion	1000,000,000,000,000

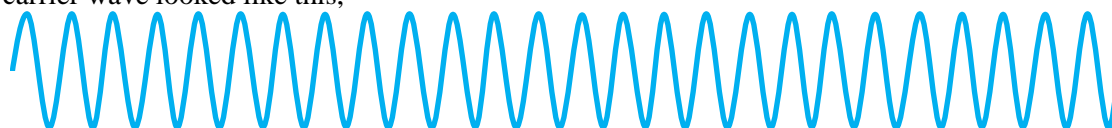
18. Rewrite the following using the correct symbols. The first two have been done for you.

- (a) 100 picometres: 100pm (b) 450 gigahertz: 450GHz (c) 300 megahertz: _____
 (d) 750 nanometres: _____ (e) 2 micrometres: _____ (f) 400 terahertz: _____

Part D

19. How are radio waves generated?

20. If a carrier wave looked like this,



and the audio signal looked like this,



draw the amplitude-modulated (AM) wave that an AM radio station would transmit. (Draw it just below the audio signal.)

21. FM stands for _____.
22. Compare and contrast an analogue transmission with a digital transmission.

23. Explain briefly how a microwave oven heats food.

- Part E** 24. Why is infrared light often called radiant heat?

25. Apart from the hot flames themselves, bush fires (or forest fires) present two other immediate hazards to humans: _____ and _____.

26. Cold objects produce _____ frequency infrared light, while hotter objects produce _____ frequency infrared light.

27. Describe the operation of a thermal imaging camera.

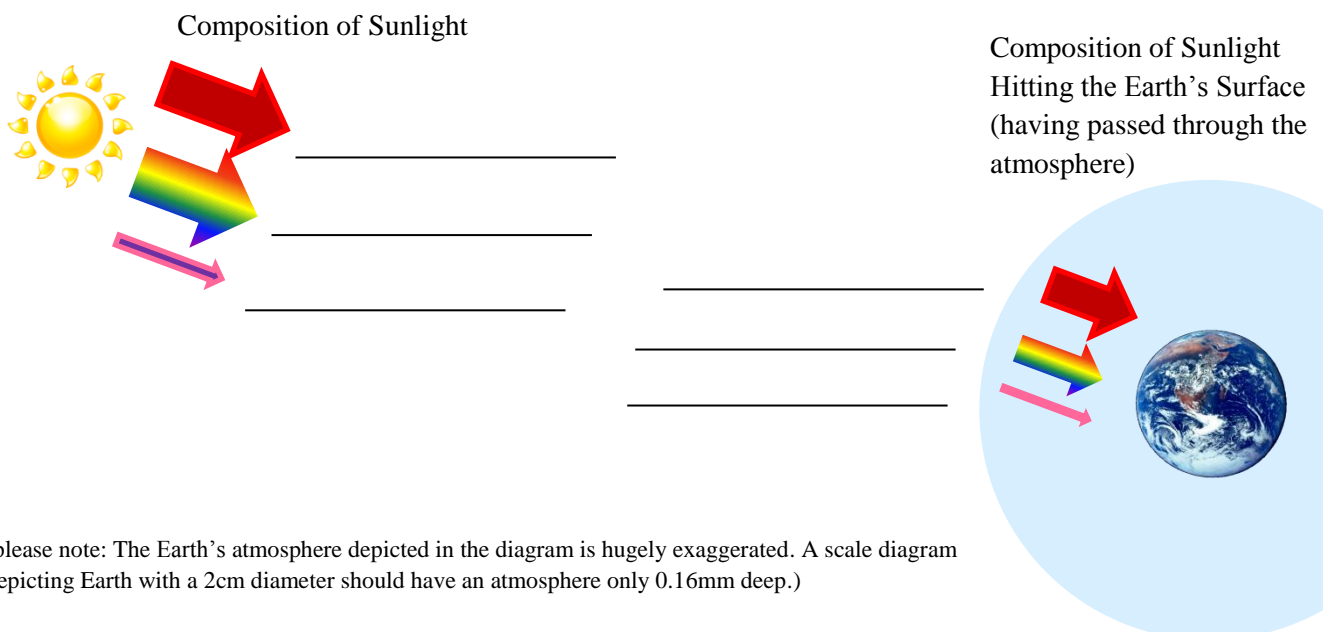
28. Describe one use of thermography.

29. What is incandescence?

- Part F** 30. In the visible spectrum, red light has the _____ frequency and the _____ wavelength.

31. How are lasers different to other light sources?

- Part G** 32. Label the diagram.



(please note: The Earth's atmosphere depicted in the diagram is hugely exaggerated. A scale diagram depicting Earth with a 2cm diameter should have an atmosphere only 0.16mm deep.)

33. List some of the hazards associated with overexposure to UV.

34. What does SPF30+ mean?

Part H 35. Draw a diagram showing the position of the X-ray machine, the body part, and the film (or electronic sensor) when an X-ray photo is taken. Explain what happens.

36. Large doses of X-rays can kill cells. How can this ability be put to good use?

Part I 37. Of all electromagnetic waves, gamma rays have the _____ frequency and the _____ wavelength.

38. Steel slabs can be made into thinner sheets by heating them and then feeding them through huge rollers. The rollers can be moved closer together (with a machine) to produce a thinner sheet or moved further apart to produce a thicker sheet. Describe how a gamma ray system can be used to automatically control the thickness of the sheet.

