**chermistry.com**
Practice paper written from an analysis of every
O-Level Science (Physics) paper, 2010–2025

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | S | | | | | INDEX NUMBER | | | | |

# SCIENCE (PHYSICS)

**Specimen**

Paper 2 Physics

PRACTICE PAPER · PAPER 2.4

**For practice before the next examination**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

This is a **chermistry practice paper**.

**READ THESE INSTRUCTIONS FIRST**

Write your name, centre number and index number in the boxes above.

You may use an HB pencil for any diagrams, graphs or rough working.

Write in dark blue or black pen.

Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

Take $g$ = 10 m/s$^2$ (or 10 N/kg) unless you are told otherwise.

**Section A**
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

**Section B**
Answer **one** question.
Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total mark for this paper is 65.

This document consists of **20** printed pages.

**NOT AN OFFICIAL EXAMINATION PAPER**

Written for classroom practice from the topic frequencies in the chermistry theory-paper analysis. It follows the layout, wording and mark scheme conventions of the O-Level Science (Physics) papers but is not set, endorsed or marked by any examination board.

## Section A

Answer **all** the questions in the spaces provided.

**1** A student investigates a battery-powered toy buggy on a laboratory bench.

**(a)** The student writes down ‘mass of buggy = 240’. State what the student has left out of this record of a physical quantity.

.....[1]

**(b)** The buggy moves along the bench between two marks. It travels at a constant speed of 0.40 m/s for 2.0 s, then stops for 3.0 s while the student resets a sensor, and finally covers the last 1.00 m in a further 4.0 s. Calculate the average speed of the buggy between the two marks.

average speed = ..... m/s [2]

[Total: 3]

**2** A steel ball bearing is released at the top of a tall measuring cylinder that holds a layer of runny oil above a layer of much thicker syrup. A motion sensor and data-logger record its speed. Fig. 2.1 is the speed-time graph.

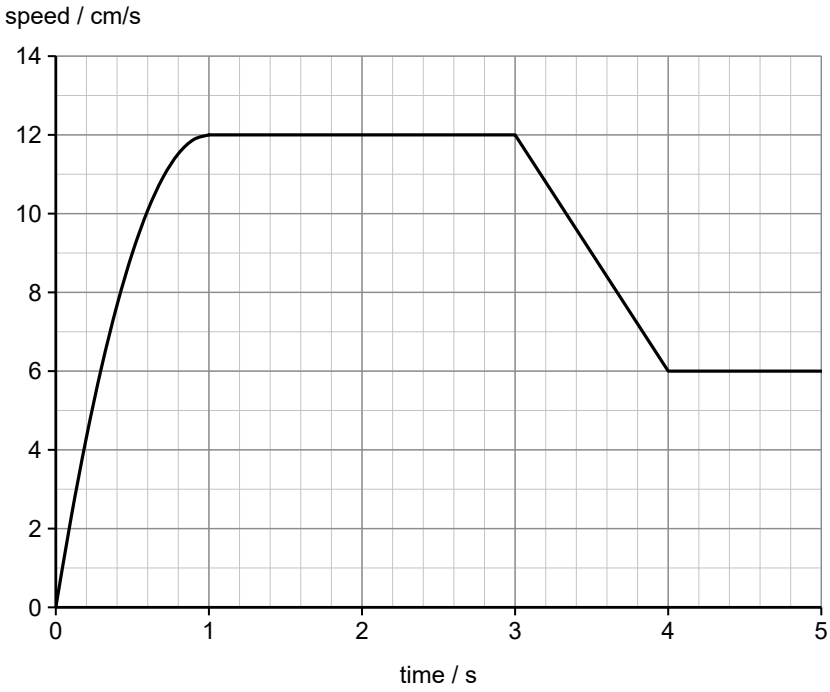



**Fig. 2.1**

**(a)** Use the gradient of the graph to describe how the acceleration of the ball bearing changes during the first 1.0 s, and state its acceleration from 1.0 s to 3.0 s.

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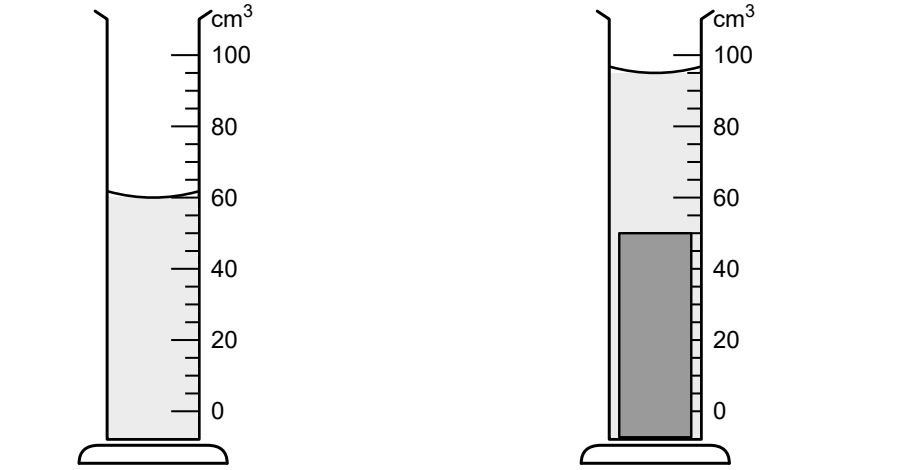
..... [1]

**(b)** Calculate the distance fallen by the ball bearing between 2.0 s and 5.0 s. Give your answer in metres.

distance = ..... m [2]

[Total: 3]

**3** A student finds the density of a metal cylinder. The cylinder hangs from a newton meter, which reads 2.8 N. The student then lowers the cylinder into water in a measuring cylinder, as shown in Fig. 3.1. Take $g$ = 10 N/kg.




before the metal cylinder is lowered in with the metal cylinder completely under water

**Fig. 3.1**

**(a)** Calculate the mass of the metal cylinder, in kg.

mass = ..... kg [2]

**(b)** Calculate the density of the metal, in g/cm$^3$.

density = ..... g/cm$^3$ [2]

[Total: 4]

**4** A student investigates a wooden block of mass 0.40 kg.

**(a)** The block makes a deeper impression in a tray of sand when it rests on its smallest face than when it rests on its largest face. Define pressure.

.....

..... [2]

**(b)** The student then pushes the block along the bench with a horizontal force of 1.8 N. Friction on the block is 0.60 N (Fig. 4.1). Calculate the acceleration of the block.

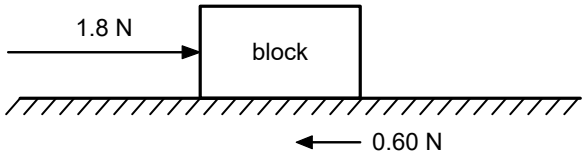



**Fig. 4.1**

acceleration = ..... $m/s^2$ [2]

**(c)** The student stops pushing. The block slides a short distance and stops. Explain, in terms of friction, why the block stops.

.....

.....

..... [2]

[Total: 6]

**5** A student builds a model catapult. Fig. 5.1 shows a uniform arm that turns about a fixed pivot P. The student pulls the arm down with a force of 6.0 N, at right angles to the arm.

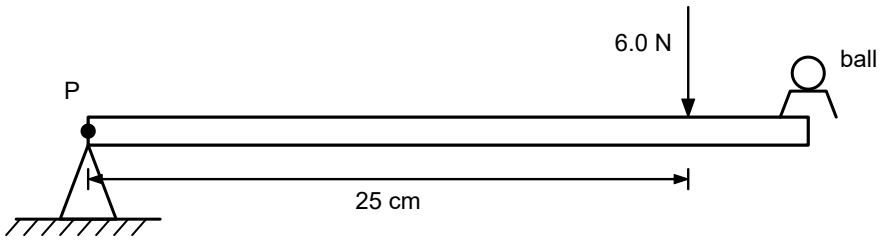



**Fig. 5.1**

**(a)** Describe what is meant by the moment of a force about a pivot.

.....

..... [1]

**(b)** Use Fig. 5.1 to calculate the moment of the 6.0 N force about P. Give your answer in N m.

moment = ..... N m [2]

**(c)** The arm is released. It launches a ball of mass 0.020 kg, which gains 0.36 J of gravitational potential energy as it rises from its release point to its highest point. Take $g$ = 10 N/kg. Calculate the height through which the ball rises.

height = ..... m [1]

[Total: 4]

**6** A student heats water in a beaker on an electric hot plate that supplies energy at a steady rate. She records the temperature of the water every two minutes (Table 6.1).

**Table 6.1**

| time / min | temperature / °C |
|---|---|
| 0 | 20 |
| 2 | 44 |
| 4 | 68 |
| 6 | 92 |
| 8 | 100 |
| 10 | 100 |
| 12 | 100 |

**(a)** Explain, in terms of the particles of water, why the temperature rises between 0 and 6 minutes.

.....

.....

..... [2]

**(b)** The water starts to boil. The hot plate still supplies energy. Use Table 6.1 to describe what happens to the temperature of the water between 8 and 12 minutes. Explain, in terms of the energy and the particles of the water, why this happens.

.....

.....

.....

.....

..... [2]

[Total: 4]

**7** A student investigates how energy is transferred through water and through a vacuum.

**(a)** A small crystal of purple dye is placed at the bottom of a beaker of cold water. The bottom left-hand corner is heated with a small flame (Fig. 7.1). The purple colour spreads upwards from the crystal and then around the water. Describe, in terms of density changes, how convection currents form in the water, and state whether the water circulates clockwise or anticlockwise as seen in Fig. 7.1.

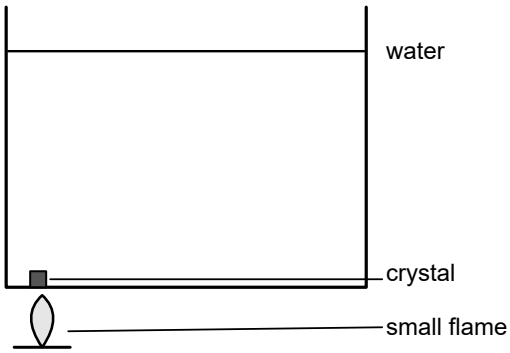



**Fig. 7.1**

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..... [2]

**(b)** Fig. 7.2 shows two thermometers in a glass jar from which the air has been removed. A lamp is switched on beside the jar. After five minutes the reading on thermometer X has risen more than the reading on thermometer Y.

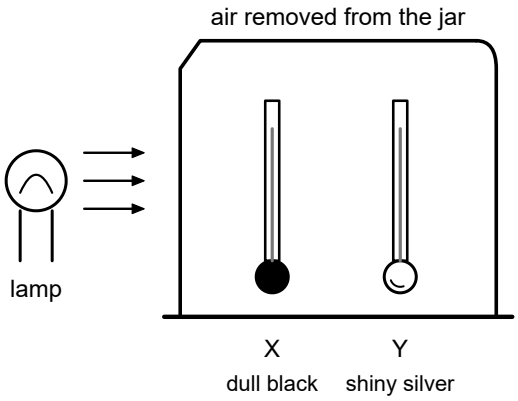



**Fig. 7.2**

**(i)** Explain how energy reaches the thermometers through the space inside the jar.

.....

..... [1]

**(ii)** Explain why the reading on X rises more than the reading on Y.

.....

..... [1]

**(c)** Infra-red and ultraviolet radiation are both regions of the electromagnetic spectrum. State one typical use of each.

.....

.....

..... [2]

[Total: 6]

**8** Fig. 8.1 shows the ripples seen from above when a vibrating dipper touches the water surface in a ripple tank.

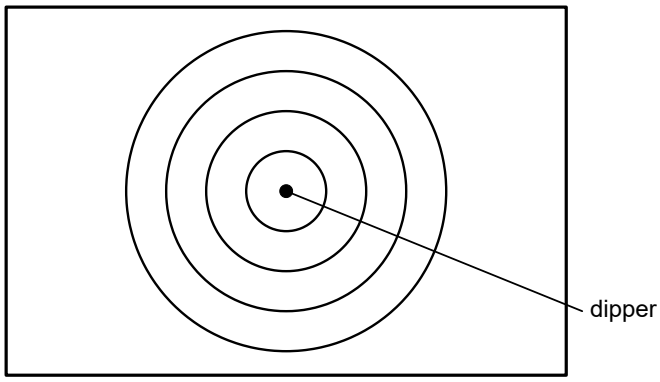



**Fig. 8.1**

**(a)** Describe what is meant by wave motion, as shown by these ripples. Use the term *wavefront* in your answer.

.....

.....

.....

..... [2]

**(b)** In another experiment a sound emitter and sensor, connected to a computer, are placed in front of a wall. The emitter sends out a short pulse of sound. The computer records 0.080 s between the pulse being sent and the echo being detected. The speed of sound in air is 340 m/s. Describe how an echo is produced and calculate the distance from the emitter to the wall.

.....

.....

.....

.....

..... [2]

[Total: 4]

**9** A technician charges a 6.0 V rechargeable battery pack for a data-logger. The charger supplies a steady current of 0.50 A.

**(a)** State what is meant by an electric current. Hence state what the unit and the value of the charger current, 0.50 A, tell you about the charge that flows.

.....

.....

..... [2]

**(b)** The battery pack is labelled 6.0 V. State the name of the quantity of the battery pack that this label gives, and state the name of the unit in which that quantity is measured.

.....

.....

..... [2]

[Total: 4]

**10** A student investigates the current in a light-emitting diode (LED).

**(a)** Draw a circuit diagram, in the box, for a cell or battery, a switch, a variable resistor and the LED, all connected in series, with an ammeter to measure the current in the LED and a voltmeter to measure the potential difference across the LED.

[2]

**(b)** Table 10.1 shows the readings on the voltmeter and on the first ammeter as the student adjusts the variable resistor. She then connects a second ammeter in the circuit between the switch and the cell and adjusts the variable resistor until the voltmeter reads 2.0 V. Use Table 10.1 to state the reading on the second ammeter and give a reason for your answer.

**Table 10.1**

| voltmeter reading / V | first ammeter reading / mA |
|---|---|
| 1.6 | 0 |
| 1.8 | 2 |
| 2.0 | 12 |
| 2.2 | 30 |

.....

.....

..... [2]

[Total: 4]

**11** A technician checks an electric water bath in the school laboratory. The insulation on its cable is cracked, exposing the wires, and the socket is next to a wet sink.

**(a)** State the hazard of using the water bath with

**(i)** damaged insulation,

.....

..... [1]

**(ii)** damp conditions.

.....

..... [1]

**(b)** State the meaning of the terms *neutral* and *earth* as used in a mains plug.

.....

.....

..... [2]

**(c)** The technician finds that the switch of the water bath has been wired into the neutral wire instead of the live wire. Explain why the water bath is still dangerous when the switch is open.

.....

.....

..... [1]

[Total: 5]

**12** A student investigates an iron nail and a steel nail.

**(a)** The iron nail is used to make a temporary magnet and the steel nail a permanent magnet. Distinguish between temporary and permanent magnets in terms of their properties and their uses.

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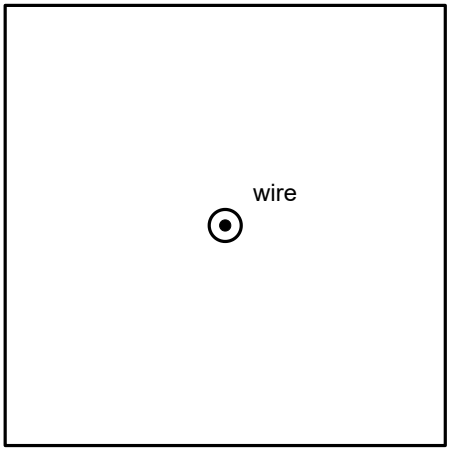
..... [2]

**(b)** Describe how a plotting compass can be used to find the direction of the magnetic field at a point near a bar magnet.

.....

..... [1]

**(c)** A straight wire passes through the centre of a horizontal card, as shown in Fig. 12.1. The current in the wire is towards the viewer, 'out of the paper'.




view from above the card

**Fig. 12.1**

**(i)** Draw two magnetic field lines on Fig. 12.1. Show the direction of the field on each.

[1]

**(ii)** The current is doubled and its direction is reversed. State the effect on the magnetic field around the wire.

.....

..... [1]

[Total: 5]

**13** A student uses a Geiger-Müller (GM) tube and counter to investigate radiation from rock samples. Table 13.1 gives data for three nuclides.

**Table 13.1**

| nuclide | proton number *Z* | nucleon number *A* |
|---|---|---|
| P | 53 | 131 |
| Q | 54 | 131 |
| R | 53 | 127 |

**(a)** State which two nuclides in Table 13.1 are isotopes of the same element. Calculate the number of neutrons in the nucleus of the one of these two isotopes that has more neutrons.

.....

..... [1]

**(b)** Before bringing a rock sample near the tube, the student records 36 counts in 10 minutes. With a rock sample near the tube she records 93 counts in 5.0 minutes.

**(i)** State one source of the radiation that gives these counts.

..... [1]

**(ii)** Show that the corrected count rate due to the rock sample is 15 counts per minute.

[1]

[Total: 3]

## Section B

Answer **one** question from this section.

**14** A student uses a large converging lens of focal length 15 cm to focus sunlight onto a small black metal block.

**(a)** Fig. 14.1 shows a parallel beam of sunlight about to enter the thin converging lens. The student first holds the block 40 cm behind the lens and finds that it heats up only slowly. Describe the action of the lens on the beam of light and use it to decide where the student should hold the block for the fastest heating. Give a reason for your decision.

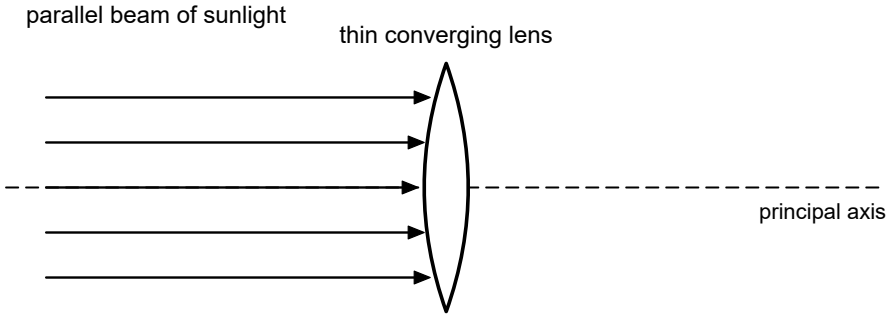



**Fig. 14.1**

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..... [3]

**(b)** The lens is made of glass. The student measures the angle of incidence *i* in air and the angle of refraction *r* in glass for a ray entering a flat glass block. Table 14.1 shows her results.

**Table 14.1**

| *i* / ° | *r* / ° | sin *i* / sin *r* |
|---|---|---|
| 20 | 13 | 1.52 |
| 40 | 25 | |
| 60 | 35 | |

**(i)** Complete Table 14.1 by calculating sin *i* / sin *r* for the last two rows. Give each answer to two decimal places.

[1]

**(ii)** The student shines another ray into the glass block at an angle of incidence of 50°. Use the results in Table 14.1 to calculate the angle of refraction.

angle of refraction = ..... deg [1]

**(c)** To focus the sunlight the student raises the lens and its holder steadily up a retort stand, from a height of 0.15 m to a height of 0.90 m above the bench. The lens has mass 0.45 kg and the holder has mass 0.35 kg. Take $g$ = 10 N/kg. Calculate the work done by the student.

work done = ..... J [3]

**(d)** The focused sunlight makes the metal block hot.

**(i)** State the energy store of the block that increases as the block gets hotter.

..... [1]

**(ii)** After some minutes the temperature of the block stops rising, although sunlight is still focused on it. Explain this in terms of energy transfers.

.....

.....

..... [1]

[Total: 10]

**15** A technician fills a jug with water at 90 °C in the preparation room, where the temperature is 20 °C. Table 15.1 shows how the temperature of the water in the bare jug changes with time. She later puts a jug on a laboratory trolley and pushes it to the laboratory.

**Table 15.1**

| time / min | temperature of water / °C |
|---|---|
| 0 | 90 |
| 10 | 63 |
| 20 | 46 |
| 30 | 36 |
| 40 | 30 |
| 60 | 24 |

**(a)** Use Table 15.1 to calculate the average fall in temperature per minute between 20 min and 40 min. Describe how energy is transferred between the hot water and the air of the room, and state what the temperature of the water will be after many hours.

.....

.....

.....

.....

.....

..... [2]

**(b)** The technician tries three ways of reducing the energy lost from a jug of water at 90 °C. Table 15.2 shows the fall in temperature of the water in each jug after 30 minutes. Jug A is the bare jug of Table 15.1.

**Table 15.2**

| jug | covering | fall in temperature / °C |
|---|---|---|
| A | bare jug, no lid | 54 |
| B | wrapped in bubble wrap, no lid | 38 |
| C | wrapped in bubble wrap, with a lid | 27 |
| D | bubble wrap, lid and a covering of shiny aluminium foil | 22 |

**(i)** Compare jugs A and B. Explain how the bubble wrap reduces the energy lost from the water.

.....

..... [1]

**(ii)** Compare jugs B and C. Explain how the lid reduces the energy lost from the water.

.....

..... [1]

**(iii)** Jug D is stood on a cold metal laboratory bench. Suggest one change that would reduce the energy lost by conduction from the base of the jug, and explain why it works.

.....

.....

..... [1]

**(c)** The trolley and jug have a total mass of 12 kg. The technician pushes the trolley along a level corridor with a force of 30 N and it moves at constant speed. Take $g$ = 10 N/kg. Fig. 15.1 shows the trolley and jug. On Fig. 15.1, draw and label arrows to show all the forces acting on the trolley and jug. Write the size of each force on your diagram.

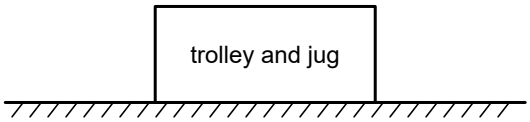



**Fig. 15.1**

[2]

**(d)** Use Newton's laws of motion to answer the following.

**(i)** Explain how the forces you have drawn in (c) show that the trolley moves at constant speed.

.....

..... [1]

**(ii)** The technician now pushes with a force of 42 N. The friction on the trolley stays the same. State the resultant force on the trolley and describe the effect on its motion.

.....

..... [1]

**(iii)** While the technician pushes with 42 N, her hands exert a force on the trolley. State the size and direction of the reaction force that goes with this force, and the object on which the reaction force acts.

.....

.....

..... [1]

[Total: 10]