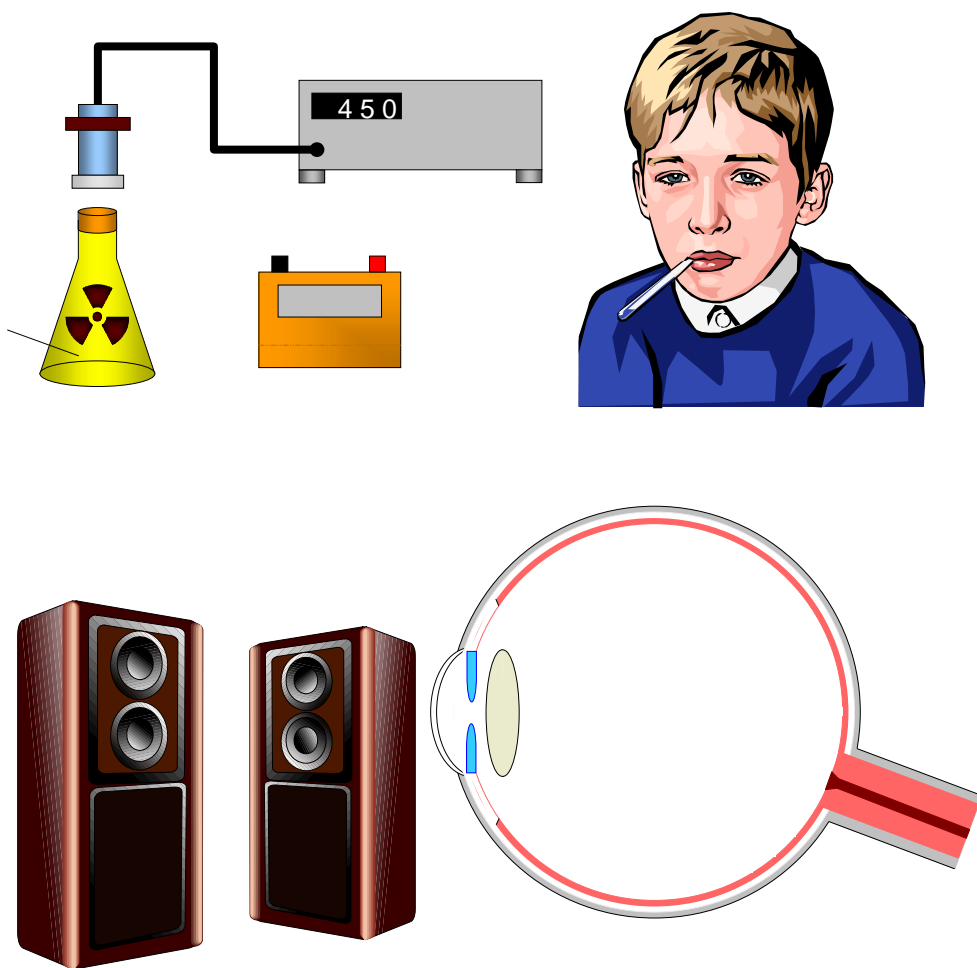


# *Standard Grade Physics*

## *North Berwick High School* *Physics Department*

### **UNIT 3** **Medical Physics**



**Homework Sheets**

# Medical Physics

## *Working at Home*

### TO THE PUPIL

Each day you have physics at school, you should set aside time for work at home. By this stage you should be accepting more responsibility for your own learning and should undertake the following tasks on a regular basis:

- Tackle the supplied homework sheets as each section of work is completed in class.
- Check your own progress in the homework sheets by referring to the homework answer files available in class. Discuss any difficulties that arise with your class teacher.
- Complete any formal homework tasks that your teacher may issue from time to time and hand them in on the due date for marking.
- Revise the work you have covered in class activities by referring to your classwork jotters.

### TO THE PARENT

Your co-operation would be appreciated in ensuring that pupils are encouraged to complete homework. It would be helpful if you could talk over the work given for homework and sign the homework record sheet on this page after they have completed each exercise.

The physics department hopes that this record of your child's achievement will be of interest to you, and we would welcome any comments on this or other areas related to the work of the department.

*Please sign here to confirm that you have seen the homework record sheet:* \_\_\_\_\_

### HOMEWORK RECORD SHEET

HOMEWORK	SECTION OF WORK	MARK	CHECK	PARENTAL SIGNATURE
3.1	The Use of Thermometers 1			
3.2	The Use of Thermometers 2			
3.3	Using Sound 1			
3.4	Using Sound 2			
3.5	Light and Sight 1			
3.6	Light and Sight 2			
3.7	Using the Spectrum			
3.8	Humans and Medicine 1			
3.9	Humans and Medicine 2			

Some questions in the pack are marked with symbols to give you specific information. Here is the key:



Credit Level question. This relates directly to the Credit Level learning outcomes.



Problem Solving question. This puts the knowledge you have gained into new contexts.

# Medical Physics

## *Homework Exercises*

### Homework 3.1 - The Use of Thermometers I

1. For each type of thermometer, state the physical quantity that changes as the temperature changes. (4)

TYPE OF THERMOMETER	MEASURABLE PHYSICAL QUANTITY
Mercury thermometer	
Crystal strip thermometer	
Rotary thermometer	
Digital thermometer	


2. (a) What is a bimetallic strip? (1)  
(b) Explain why a bimetallic strip bends when heated. (2)
3. (a) Name the two liquids most commonly found in liquid-in-glass thermometers. (1)  
(b) Describe how a liquid-in-glass thermometer works. (2)

**Total 10 marks**

# Medical Physics

## *Homework Exercises*

### Homework 3.2 - The Use of Thermometers II

1. (a) State the two main differences between a clinical and an ordinary thermometer. (2)  
(b) For each one, explain how it makes reading body temperature easier. (2)
2. (a) What is normal human body temperature? (1)  
(b) What would be the most likely effect on your body temperature if you had a fever? (1)  
(c) What is it called when a person's core body temperature drops far below normal? (1)
3. Rearrange the following steps to show how you would measure someone's body temperature using a clinical thermometer, and **write them out in full** in your jotter. (2)  

  - (1) Leave the thermometer for a few minutes
  - (2) Disinfect the thermometer
  - (3) Remove the thermometer and read the scale
  - (4) Place the thermometer under the patient's tongue
  - (5) Shake the thermometer
4. When you are measuring someone's temperature with a clinical thermometer, why do you have to shake the thermometer? (1)

**Total 10 marks**

# Medical Physics

## Homework Exercises

### Homework 3.3 - Using Sound I

1. Answer the following questions in your jotter.

- (a) What is sound produced by? (½)
- (b) What do we call the number of vibrations per second? (½)
- (c) What do we call sound frequencies greater than 20 000 Hz? (½)

2. In each of the following situations, state whether the sound is travelling through a solid, a liquid or a gas.

- (a) Native Americans could hear horses a long way off by putting their ear to the ground. (½)
- (b) Dolphins use high-pitched sounds to locate fish for food. (½)
- (c) A teacher shouts at you for not attempting your homework! (½)

PS

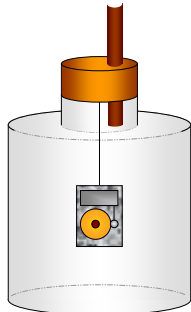
3. In the Star Wars films (and similar), there are many loud explosions as spaceships blow up. In reality, you wouldn't hear the explosions at all. Why not? (1)

4. Sound can be useful in medicine. Doctors often use a device called a stethoscope placed against your chest or back.

- (a) Which two organs would the doctor be listening to? (1)
- (b) Give two ways in which the stethoscope helps the doctor hear these sounds. (1)

PS

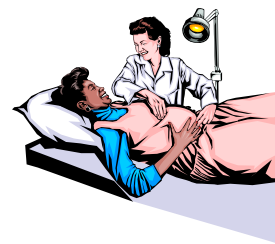
5. A teacher puts a bell inside a large jar, and switches it on. His pupils can hear the bell clearly. The teacher then pumps the air out of the jar using a vacuum pump.



- (a) What would happen to the sound? (1)
- (b) Why would this happen? (1)

CR

6. (a) Name one use for ultrasound in medicine. The diagram may give you a hint! (1)  
(b) Explain why ultrasound waves are used for this purpose rather than x-rays. (1)



**Total 10 marks**

# Medical Physics

## Homework Exercises

### Homework 3.4 - Using Sound II

1. Copy the following table, and use the figures below to show the typical sound level of each sound: (3)

10 dB, 30 dB, 60 dB, 70 dB, 90 dB, 120 dB

TYPICAL SOUND	SOUND LEVEL (dB)
Busy street	
Inside a boiler factory	
Heavy truck passing by	
Leaves rustling in the wind	
Whisper	
Normal conversation at 1 metre	

2. Give two examples of noise pollution. (2)

3. (a) In what way could a noisy factory cause harm to its workers? (1)  
(b) How could the workers avoid this harm? (without quitting their jobs!) (1)

4. Ear plugs and earmuffs are used to protect hearing. (1)  
(a) What do these protectors do to the sound's energy? (1)  
(b) Suggest a material that could be used for the filling of the protectors. (1)



5. On the decibel scale, every 10 dB represents an effective doubling of the perceived loudness of sounds. More simply, a sound of 50 dB will **sound** twice as loud to you compared to a sound of 40 dB. (1)  
How many times louder than leaves rustling in the wind does normal conversation sound? Use values from the table in *question 1* to help you.

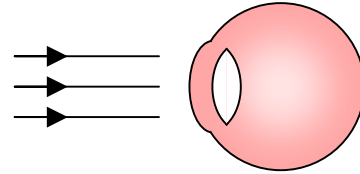
**Total 10 marks**

# Medical Physics

## Homework Exercises

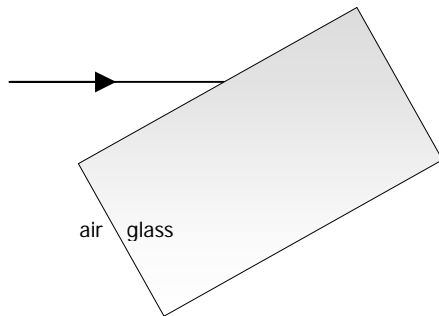
### Homework 3.5 – Light and Sight I

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



(1)

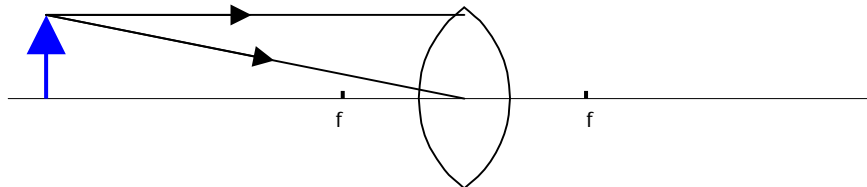
2. A ray of light passes from air to glass as shown:



- (a) Copy and complete this diagram to show what happens to the ray in the glass. (1)  
(b) What is this effect called? (1)  
(c) Add the **normal** to the diagram, and label the **angle of incidence** and **angle of refraction**. (2)

CR

3. (a) State the difference between the image formed on the retina and the object being looked at (other than size!) (1)  
(b) Copy and complete this ray diagram to show how this happens. (2)



4. (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)

**Total 10 marks**

# Medical Physics

## Homework Exercises

### Homework 3.6 – Light and Sight II

1. A girl wants to find the focal length of a convex lens she has found in the classroom. She uses light from the window in her experiment.
- (a) What other equipment will she need to do her experiment? (1)
- (b) What measurement should she make? (1)
- (c) Why does she use light from the window rather than from the classroom lights? (1)

PS

CR

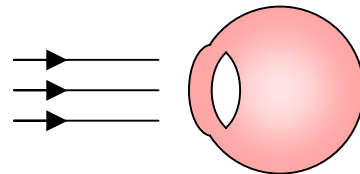
2. (a) If a spherical convex lens has a focal length of +5.88 cm, what is its power? (2)
- (b) A spherical concave lens has a power of -10 D. What is its focal length? (1)

3. Copy the table below, and fill in the blanks to give information about short & long sight: (3)

EYE DEFECT	DESCRIPTION	LENS USED
Short sight		
Long sight		

PS

4. Copy and complete the eye diagram to the right to show how the eye of a short-sighted person would focus the rays of light.



(1)

**Total 10 marks**

# Medical Physics

## Homework Exercises

### Homework 3.7 – Using the Spectrum

1. When tissue absorbs laser light, the light energy is converted to heat energy. This makes it very useful in health physics

Give two ways in which laser light is used in medicine.

(1)

2. (a) Give one use for x-rays in medicine.  
(b) Explain why x-rays are used for this purpose.  
(c) What detector is used to pick up the x-rays in hospitals?



(1)

(2)

(1)

3. (a) Thermal cameras are sometimes used in hospitals. They do not detect light like normal cameras. Which electromagnetic waves do they detect?  
(b) A thermal camera can detect tumours. In what way is the tumour different from the surrounding tissue?

(1)

(1)

4. What is the main danger of overexposure to ultraviolet radiation?

(1)

- CR** 5. Give two advantages of a CT scan over an ordinary x-ray photograph.

(2)

**Total 10 marks**

# Medical Physics

## Homework Exercises

### Homework 3.8 – Nuclear Radiation: Humans and Medicine I

1. (a) Describe a medical use of radiation that is based on the fact that it can kill cells. (1)  
(b) Describe a medical use of radiation that is based on the fact that it is easily detected. (1)

2. Copy and complete the following table, using a '✓' if the radiation can pass through, and a '✗' if the radiation is absorbed. (3)

RADIATION	PAPER	3mm ALUMINIUM	3cm LEAD
Alpha ( $\alpha$ )			
Beta ( $\beta$ )			
Gamma ( $\gamma$ )			

4. Draw a diagram of a model of the atom. Carefully label the nucleus, and a proton, a neutron, and an electron. (3)



7. Describe how a Geiger-Muller tube detects radiation. (2)

*Total 10 marks*

# Medical Physics

## Homework Exercises

### Homework 3.9 – Nuclear Radiation: Humans and Medicine II

1. Copy and complete the following table, matching the correct units to the quantities listed. (1)

QUANTITY	UNIT
Activity	
Dose Equivalent	

- CR** 2. In 1969, a new man-made element called Rutherfordium was created in America. Some tests were done to discover its half-life. The element's starting activity was measured as 20 480 Bq, and 18 seconds later, it had dropped to just 320 Bq.

Calculate the half-life of Rutherfordium from these figures. (3)

- PS** 3. Living plants incorporate a radioactive isotope of carbon ( $C_{14}$ ) into their living tissue. This radioactive carbon is always found in the same ratio to ordinary carbon ( $C_{12}$ ) in something that is alive, but once it dies, the ratio of  $C_{14}$  to  $C_{12}$  decreases.

By comparing the ratio of the two types of carbon the age of a piece of dead plant material can be calculated. The half-life of  $C_{14}$  is approximately 6000 years. That is, after 6000 years, the ratio of  $C_{14}$  to  $C_{12}$  will be half the original value.

The amount of  $C_{14}$  left after 7 half-lives is only just detectable. This puts a limit on the maximum age that can be estimated using this technique.

- (a) What is the half-life of  $C_{14}$ ? (1)
- (b) A piece of wood preserved in a peat bog is found to have a ratio of  $C_{14}$  to  $C_{12}$  of only  $\frac{1}{16}$ th that found in a living tree. Estimate the age of the wood. (2)
- (c) What the maximum age that can be estimated using this technique? (1)
8. List **two** safety precautions necessary when dealing with radioactive sources. (1)
9. How are hospital staff protected from radiation and x-rays when they work with these resources? (1)

**Total 10 marks**