

Paper Reference(s) 1PH0/1H  
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Physics  
PAPER 1  
Higher Tier

Total Marks
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Wednesday 22 May 2024 – Morning

Time: 1 hour 45 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

**YOU MUST HAVE**

**Calculator, ruler, writing and drawing equipment, Equation Booklet (enclosed)**

**YOU WILL BE GIVEN**

**Diagram Booklet**

**INSTRUCTIONS**

**Answer ALL questions.**

**Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.**

## **INFORMATION**

**The total mark for this paper is 100.**

**The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.**

**In questions marked with an ASTERISK (\*), marks will be awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other where appropriate.**

**There may be spare copies of some diagrams.**

## **ADVICE**

**Read each question carefully before you start to answer it.**

**Try to answer every question.**

**Check your answers if you have time at the end.**

**Answer ALL questions. Write your answers in the spaces provided.**

**Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.**

- 1 (a) Nuclear fusion is a process that releases energy.**

**Which of these statements applies to a nuclear fusion reaction?  
(1 mark)**

- ☐ **A it emits daughter nuclei**
- ☐ **B it is a controlled chain reaction**
- ☐ **C it produces radioactive waste**
- ☐ **D it requires high temperature and pressure**

**(continued on the next page)**

**1 continued.**

**(b) In the Sun, four protons start the process of nuclear fusion.**

**These protons combine and finally produce a helium nucleus.**

**The helium nucleus has a smaller mass than the four protons.**

**This difference in mass is converted to energy.**

**Four protons have a total mass of  $6.69 \times 10^{-27}$  kg**

**A helium nucleus has a mass of  $6.64 \times 10^{-27}$  kg**

**Calculate the percentage of the original mass that has been converted to energy.  
(3 marks)**

**Answer space continues on the next page.**

**Turn over**

**1(b) continued.**

**percentage of mass  
converted to energy \_\_\_\_\_%**

**(continued on the next page)**

**Turn over**

**1 continued.**

**(c) Look at Figure 1 for Question 1(c) in the Diagram Booklet. It shows the spectrum of an element detected in the light from a distant galaxy, from a nearby galaxy and from a source on Earth.**

**(i) Estimate the difference between the wavelength of line **P** in the spectrum from the distant galaxy and the wavelength of line **P** in the spectrum on Earth.  
(1 mark)**

**difference in wavelength = \_\_\_\_\_ nm**

**(continued on the next page)**

**Turn over**

**1(c) continued.**

- (ii) Scientists have discovered that light from almost all distant galaxies has spectral lines shifted towards the red end of the spectrum.**

**Explain how red shift in light, received from galaxies at different distances from the Earth, supports the idea that the Universe is expanding.  
(3 marks)**

**Answer space continues on the next page.**

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**Turn over**

**1(c)(ii) continued.**

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**(Total for Question 1 = 8 marks)**

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- 2 Look at Figure 2 for Question 2 in the Diagram Booklet. It shows a person on a skateboard at the top of a ramp.**

**At P, the person is not moving.**

- (a) The person rides the skateboard down the ramp from P to Q.**

**The gravitational potential energy of the person decreases by 980 J**

**The mass of the person is 35 kg**

**Calculate  $h$ , the height of the ramp.  
(2 marks)**

**Use  $g = 10 \text{ N/kg}$**

**Use the equation**

**change in gravitational potential  
energy =  $m \times g \times h$**

**Answer space continues on the next page.**

**Turn over**

**2(a) continued.**

**change in gravitational potential  
energy =  $m \times g \times h$**

**$h =$  \_\_\_\_\_ **m****

**(continued on the next page)**

**Turn over**

**2 continued.**

**(b) The kinetic energy,  $KE$ , of the person at  $Q$  is  $950\text{ J}$**

**The mass of the person is  $35\text{ kg}$**

**Calculate the velocity of the person at  $Q$ .  
(3 marks)**

**Use the equation**

$$v^2 = \frac{2 \times KE}{m}$$

**Answer space continues on the next page.**

**Turn over**

**2(b) continued.**

$$v^2 = \frac{2 \times KE}{m}$$

**velocity = \_\_\_\_\_ m/s**

**(continued on the next page)**

**Turn over**

**2 continued.**

**(c) Look at Figure 3 for Question 2(c) in the Diagram Booklet. It is a diagram that represents energy changes from P to Q.**

**(i) State what is represented by X.  
(1 mark)**

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**(continued on the next page)**

**2(c) continued.**

- (ii) Look again at Figure 3 for Question 2(c) in the Diagram Booklet. Calculate the value of  $X$ . (1 mark)**

**value of  $X$  = \_\_\_\_\_ J**

**(continued on the next page)**

**Turn over**

**2(c) continued.**

- (iii) Look again at Figure 3 for Question 2(c) in the Diagram Booklet. Calculate the efficiency of the system represented in Figure 3.  
(2 marks)**

**efficiency = \_\_\_\_\_**

**(Total for Question 2 = 9 marks)**

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**Turn over**

- 3 (a) Two people, L and M, have a 100 m race.**

**L starts running before M.**

**Look at Figure 4 for Question 3(a) in the Diagram Booklet. It shows a distance/time graph of the race.**

- (i) State the DISTANCE that L has run when M overtakes.  
(1 mark)**

**distance = \_\_\_\_\_ m**

**3(a) continued.**

- (ii) Look again at Figure 4 for Question 3(a) in the Diagram Booklet. Calculate the velocity of L when running the 100 m race. (2 marks)**

**velocity = \_\_\_\_\_ m/s**

**(continued on the next page)**

**Turn over**

**3 continued.**

**(b) A motorcycle is travelling at a velocity of  $6.2 \text{ m/s}$**

**The motorcycle accelerates at  $2.5 \text{ m/s}^2$  until its velocity is  $10 \text{ m/s}$**

**(i) Calculate the time taken for this acceleration.  
(2 marks)**

**Use the equation**

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

**Answer space continues on the next page.**

**Turn over**

**3(b)(i) continued.**

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

**time taken = \_\_\_\_\_ s**

**(continued on the next page)**

**Turn over**

**3(b) continued.**

**(ii) The motorcycle now decelerates (slows down) from 10 m/s to a stop.**

**The deceleration is at a constant rate of 4.4 m/s<sup>2</sup>**

**Calculate the distance the motorcycle travels as it slows down to a stop.  
(2 marks)**

**Use the equation**

$$v^2 - u^2 = 2 \times a \times x$$

**Answer space continues on the next page.**

**Turn over**

**3(b)(ii) continued.**

$$v^2 - u^2 = 2 \times a \times x$$

**distance = \_\_\_\_\_ m**

**(continued on the next page)**

**Turn over**

**3 continued.**

**(c) A car collides with a barrier on a road.**

**The time of the collision is very short.**

**Explain ONE factor, other than the time of the collision, that would affect the force on the car in the collision.**

**Your explanation should refer to an equation in the Equation Booklet.  
(2 marks)**

**Answer space continues on the next page.**

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**Turn over**

**3 continued.**

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**(Total for Question 3 = 9 marks)**

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- 4 (a) Radiation is used to treat tumours (cancer).**

**The source of the radiation can be inside or outside the human body.**

**Which of these has a radiation source that can be positioned inside the body to treat tumours?  
(1 mark)**

☐ **A gamma rays**

☐ **B x-rays**

☐ **C radio waves**

☐ **D microwaves**

**(continued on the next page)**

**4 continued.**

**(b) Look at Figure 5 for Question 4(b) in the Diagram Booklet. It shows a PET scanner used to detect cancerous tumours.**

**A radioactive isotope is injected into a patient.**

**The isotope is absorbed by the tumour.**

**The isotope emits positrons from the location of the tumour.**

**The ring of radiation detectors rotates around the person.**

**(i) Explain how the scan can give the location of the tumour.  
(3 marks)**

**Answer space continues on the next page.**

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**Turn over**

**4(b)(i) continued.**

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**(continued on the next page)**

**4(b) continued.**

- (ii) Explain why the radioactive isotope injected into the patient must be produced near to the place where it is to be used.  
(2 marks)**

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**(continued on the next page)**

**4 continued.**

**(c) Radiotherapy can involve irradiation of patients.**

**Radioactive tracers can involve contamination of patients.**

**State TWO differences between irradiation and radioactive contamination.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**Turn over**

**4 continued.**

**(d) Look at Figure 6 for Question 4(d) in the Diagram Booklet. It shows the decay curves of two different isotopes, Q and P.**

**(i) Use the graph in Figure 6 to determine the half-life of isotope P. (2 marks)**

**half-life of  
isotope P = \_\_\_\_\_ hours**

**(continued on the next page)**

**4(d) continued.**

- (ii) Suggest a reason why the sample of isotope Q could be more dangerous to humans than the sample of isotope P.  
(1 mark)**

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**(Total for Question 4 = 11 marks)**

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**5 Ultraviolet (UV) waves from the Sun travel towards the Earth.**

**Ultraviolet waves can be grouped by wavelength.**

**The three groups of wavelengths are UVA, UVB and UVC.**

**Look at Figure 7 for Question 5 in the Diagram Booklet. It shows, for each group,**

- **the wavelength range**
- **the effect of the Earth's atmosphere on each type of UV wave.**

**(continued on the next page)**

**5 continued.**

- (a) (i) Explain why UVC is potentially the most dangerous ultraviolet radiation but does not cause harm to people.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**5(a) continued.**

**(ii) The speed of electromagnetic radiation is  $3.00 \times 10^8 \text{ m/s}$**

**Calculate the frequency of the shortest wavelength of UVB radiation.  
(3 marks)**

**frequency = \_\_\_\_\_ Hz**

**5 continued.**

**(b) UV radiation of wavelength 365 nm is used to detect forged banknotes.**

**In a genuine banknote there are marks that CANNOT be seen using visible light. These marks CAN be seen using UV radiation.**

**Explain why the marks can be seen when the UV radiation shines on the banknote.**

**Your answer should refer to the energy of electrons in atoms.**

**You may draw a diagram to help with your answer.  
(4 marks)**

**Answer space continues on the next 2 pages.**

**Turn over**

**5(b) continued.**

**(continued on the next page)**

**Turn over**

**5(b) continued.**

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**(Total for Question 5 = 9 marks)**

**Turn over**

**6 (a) (i) The law of reflection of light applies to reflections from (1 mark)**

- ☐ **A all surfaces**
- ☐ **B only shiny surfaces**
- ☐ **C only rough surfaces**
- ☐ **D only smooth surfaces**

**(continued on the next page)**

**6(a) continued.**

- (ii) A student uses a mirror to demonstrate that the angle of incidence is equal to the angle of reflection.**

**Look at Figure 8 for Question 6(a)(ii) in the Diagram Booklet. It shows the apparatus the student uses.**

**Describe the procedure the student should use with the ray and mirror in the position shown in Figure 8.**

**You should include any extra equipment needed.**

**You may add to Figure 8 to help your answer.  
(3 marks)**

**Answer space continues on the next page.**

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**6(a)(ii) continued.**

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**(continued on the next page)**

**6 continued.**

**(b) Look at Figure 9 for Question 6(b) in the Diagram Booklet. It shows a ray of light from a ray box passing through a semi-circular glass block.**

**A student uses the apparatus in Figure 9 to determine the critical angle for glass.**

**(i) State why the ray of light does not change direction as it enters the glass block at X.  
(1 mark)**

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**(continued on the next page)**

**Turn over**

**6(b) continued.**

- (ii) Describe how the critical angle for glass can be determined using the apparatus shown in Figure 9.  
(3 marks)**

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**(continued on the next page)**

**Turn over**

**6 continued.**

**(c) Look at Figure 10 for Question 6(c) in the Diagram Booklet. It shows a ray diagram of the VIRTUAL IMAGE produced by a diverging lens.**

**State what is meant by the term VIRTUAL IMAGE.  
(1 mark)**

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**(Total for Question 6 = 9 marks)**

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**7 (a) Look at Figure 11 for Question 7(a) in the Diagram Booklet. A car starts from rest and then travels for 70 s as shown on the graph in Figure 11.**

**(i) Complete the sentence using data from Figure 11.  
(1 mark)**

**The car is travelling at  
constant velocity**

**from \_\_\_\_\_ s**

**to \_\_\_\_\_ s.**

**(continued on the next page)**

**7(a) continued.**

- (ii) Look again at Figure 11 for Question 7(a) in the Diagram Booklet. Use data from the graph in Figure 11 to show that the car travels a total distance of about 710 m in 70 s.  
(3 marks)**

**Answer space continues on the next page.**

**7(a)(ii) continued.**

**(continued on the next page)**

**Turn over**

**7(a) continued.**

- (iii) Calculate the average speed of the car for the total distance travelled.  
(1 mark)**

**average speed = \_\_\_\_\_ m/s**

**(continued on the next page)**

**Turn over**

**7 continued.**

**(b) The INERTIAL mass of an object is a measure of how difficult it is to change the velocity of the object.**

**A force of 450 N acts on a car to give the car an acceleration of  $0.35 \text{ m/s}^2$**

**Calculate the INERTIAL mass of the car.  
(2 marks)**

**inertial mass of car \_\_\_\_\_ kg**

**(continued on the next page)**

**Turn over**

**7 continued.**

**(c) Look at Figure 12 for Question 7(c) in the Diagram Booklet. It shows a different velocity/time graph.**

**This straight line graph can be represented by the equation**

$$y = mx + c$$

**(i) Give the quantities that  $x$  and  $y$  represent in the equation.  
(1 mark)**

**$x$  represents \_\_\_\_\_**

**$y$  represents \_\_\_\_\_**

**(continued on the next page)**

**7(c) continued.**

- (ii) Look again at Figure 12 for Question 7(c) in the Diagram Booklet. Calculate the value of  $m$  from the graph in Figure 12. (2 marks)**

**$m =$  \_\_\_\_\_  $\text{m/s}^2$**

**(continued on the next page)**

**Turn over**

**7(c) continued.**

- (iii) Look again at Figure 12 for Question 7(c) in the Diagram Booklet. State the value of C from the graph in Figure 12.  
(1 mark)**

**value of C = \_\_\_\_\_**

**(Total for Question 7 = 11 marks)**

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8 (a) An electron has a charge of  $-1$

The charge on an alpha particle is  
(1 mark)

☐ A  $-2$

☐ B  $0$

☐ C  $+1$

☐ D  $+2$

(b) Alpha, beta and gamma are all  
**IONISING** radiations.

Give the meaning of the  
term **IONISING**.  
(1 mark)

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(continued on the next page)

Turn over

**8 continued.**

**(c) A teacher determines the background radiation count rate in a laboratory.**

**Explain how to determine a value for the background radiation count rate.  
(3 marks)**

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**(continued on the next page)**

**Turn over**

**8 continued.**

**(d) The teacher now investigates the absorption of beta radiation by different thicknesses of aluminium.**

**The apparatus available is**

- **a source of beta radiation**
- **a Geiger–Müller (G-M) tube and counter**
- **10 pieces of aluminium, each 0.5 mm thick**
- **a metre rule.**

**(continued on the next page)**

**8(d) continued.**

- (i) Sketch a labelled diagram showing the positions of the apparatus when the measurements are being taken. (2 marks)**

**8(d) continued.**

**(ii) Give the independent variable in this investigation.  
(1 mark)**

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**(iii) Name a quantity that must be kept constant during the investigation.  
(1 mark)**

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**(continued on the next page)**

**8(d) continued.**

- (iv) Strontium-90 is the source of beta minus radiation in this investigation.**

**Look at the equation for Question 8(d)(iv) in the Diagram Booklet. Complete the nuclear equation for this emission of beta minus radiation.  
(2 marks)**

**(Total for Question 8 = 11 marks)**

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**9 (a) Look at Figure 13 for Question 9(a) in the Diagram Booklet. It shows a ball being rotated in a horizontal circle.**

**(i) Which arrow in Figure 13 shows the direction of the centripetal force on the ball?  
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**(continued on the next page)**

**Turn over**

**9(a) continued.**

**(ii) The ball is moving at constant speed. Give ONE reason why the velocity of the ball is continuously changing.  
(1 mark)**

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**(continued on the next page)**

**9 continued.**

**(b) Look at Figure 14 for Question 9(b) in the Diagram Booklet. It shows a gymnast landing on a mat and coming to rest.**

**The gymnast has a mass of 53 kg**

**The gymnast lands on the mat with a velocity of 4.0 m/s**

**The average force exerted by the mat on the gymnast is 3500 N**

**Calculate the time taken for the gymnast to come to rest.**

**Give your answer to an appropriate number of significant figures.  
(3 marks)**

**Use the equation**

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

**Answer space continues on the next page.**

**Turn over**

9(b) continued.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

$$\text{time} = \underline{\hspace{10cm}} \text{ s}$$

(continued on the next page)

Turn over

**9 continued.**

**\*(c) Look at Figure 15 for Question 9(c) in the Diagram Booklet. It shows two trolleys, P and Q, moving at the same speed,  $v$ , directly towards each other.**

**The trolleys have the same mass.**

**When the trolleys collide, they stick together and stop.**

**Explain how momentum and energy are both conserved in this collision.  
(6 marks)**

**Answer space continues on the next 2 pages.**

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**Turn over**

**9(c) continued.**

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**9(c) continued.**

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**(Total for Question 9 = 11 marks)**

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**10 (a) Which row of the table shows two transverse waves?  
(1 mark)**

<input type="checkbox"/> <b>A</b>	<b>infrasound</b>	<b>infrared</b>
<input type="checkbox"/> <b>B</b>	<b>infrared</b>	<b>ultraviolet</b>
<input type="checkbox"/> <b>C</b>	<b>ultrasound</b>	<b>infrasound</b>
<input type="checkbox"/> <b>D</b>	<b>ultraviolet</b>	<b>ultrasound</b>

**(continued on the next page)**

**10 continued.**

**(b) Look at Figure 16 for Question 10(b) in the Diagram Booklet. It is an energy diagram for a sound wave incident on a sound-insulating board.**

**(i) The incident energy is 0.25 J**

**The absorbed energy is 67% of the incident energy.**

**The reflected energy is 15% of the incident energy.**

**Calculate the amount of the transmitted energy.  
(2 marks)**

**Answer space continues on the next page.**

**Turn over**

**10(b)(i) continued.**

**transmitted energy = \_\_\_\_\_ J**

**(continued on the next page)**

**10(b) continued.**

**(ii) Give ONE way to reduce the percentage of energy transmitted through the sound-insulating board.  
(1 mark)**

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**(continued on the next page)**

**10 continued.**

- (c) The ratio of the absorbed energy  $E_a$  to incident energy  $E_i$  is the coefficient of absorption of sound  $\alpha$ .**

$$\alpha = \frac{E_a}{E_i}$$

**Look at Figure 17 for Question 10(c) in the Diagram Booklet. The table gives the coefficient of absorption for various materials.**

**Explain why rooms with carpets and curtains are less noisy than rooms without them.**

**Use the information given in Figure 17 in your answer.  
(2 marks)**

**Answer space continues on the next page.**

**Turn over**

**10(c) continued.**

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**(continued on the next page)**

**10 continued.**

**\*(d) Explain how sound waves can be used to determine the depth of the ocean directly underneath a boat.**

**You may draw a diagram to help with your answer.  
(6 marks)**

**Answer space continues on the next 3 pages.  
Turn over**

**10(d) continued.**

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**Turn over**

**10(d) continued.**

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**10(d) continued.**

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**(Total for Question 10 = 12 marks)**

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**TOTAL FOR PAPER = 100 MARKS**  
**END OF PAPER**