Barrhead High School
Physics Department

National Physics

Waves & Radiation

Homework 2

Name:

Waves & Radiation
Homework Exercises

Homework record			
Homework	**Date due**	**Mark %**	**Sign**
1			
2			
3			
4			
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7			

Waves & Radiation
Homework Exercises

Summary

Homework 1:	Waves I -Wave definitions - Speed, distance, time calculations - Types of wave
Homework 2:	Waves II - Frequency calculations - Speed, frequency, wavelength calculations - Diffraction
Homework 3:	Sound - Waveforms - Effect on amplitude and frequency - Measuring the speed of sound - Sound level measurement & noise pollution - Sonar / echo calculations
Homework 4:	Electromagnetic Spectrum - Relative frequencies and energy - Uses and applications of EM radiations - Detection of EM radiations - Associated hazards & risks
Homework 5:	Light - Refraction - Lenses - Eyesight defects & correction
Homework 6:	Nuclear Radiation I - Atomic structure - Types of radioactivity - Background radiation - Risks & Benefits
Homework 7:	Nuclear Radiation II - Dosimetry: definitions & calculations - Absorbed dose & equivalent dose - Activity & half life - Fission & fusion

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Homework 1 – Waves I

1. **Draw** a wave and **identify** the amplitude and wavelength clearly on your diagram. (2)

2. **Copy** the table below and fill in the 'wave term', 'symbol' and 'unit' to correctly match each of the definitions. (3)

WAVE TERM	SYMBOL	UNIT	DEFINITION
			The number of waves passing a point in a unit of time
			The distance from the point on a wave to the same point on the next wave.
			The distance travelled in a unit of time

3. Calculate the missing values (A and B) from the following table.

(NOTE: You **must** show all your working for each answer.) (4)

SPEED	DISTANCE	TIME
A	3000 m	150 s
1.2 m/s	B	30 s

4. Ten pupils are standing on Calton Hill, looking at Edinburgh Castle. They measure the time difference between seeing the smoke from the one o'clock gun and hearing the bang.

Their measured times were
3.8 s, 4.2 s, 4.0 s, 3.8 s, 4.4 s, 3.8 s, 4.0 s, 4.2 s, 3.6 s and 4.2 s.

(a) Calculate the average time for the group. (1)
(b) Calculate the distance from the Castle to Calton Hill, if the speed of sound is 340 m/s (3)

5. A diver 4.5 km away from a diving rig hears the warning siren telling her to return 3s after it is sounded. What value does this give for the speed of sound in water? (3)

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Homework 1 – Waves I (continued)

6. A person at the mouth of a cave shouts, and hears an echo from the back wall of the cave. Using a stopwatch, she times 1 second between shouting and hearing the echo. Calculate how far away she is from the back wall of the cave.
Take the speed of sound to be 340 m/s. (4)

7. Explain, using diagrams, the difference between a transverse and a longitudinal wave (2)

8. Give an example of:

a) a transverse wave

and b) a longitudinal wave. (1)

Total 23 marks

==== **End of Homework 1** ====

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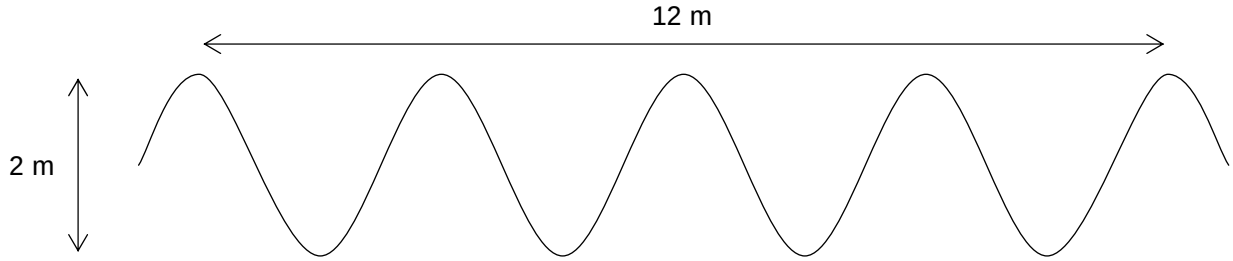
Homework 2 – Waves II

1. If 10 waves pass a point in 5s, what is the frequency of the waves? (2)

2. An optical fibre is 1200km long and it takes light 0.006s to travel from one end to the other. Calculate the speed of light in glass. (3)

3. The questions below refer to this diagram.



(a) From the diagram calculate the wavelength of the waves shown. (1)
(b) If the waves took 6 seconds to travel this distance, what is their frequency? (2)
(c) What is the amplitude of these waves? (1)
(d) Use the **wave equation** to calculate the speed of the waves. (3)

4. A wave of frequency 8 Hz has a wavespeed of 16 m/s. What is its wavelength? (3)

5. A source produces 400 waves every minute. If the speed of the waves is 8 mm/s, calculate the distance between adjacent troughs. (3)

5 **6.** Using a diagram, describe diffraction of waves (2)

7. All radio waves travel at 3×10^8 m/s in air. Radio Scotland broadcasts an AM signal on 810 kHz and an FM signal on 94.3 MHz.

(a) Calculate the wavelength of each signal. (3)

5 (b) State and explain which signal (AM or FM) is more likely to be received if you live in an area surrounded by hills. (2)

Total 25 marks

==== End of Homework 2 ====

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4 Homework 3 – Sound

1. (a) What quantity is a measure of the number of vibrations per second? (1)

(b) If the number of vibrations per second is greater than 20000, what is this type of sound called? (1)

2. Give an everyday example that shows that :-

(a) Sound can travel through solid. (1)

(b) Sound can travel through gas. (1)

3. In the Star Wars films (and similar), there are many loud explosions as spaceships blow up. In reality, you wouldn't hear the explosions at all. Why not? (1)

4. What is the full name of the unit used to measure sound level (loudness)? (1)

5. (a) Name one use for ultrasound in medicine. (1)

(b) Explain why ultrasound waves are used for this purpose rather than x-rays. (1)

6. Copy and complete the following table, using the figures below to show the typical sound level of each sound: (2)

30 dB, 70 dB, 90 dB, 120 dB

Typical Sound	Sound Level (dB)
Busy street	
Pneumatic drill at 10m	
Heavy truck passing by	
Leaves rustling in the wind	10 dB
Whisper	
Normal conversation at 1 metre	60 dB

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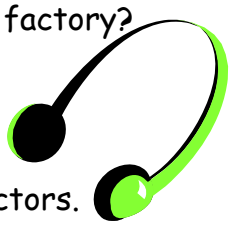
Homework 3 - Sound (continued)

7. Give a common example of noise pollution:

(a) In your home

(b) In the town centre (1)

8. (a) Why is it important to use ear protectors when working in a noisy factory? (1)

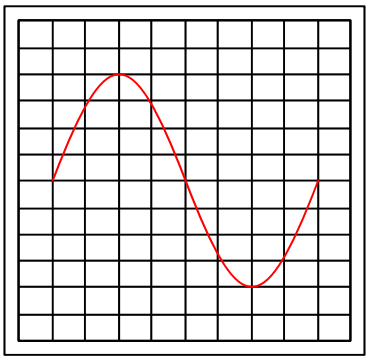


(b) What do these protectors do to the sound's energy? (1)

(c) Suggest a material that could be used for the filling of the protectors. (1)

9. When measuring sound, an increase of +10 dB represents an effective tenfold (x10) increase in the power of a sound. More simply, a sound of 50 dB will **be** ten times more powerful than a sound of 40 dB.
How many times more powerful than leaves rustling in the wind does normal conversation sound? Use values from the table in ***question 6*** to help you. (1)

10. Look at this diagram of a sound signal pattern displayed on an oscilloscope. Describe in words what would happen to its **frequency** *and* **amplitude** in each of the following situations:



(a) The volume of the sound is increased. (1)
(b) The pitch is increased, but the volume is the same (1)
(c) The pitch is decreased and the volume is decreased. (1)

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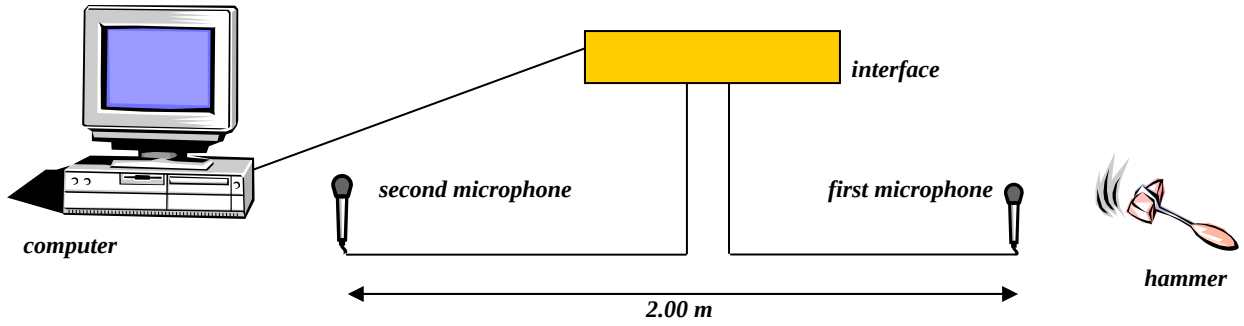
Homework 3 - Sound (continued)

11. A pupil reads about an experiment that can be carried out to measure the speed of sound in air. When the hammer hits the metal block a sound wave is produced. The computer is used to measure the time it takes for the sound wave to travel from one microphone to the other. The computer will display the time taken for the sound to travel this distance or it can be used to calculate the speed of sound directly.



The pupil carried out the experiment, and the time measured was 0.006 s.

(a) What other information does the computer need to calculate the speed of sound? (1)

(b) Find the speed of sound using the pupil's results. (3)

Total 22 marks

==== End of Homework 3 ====

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Homework 4 – The Electromagnetic Spectrum

1. Copy the table and complete the first row to show seven bands in the electromagnetic spectrum in order of increasing frequency from left to right.

(2)

Name of wave band	Radio		I.R.		U.V.		
Possible Detector		Diode probe					
Useful Application							Sterilising plastic syringes.

2. For each type of wave, name a device which can absorb some of the waves to detect or measure them. Enter this information in the second row.

(3)

3. For each band name an application and complete the third row in the table.

(3)

4. Give one industrial and one non-industrial use of lasers.

(2)

5. (a) Why are electromagnetic waves **not** used for scans of unborn babies?
(b) What is used instead?

(2)

6. Why are cheap sunglasses probably best avoided?
Use your knowledge of physics to suggest an alternative.

(2)

7. (a) What is the main long term danger of overexposure to ultraviolet radiation?

(1)

(b) How could the risk of this danger be minimised?

(1)

8. Calculate how long it takes for a signal sent from a remote control to arrive at the sensor on a TV which is 3m away.

(3)

9. From your table in Q1, which band has the longest wavelength and which band has the highest energy?

(2)

Total 21 marks

==== **End of Homework 4** ====

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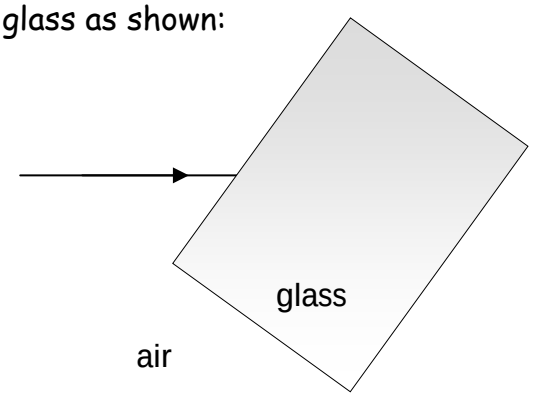
Homework 5 - Light

5 **1**. Describe what is meant by 'refraction' of light? (1)

5 **2**. A ray of light passes from air to glass as shown:



(a) Copy and complete this diagram to show the path of the ray as it enters the glass. (1)

(b) On your diagram
- Draw and label the **normal**, and
- Label the **angle of incidence** and **angle of refraction**. (2)

3. (a) Draw a convex lens and show how it affects parallel rays of light. (1)

(b) Draw a concave lens and show how it affects parallel rays of light. (1)

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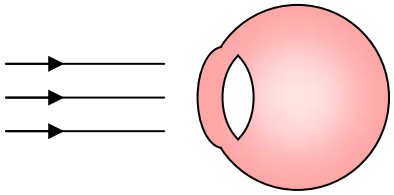
Homework 5 (continued)

5

4. Copy and complete the eye diagram to show how a healthy eye would focus the rays of light.

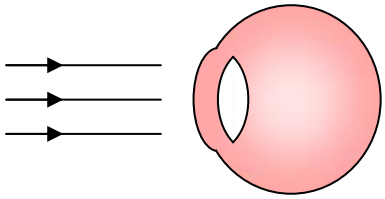


(1)

5. Copy the table below, and fill in the blanks to give information about short & long sight: (2)

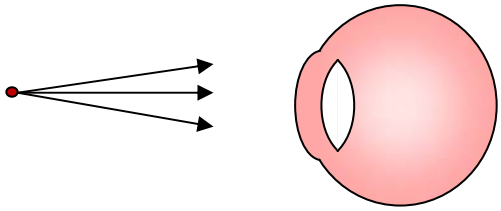
EYE DEFECT	VISION PROBLEM	CORRECTION LENS
Short sight		
Long sight		

PS 6. Copy and complete the eye diagram to show how the eye of a **short-sighted** person would focus the rays of light, if they are not wearing glasses.



(1)

PS 7. Copy and complete the diagram to show how the the correct lens is used, in front of the eye, of a **long-sighted** person, to enable them to focus on a close object.



(3)

Total 13 marks

==== End of Homework 5 ====

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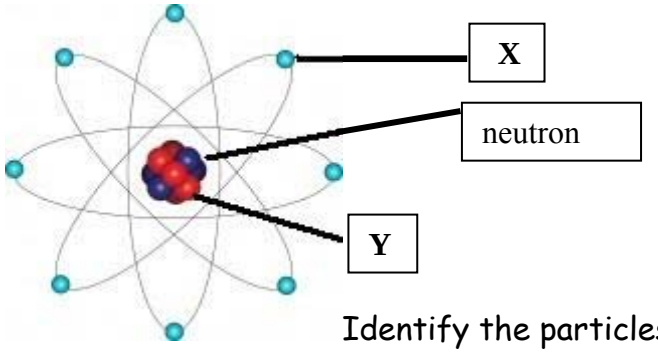
5 Homework 6 – Nuclear Radiation I

1.



Identify the particles X and Y **and** their charges (2)

2. Copy and complete the following table about nuclear radiations. (4)

Name of Radiation	Symbol	What is it?	What's it absorbed by?	Relative ionisation level?
alpha			Thin paper, skin, a few cm of air	high
beta		high energy electron		
gamma	γ			

3. Explain what is meant by '**ionisation**'. (1)

4. List three natural and three man-made sources of background radiation. (3)

5. Some workers in hospitals are exposed to ionising radiations. State three methods employed to reduce/limit this radiation exposure? (3)

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Homework 6 – Nuclear Radiation I (cont'd)

6. State and explain 2 **advantages** of using nuclear fuel to generate electricity. (2)

7. State and explain 2 **disadvantages** of using nuclear fuel to generate electricity. (2)

8. Film badges are used in the nuclear industry as radiation detectors.
Explain how a film badge can show the **type** and **level** of radiation exposure. (2)

9. Define the term '**scintillation**' (1)

Total 20 marks

==== End of Homework 6 ====

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5 Homework 7 - Nuclear Radiation II

1. Physicists can measure various quantities in nuclear medicine.
Suggest a reason why the energy given out by a source might not be the most helpful quantity to measure for a doctor.

(1)

2. Medical physicists and health and safety officers measure "absorbed dose", D.
Does this quantity relate to the source or the patient and what exactly does it measure? (2)

3. As you know, one hertz could be described as one vibration per second.
How could you describe a gray? (1)

4. Why did someone invent "equivalent dose", H; wasn't "absorbed dose", D good enough for everything? State and explain the difference between 'equivalent dose' and 'absorbed dose'. (2)

5. Traffic 'activity' could be described as the 'number of vehicles passing in an hour'.
What is the activity in nuclear medicine and does this refer to the source or the patient?

(2)

6. As you should know by now, one hertz could be described as one vibration per second.
Describe a becquerel in a similar way.

(1)

7. Name the main nuclear process taking place in the Sun. (1)

8. Describe (with the aid of a diagram) what is meant in nuclear physics by a 'chain reaction'. (2)

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Homework 7 - Nuclear Radiation II (continued)

Type of radiation	w_r *(Radiation weighting factor)*
alpha	20
beta	1
gamma	10
fast neutrons	1
slow neutrons	3

9. Gold-198 is a radioactive source that is used to trace factory waste which may cause river pollution. A small quantity of the radioactive gold is added into the waste as it enters the river. Scanning the river using radiation detectors allows scientists to trace where the waste has travelled. Gold-198 has a half-life of 2.7 days.

(a) What is meant by the term "half-life"?

(1)

(b) A sample of Gold-198 has an activity of 64kBq when first obtained by the scientists. Calculate the activity after 13.5 days.

(2)

(c) Describe two precautions taken by the scientists to reduce the equivalent dose they receive while using radioactive sources.

(2)

(d) A scientist receives an absorbed dose of 10 mGy of alpha radiation.

(i) Calculate the equivalent dose received. (3)

(ii) The risk of biological harm from radiation exposure depends on the absorbed dose and the type of radiation. Which other factor affects the risk of biological harm? (1)

Total 21 marks

==== End of Homework 7 ====

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