

# Physics Higher Level Radiation and Matter Practice Unit Assessment

Time 45 minutes

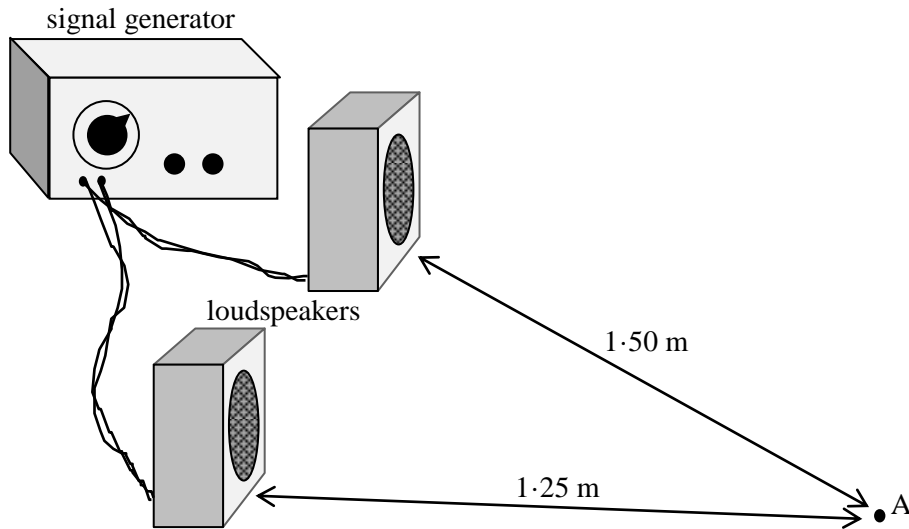
## Read Carefully

- 1 All questions should be attempted.
- 2 Enter the question number clearly beside the answer to each question.
- 3 Care should be taken to give an appropriate number of significant figures in the final answers to calculations.
- 4 The following data should be used when required.

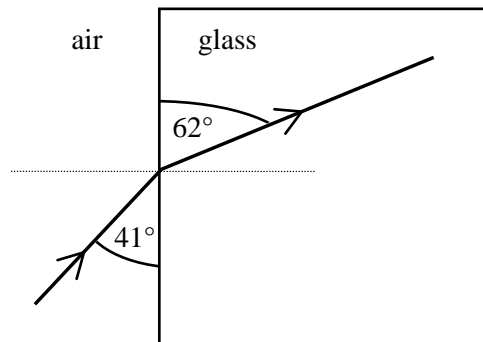
Speed of light in vacuum $c$	$3.00 \times 10^8 \text{ m s}^{-1}$	Planck's constant $h$	$6.63 \times 10^{-34} \text{ J s}$
Magnitude of the charge on electron $e$	$1.60 \times 10^{-19} \text{ C}$	Mass of electron $m_e$	$9.11 \times 10^{-31} \text{ kg}$
Acceleration due to gravity $g$	$9.8 \text{ m s}^{-2}$	Mass of proton $m_p$	$1.67 \times 10^{-27} \text{ kg}$

NOTE: This is a **trial paper** and contains questions **of the type** that will be encountered in the actual unit assessment. The threshold of attainment of the unit assessment (pass mark) is 18 marks.

1. Two loudspeakers are connected to a signal generator which produces a steady note with a frequency of 3400 Hz.



- (a) Calculate the wavelength of the sound waves being produced by the loudspeakers given that the speed of sound in air is  $340 \text{ m s}^{-1}$ . 2
- (b) A microphone is placed at position A which is 1.25 m from one loudspeaker and 1.50 m from the other. State, providing evidence for your answer, whether constructive or destructive interference will be found at this point. 2
- (c) The experiment is moved from a large open space to a small room in which there are many reflections of sound from the walls. Why would this make it very hard to detect accurately the position of a maxima or minima of sound? 1
- (5)**
2. (a) What is the velocity of light in air? 2
- (b) What will be the velocity of light within a lens made of glass with a refractive index of 1.48? 1
- (3)**
3. Find the refractive index of the glass block shown below.



2  
**(2)**

4. A photographic light meter indicates a light intensity of  $4 \text{ W m}^{-2}$  at a distance of 2.0 m from a light source. What separation from the light source would be required to produce a light intensity of  $0.25 \text{ W m}^{-2}$ ? 2  
(2)

5. The work function of a metal is  $6.4 \times 10^{-19} \text{ J}$ .

(a) Explain what is meant by the term ‘work function’. 1

(b) Light with a frequency of  $1.2 \times 10^{15} \text{ Hz}$  is shone onto the metal surface.

Find whether or not the photons of this light will cause the photoelectric effect to take place. 2

(c) The light source is now replaced with a light source which produces light with a frequency of  $1.5 \times 10^{15} \text{ Hz}$ .

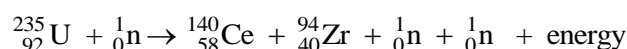
(i) The photons from this source contain more energy than is required to release the electrons. How much extra energy is available after the electron has been released? 2

(ii) Into what energy type will this extra energy be converted? 1

(iii) Photons come from three lamps that emit red, green and blue light. Which of these lamps produces photons with the highest energy? 1

(7)

6. The equation for a nuclear reaction is given below.



(a) State whether this is a fission or fusion reaction. 1

(b) Explain the difference between a spontaneous fission reaction and an induced fission reaction. 2

(c) (i) Explain, using  $E = mc^2$ , how this nuclear reaction results in the production of energy. 2

(ii) Using the information given below, and any other data required from the front cover, calculate the energy released in the above nuclear reaction. 2

$$\text{mass of } {}_{92}^{235}\text{U} = 390.173 \times 10^{-27} \text{ kg}$$

$$\text{mass of } {}_{58}^{140}\text{Ce} = 232.242 \times 10^{-27} \text{ kg}$$

$$\text{mass of } {}_{40}^{94}\text{Zr} = 155.883 \times 10^{-27} \text{ kg}$$

$$\text{mass of } {}_0^1\text{n} = 1.675 \times 10^{-27} \text{ kg} \quad (7)$$

7. (a) State **two** factors that determine the risk of biological harm from ionising radiation. **2**
- (b) A welder uses radioactive materials to help detect welding faults in a pipeline. Over a period of a year he receives 6 mGy of gamma radiation and 0.5 mGy of alpha radiation. Use the table below to calculate the total dose equivalent he receives for the year? **2**

<i>Type of radiation</i>	<i>Quality factor, Q</i>
X-rays	1
gamma rays	1
beta particles	1
slow neutrons	5
fast neutrons	10
alpha particles	20

**(4)**