ESSENTIAL
SQA EXAM PRACTICE

# QUESTIONS & PAPERS

NATIONAL 5
# PHYSICS
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Paul Van der Boon

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## Practice Questions

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# Practice Paper 1

| Area | Key Area | Section 1 | Section 2 | | | | | Check |
|---|---|---|---|---|---|---|---|---|
| | | Multiple choice | Course content – extended | | Experimental and data handling | Open ended | Scientific literacy | |
| | | | Calculate/ show that | State/ explain/ describe | | | | |
| Dynamics | D1 Vectors and scalars | 1, 2 | | | | | 4c | 5 |
| | D2 Velocity–time graphs | | 1aiii | | | | | 3 |
| | D3 Acceleration | 3 | | | 1ai | | | 4 |
| | D4 Newton's laws | 4 | 1aii, 1b | | | 3 | | 11 |
| | D5 Energy | | 2 a, 2 b, 5 ai | 2c | | | | 10 |
| | D6 Projectile motion | 5 | | | | | | 1 |
| Space | S1 Space exploration | 6,7 | 5 bi, 5 bii | 5 aii, 5 aiii | | | 4a | 11 |
| | S2 Cosmology | 8 | 12b | | | | | 4 |
| Electricity | E1 Electrical charge carriers | 9, 10 | | | | | | 2 |
| | E2 Potential difference (voltage) | 11 | | | | | | 1 |
| | E3 Ohm's law | 12 | 6 aiii | | | | | 5 |
| | E4 Practical electrical and electronic circuits | 13, 14 | 7 aii, 7 bi | 6 aii, 6 b, 7 bii | 6 ai | | | 12 |
| | E5 Electrical power | | 7 ai, 8 b | | | | | 6 |

| Area | Key Area | Section 1 | Section 2 | | | | | Check |
|---|---|---|---|---|---|---|---|---|
| | | Multiple choice | Course content – extended | | Experimental and data handling | Open ended | Scientific literacy | |
| | | | Calculate/ show that | State/ explain/ describe | | | | |
| Properties of matter | PM1 Specific heat capacity | | | | 8a | | | 3 |
| | PM2 Specific latent heat | 15 | | 9a, 9c | 9b | | | 7 |
| | PM3 Gas laws and the kinetic model | 16 | 10 a, 10 bi | 10 bii | | | | 8 |
| Waves | W1 Wave parameters and behaviours | 17 | 11ai, 11aii, 12cii | 12 ci, 11 aiii | | | | 13 |
| | W2 Electromagnetic spectrum | | | 12 ai, 12 aii, 12 aiii | | 13 | 4b | 8 |
| | W3 Refraction of light | 18 | | 11b | | | | 4 |
| Radiation | R1 Nuclear radiation | 19–25 | 1c, 14 cii | 14 bi, 14 ci | 14 a, 14 bii | | | 17 |
| **Totals** | | **25** | **62** | **23** | **13** | **6** | **6** | **/135** |

# Practice Paper 2

| Area | Key Area | Section 1 | Section 2 | | | | | Check |
|---|---|---|---|---|---|---|---|---|
| | | Multiple choice | Course content – extended | | Experimental and data handling | Open ended | Scientific literacy | |
| | | | Calculate/ show that | State/ explain/ describe | | | | |
| Dynamics | D1 Vectors and scalars | 1 | 3 biii, 5 c | 10 biii | | | | 9 |
| | D2 Velocity–time graphs | 2 | | | | | | 1 |
| | D3 Acceleration | 3, 4 | | | | | | 2 |
| | D4 Newton's laws | 5, 6 | 1b | 1c | 3ai | | | 8 |
| | D5 Energy | 7 | 3aii, 3bii | 8biii | | 2 | | 11 |
| | D6 Projectile motion | 8 | 3bi | | | | | 4 |
| Space | S1 Space exploration | 9, 10, 11, 12 | | 5aii, 5d | | | 4a | 8 |
| | S2 Cosmology | 13 | | | | | 4b, c | 5 |
| Electricity | E1 Electrical charge carriers | 14 | | 11a | | | | 2 |
| | E2 Potential difference (voltage) | | | 1a | | | | 1 |
| | E3 Ohm's law | 15, 16 | | | 6 bi, 6 bii, 6 biii | | | 9 |
| | E4 Practical electrical and electronic circuits | 17, 18 | | 6a, 7ai, 11ci, 11cii | | | | 6 |
| | E5 Electrical power | 19 | 7aii, 7 b, 8 bi | | | | | 10 |

| Area | Key Area | Section 1 | Section 2 | | | | | Check |
|---|---|---|---|---|---|---|---|---|
| | | Multiple choice | Course content – extended | | Experimental and data handling | Open ended | Scientific literacy | |
| | | | Calculate/ show that | State/ explain/ describe | | | | |
| Properties of matter | PM1 Specific heat capacity | | 8a | | | | | 3 |
| | PM2 Specific latent heat | | 8 bii | | | | | 3 |
| | PM3 Gas laws and the kinetic model | 20, 21 | 9 b, 10 a, 10 bi, 10 bii | 9 a | | | | 13 |
| Waves | W1 Wave parameters and behaviours | 22 | 5b, 11biii | | 11 bi, 11bii | 12 | | 12 |
| | W2 Electromagnetic spectrum | | | 5 ai | | | 4d | 3 |
| | W3 Refraction of light | 23, 24 | | | | | | 2 |
| Radiation | R1 Nuclear radiation | 25 | 13f, 14bii, 14ci, 14cii | 13a–e, 14a, 14ciii, 14d | 14bi | | | 23 |
| Totals | | 25 | 61 | 26 | 11 | 6 | 6 | /135 |

# Question type: Extended

## HOW TO ANSWER

In the National 5 Physics exam, Section 2 contains restricted and extended-response questions worth from 3 to around 12–16 marks each, totalling 110 marks altogether.

The marks are distributed proportionately across all six topics of the course content. In Section 2, 70–80 marks are for the demonstration and application of knowledge based on the course content. The remaining 30–40 marks are for the application of skills of scientific inquiry.

**Top Tip!**

Remember, Section 2 of your exam should take no more than 2 hours.

As with Section 1, 1 mark should take just over a minute (67 seconds) but questions with lots of reading, thinking time or those with calculations or information to process will take longer and other questions may be quicker.

Questions are taken from all six areas of the course. The number of marks for questions from each area is approximately in proportion to its content or size. Extended questions usually consist of several parts and require you to apply your knowledge and skills, from one or more areas.

**Top Tip!**

Most questions in Section 2 require calculations. You will need to select the correct equation from the Relationship sheet.

Usually, the mark allocation and the space provided gives an indication of what length of response is required. Each individual mark is awarded separately for statements or explanations, so if a question is worth 2 marks there will be two parts required for the answer.

The questions in Section 2 usually use key phrases which indicate the type of response required. These are called 'Command terms'. The headings below show some commonly used command terms, followed by how to answer these kinds of questions.

### Calculate

Use a relationship from the Relationship sheet to calculate a value for the quantity in the question.

- Write down the appropriate relationship as written in the Relationship sheet.
- Convert any number in the question to standard units (for example, km to m), preferably using scientific notation (for example, km to $\times 10^3$ m).
- Substitute the (converted) numbers from the question into the relationship.
- Use a calculator to perform the calculation.
- Write down the answer with units to the appropriate precision, i.e. the fewest number of significant figures in the question.

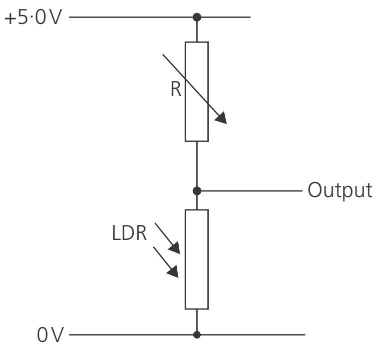
This is usually a 3-mark question, with marks given for:

- selection of correct relationship **(1 mark)**
- number substitution **(1 mark)**
- correct answer with units. **(1 mark)**

Full marks will be given for just the correct answer with units but it is always better to show the complete working in order to avoid lost marks for errors in the final answer.

MARKS | STUDENT MARGIN

**6** A light-dependent resistor (LDR) is used as a light sensor in a circuit to monitor the light level outside a greenhouse. When the light level outside the greenhouse falls below a certain level, lamps are switched on inside the greenhouse. Part of the circuit is shown.

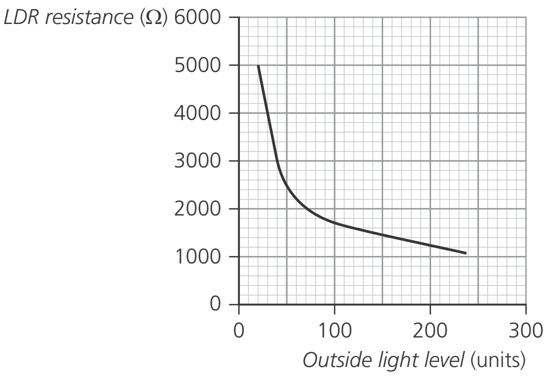



**a)** **(i)** The variable resistor R is set at a resistance of 2250 Ω. **4** Electricity 3

Calculate the resistance of the LDR when the voltage across the LDR is 2·0V.

*Space for working and answer*

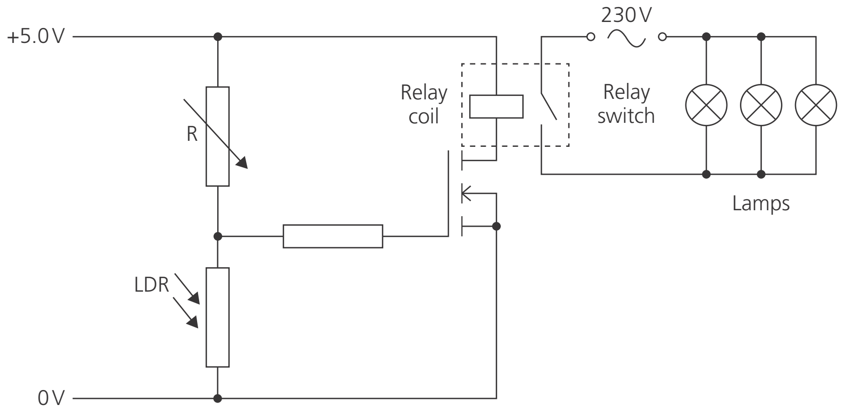
**(ii)** The graph shows how the resistance of the LDR varies with the outside light level. **1**




Use the graph to determine the outside light level when the voltage across the LDR is 2·0V.

MARKS | STUDENT MARGIN

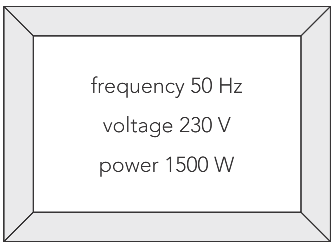
**b)** The circuit is now connected to a switching circuit to operate the lamps inside the greenhouse.




**(i)** Explain how the circuit operates to switch on the lamps when the outside light level falls below a certain value. — **3** — Electricity 4

**(ii)** The resistance of the variable resistor R is now increased.
What effect does this have on the outside light level the lamps switch on at?
You must justify your answer. — **3** — Electricity 4

**7** A deep fat fryer is used in a kitchen to fry vegetables.
The rating plate of the deep fat fryer is shown. — Electricity 4




**a)** The deep fat fryer contains 2·8 kg of vegetable oil at an initial temperature of 20 °C. The specific heat capacity of the oil is 1800 J kg$^{-1}$ °C$^{-1}$.
Calculate the energy required to raise the temperature of the oil to 170 °C. — **3** — Properties of matter 1

*Space for working and answer*

# Question type: Open-ended

## HOW TO ANSWER

There is a maximum of two open-ended questions in Section 2. They are usually stand-alone questions, but sometimes they form a part of a more extended question. They are worth a maximum of 3 marks each and the marks awarded depend on the depth of your answer.

The open-ended question usually discusses a physics phenomenon and usually asks you to '**use your knowledge**' of physics to explain it. You have to think about the issue and give a step-by-step logical answer. There may be more than one area of physics used to answer this type of question. There can be a number of acceptable answers for this type of question.

When you answer an open-ended question:

- Try to make three relevant comments about the context of the question – these can be bullet points. Your answer does not have to consider every single part of physics which may apply to the description. However, you should not state anything that is wrong in terms of physics.
- If there is an obvious equation or relationship, write it down and/or sketch the graph as part of one of your comments.
- If a graph is relevant, you could also describe the effect of changing the independent variable on the dependent variable within the question context.

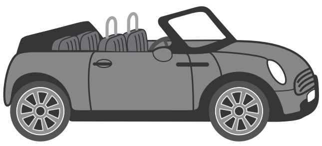
Be careful not to spend longer than necessary on these 3-mark questions – up to 5 minutes is a good guide.

### Top Tip!

The number of marks awarded will depend on how much your answer demonstrates your understanding of the physics in the question:

- no understanding – 0 marks
- limited understanding – 1 mark
- reasonable understanding – 2 marks
- good understanding – 3 marks.

| | MARKS | STUDENT MARGIN |
|---|---|---|
| **1** Car designers are constantly trying to reduce the environmental impact of cars. One way to do this is to make them more fuel efficient, as the less fuel cars need, the fewer dangerous gases they emit into the atmosphere. Use your knowledge of physics to comment on how car manufacturers might produce cars that are more fuel efficient. | 3 | Dynamics 4 |



# Section 1

**Total marks:** 25

Attempt ALL questions.

The answer to each question is **either** A, B, C, D or E. Decide what your answer is, then circle the appropriate letter. There is **only one correct** answer to each question.

Reference may be made to the Data sheet and to the Relationships sheet.

Allow yourself around 30 minutes for Section 1.

MARKS STUDENT MARGIN

**1** Which of the following contains two scalar quantities and one vector quantity? **1** Dynamics 1

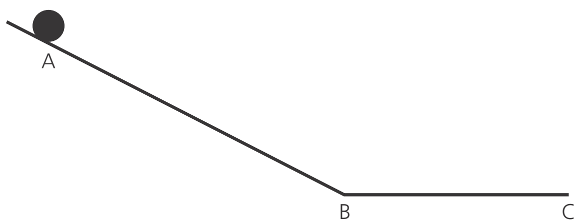
**A** displacement, velocity, acceleration
**B** speed, velocity, displacement
**C** time, distance, force
**D** acceleration, mass, displacement
**E** displacement, force, velocity

**2** An athlete sprints 50 m South then 30 m North in 8 seconds. **1** Dynamics 1

Which row in the table shows the average speed and average velocity of the athlete?

| | *Average speed* ($m\,s^{-1}$) | *Average velocity* ($m\,s^{-1}$) |
|---|---|---|
| **A** | 2·5 | 2·5 North |
| **B** | 2·5 | 10 South |
| **C** | 10 | 2·5 North |
| **D** | 10 | 2·5 South |
| **E** | 10 | 10 South |

**3** A ball is placed on a slope. **1** Dynamics 3




The ball is released from rest at point A and rolls down the slope. The ball takes 5 s to reach point B and has a speed of $4\,m\,s^{-1}$.

The acceleration of the ball between A and B, in $ms^{-2}$, is

**A** 0·8
**B** 1·25
**C** 9·0
**D** 10·0
**E** 20·0.

# Section 2

**Total marks:** 110

Attempt ALL questions.

Write your answers clearly in the spaces provided. If you need additional space for answers or rough work, please use separate pieces of paper.

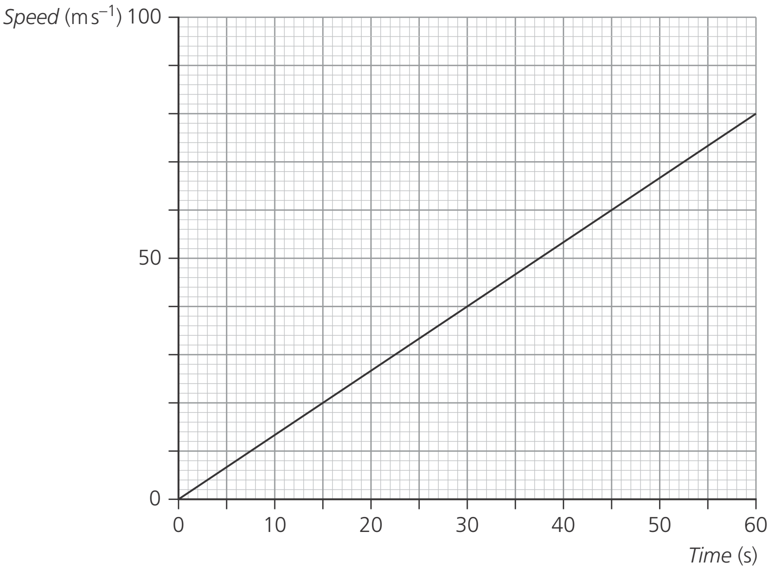
Reference may be made to the Data sheet and to the Relationships sheet.

Allow yourself around 2 hours for Section 2.

MARKS STUDENT MARGIN

**1** A passenger aircraft of mass 360 000 kg prepares for take-off.

The speed–time graph for the aircraft's motion on the runway from rest until it takes off is shown.




**a)** **(i)** Calculate the acceleration of the aircraft during take-off. **3** Dynamics 3

*Space for working and answer*

MARKS STUDENT MARGIN

**(ii)** The forward force produced by the aircraft engines is 500 kN.
Calculate the average frictional force acting on the aircraft during take-off. **4** Dynamics 4

*Space for working and answer*

**(iii)** Calculate the length of runway required by the aircraft for take-off. **3** Dynamics 2

*Space for working and answer*

**b)** During the flight, the aircraft flies at a constant speed and height.

Calculate the upward force acting on the aircraft. **3** Dynamics 4

*Space for working and answer*

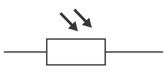
**c)** When flying an aircraft between London and New York, an airline pilot is exposed to cosmic radiation at an equivalent dose rate of $8\,\mu Sv\,h^{-1}$. Each flight lasts 7 hours. The pilot makes 106 of these flights in one year.

Calculate the equivalent dose received by the pilot from this exposure in one year. **3** Radiation 1

*Space for working and answer*

# Practice Paper 1

## Section 1

| Question | Answer | Max. mark | Commentary with hints and tips |
|---|---|---|---|
| **1** | C | **1** | Hint: it is sometimes helpful to mark each quantity in the answers with '$v$' for a vector and 's' for a scalar to make the correct selection of the answer easier. |
| **2** | D | **1** | For average speed, use $d = vt$, $(50 + 30) = v \times 8$, $v = 10\,\mathrm{m\,s^{-1}}$.<br>For average velocity, use $s = \overline{v}t$, $(50 - 30) = \overline{v} \times 8$, $\overline{v} = 2{\cdot}5\,\mathrm{ms^{-1}}$ South. |
| **3** | A | **1** | Use acceleration $a = \dfrac{v-u}{t} = \dfrac{4-0}{5} = 0{\cdot}8\,\mathrm{ms^{-2}}$. |
| **4** | E | **1** | Use $W = mg = 1 \times 9{\cdot}8 = 9{\cdot}8\,\mathrm{N}$ to calculate the weight of the ball. The weight of the ball is the downward force of gravity acting on the ball at all times. |
| **5** | C | **1** | Each ball takes the same time to reach sea level because they are released from the same height and have the same vertical acceleration.<br>Air resistance is ignored in this question, so there is no horizontal force acting on the balls; there is no horizontal acceleration.<br>Different horizontal distances travelled mean that the horizontal velocities are different because the balls are in the air for the same time. |
| **6** | D | **1** | You need to be able to identify the terms *planet*, *dwarf planet*, *moon*, *Sun*, *asteroid*, *solar system*, *star*, *exoplanet*, *galaxy* and *universe* correctly and in context. |
| **7** | C | **1** | The period of a satellite increases as its orbital height increases.<br>20 000 km is greater than 1340 km and less than 35 900 km, so the period of a satellite in orbit at 20 000 km must be between the periods of satellites at these altitudes. The only one in the list is 720 minutes. |
| **8** | E | **1** | You must know the approximate estimated age of the universe, which is 14 billion years to the nearest billion. |
| **9** | D | **1** | The definition of electrical current is the electric charge transferred per unit time, which is one coulomb per second. |
| **10** | D | **1** | First calculate the current using Ohm's law:<br>$I = \dfrac{V_s}{\text{total resistance}} = \dfrac{60}{30} = 2\mathrm{A}$<br>The charge passing through the series circuit has the same value at all positions. The relationship used to calculate charge is $Q = It$ (convert 2 minutes into seconds). |
| **11** | D | **1** | You need to know the path of a charged particle between two oppositely charged parallel plates or near a single point charge or **between two oppositely charged points** or between two like charged points. Protons follow electric field lines from positive to negative, electrons from negative to positive. |
| **12** | B | **1** | Use Ohm's law, $V = IR$, to calculate each resistor using values for $V$ and $I$ from the graph.<br>$V = IR_P$, $20 = 2 \times R_P$, $R_P = 10\,\Omega$<br>$V = IR_Q$, $10 = 4 \times R_Q$, $R_Q = 2{\cdot}5\,\Omega$ |
| **13** | B | **1** | LDR: <br>The circuit symbol, function and application of standard electrical and electronic components should be studied and memorised. |