

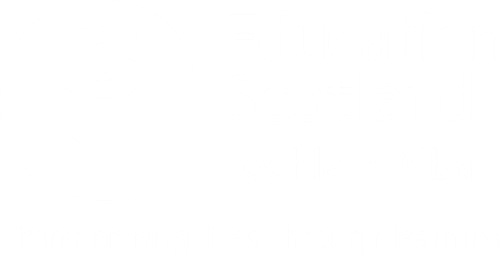
**National 5 Physics**

**Relevant Past Paper Questions from SQA Standard Grade Credit**

**and Intermediate 2 papers**

**Unit 3: Dynamics and Space**

**March 2014**



Transforming lives through learning

**N5 Physics Past Paper Questions**

This resource has been produced in response to the requests from practitioners who attended the National Qualifications Sciences events at Hampden Stadium in December 2013 which Education Scotland organised in partnership with the SQA.

The questions in this resource relate to the Dynamics and Space Unit for National 5 Chemistry and have been taken from the 2011, 2012 and 2013 Standard Grade and Intermediate 2 Past Papers.

For Dynamics and Space (Unit 3), the mandatory course key areas are as follows:

* Velocity and displacement- vectors and scalars
* Velocity - time graphs
* Acceleration
* Newton’s Laws
* Projectile Motion
* Space Exploration
* Cosmology

In cases where the questions relate to more than one of the National 5 Units, the constituent parts of the question have been separated into their respective key areas. The stem of the question has been retained to give the context of the question. If practitioners require the full integrated question, they should refer to the original past paper on the [SQA website](http://www.sqa.org.uk/pastpapers/findpastpaper.htm?subject=Chemistry&level=).

Past paper questions for the other two National 5 Units, Energy and Electricity and Waves and Radiation, are also available from Education Scotland’s National Qualifications Glow portal: <http://www.educationscotland.gov.uk/nqcoursematerials/> (cut and paste link into your browser).

Education Scotland would like to acknowledge the support of the SQA in helping us produce this resource. We hope it proves helpful to practitioners across Scotland and assists with the implementation of the national qualifications.

**Velocity and displacement - vectors and scalars**

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| Int 2  2013 Q1 | Which row contains two scalar quantities and one vector quantity? | Marks |
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| **Question** | | | **Answer** |
| 1 |  | B | |

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| Int 2 2013 Q2 | A student follows the route shown in the diagram and arrives back at the starting point. | Marks |
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|  | Which row in the table shows the total distance walked and the magnitude of the final displacement? |  |
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| **Question** | | | **Answer** |
| 2 |  | D | |

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| Int 2 2013 Q 5 | Four tugs apply forces to an oil-rig in the directions shown. | Marks |
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|  | Which of the following could represent the direction of the resultant force? |  |
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| **Question** | | | **Answer** |
| 5 |  | E | |

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| Int 2 2011 Q1 | During training an athlete sprints 30 m East and then 40 m West.  Which row shows the distance travelled and the displacement from the starting point? | Marks |
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| **Question** | | | **Answer** |
| 1 |  | D | |

**Acceleration**

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| Int 2 2011 Q 22 (a) i | A satellite moves in a circular orbit around a planet. The satellite travels at a constant speed whilst accelerating. | Marks |
| (i) | State the meaning of the term *acceleration*. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **22** | (a) | (i) | Acceleration is the change of velocity (not speed)  in unit time | 1 | Need to be indication of time requirement. |

**Newton’s Laws**

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| St Gr. 2011 Q 15 | The first manned space flights took place 50 years ago. Spacecraft were launched into space using powerful rockets. | Marks |
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| (a) | The operation of a rocket engine can be explained using Newton’s Third Law of Motion. |  |
| (i) | State Newton’s Third Law of Motion. | 1 |
| (ii) | Explain, in terms of Newton’s Third Law, how the rocket engines propel the rocket upwards. | 1 |
| (b) | At lift-off, one rocket has a total mass of 2.05 x 106 kg. The resultant force acting upwards on the rocket is 8.2 x106 N.  Calculate the acceleration of the rocket at lift-off. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **15** | (a) | (i) | If A exerts a force on B, B exerts an equal but opposite force on A.  Or  To every action (force) there is an equal and opposite reaction (force) | 1 | Must show a good attempt at stating Law |
|  |  | (ii) | Engine/exhaust gases pushed down(A on B);  gases push rocket up (B on A) | 1 | Must refer to engine/exhaust gases |
|  | (b) |  | (1)  (1)  (1)  m s-2 | 3 |  |

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| St Gr. 2012 Q 10 (c) i |  | Marks |
| (c) | The diagram shows some of the forces acting on the cyclist during the race. |  |
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| (i) | Suggest **one** way in which the cyclist reduces air resistance. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
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|  | (c) | (i) | * (wear) tight fitting clothes * Crouch * (wear) streamlined helmet * Streamlined shoes * Solid wheels | 1 | Question refers to the cyclist in picture so answer should refer to this  Not: ‘Pushes forward’ |

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| St Gr. 2013 Q 13 (a), (b) & (d) | In 2014 the European Space Agency will fly a manned mission to the International Space Station (ISS). | Marks |
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|  | A spacecraft with booster rockets attached will be launched. |  |
| (a) | On the diagram above draw and label the two forces acting on the spacecraft at lift off. | 1 |
| (b) | The combined mass of the spacecraft and booster rockets is 3·08 × 105 kg and the initial thrust on the rocket at lift off is 3352 kN. The frictional forces acting on the rocket at lift off are negligible. |  |
| (i) | Calculate the weight of the spacecraft and booster rockets at lift off. | 3 |
| (ii) | Calculate the acceleration of the spacecraft and booster rockets at lift off. | 4 |
| (d) | An astronaut on board the ISS takes part in a video link-up with a group of students. The students see the astronaut floating. |  |
| (i) | Explain why the astronaut appears to float. | 1 |
| (ii) | The astronaut then pushes against a wall and moves off.  Explain in terms of Newton’s Third Law why the astronaut moves. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| 13 | (a) |  |  | 2 | Must have correct label and direction.  Accept:   * Upthrust * Upward thrust * Upwards force * Force of gravity on the rocket * Force of gravity   Do not accept:   * Gravity alone, |
|  | (b) | (i) | W = mg (1)  = 3·08 x 105 x 9.8 (1)  = 3·02 x 106 N (1) | 3 |  |
|  |  | (ii) | Fun = 3352 000 – 3020 000 = 332 000 (N) (1)  F = ma (½) (1)  332 000 = 3.08 x 105 x a (1)  a = 1.08 m s-2 (1) | 4 | or consistent with answer in 13(b)(i)  If arithmetic error can be seen in subtraction to get Fun then deduct (1) mark. Candidate can still get next (3) marks.  **If no subtraction is attempted** and 3352000 or answer from 13(b)(i) is used in calculation for acceleration then (1) MAX for equation.  sig. fig. range 2–5  1.1  1.08  1.078  1.0779 |
|  | (d) | (i) | The astronaut is falling (towards Earth) at the same rate as the ISS  OR  The astronaut is in freefall | 1 | Answer must refer to the astronaut.  Do not accept:  a straight statement of Newton III |
|  |  | (ii) | The astronaut exerts a force against the wall and the wall exerts an equal and opposite force against the astronaut (causing him to move) | 1 | Answer must refer to the astronaut.  Do not accept:  a straight statement of Newton III |

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| Int 2 2011 Q 4 | An engine applies a force of 2000 N to move a lorry at a constant speed.  The lorry travels 100 m in 16 s.  The power developed by the engine is | Marks |
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| **Question** | | | **Answer** |
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| Int 2 2011 Q 22 (b) | | A satellite moves in a circular orbit around a planet. The satellite travels at a constant speed whilst accelerating. | | | Marks |
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| (b) | At one particular point in its orbit the satellite fires two rockets. The forces exerted on the satellite by these rockets are shown on the diagram. |  |
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|  | The satellite has a mass of 50 kg.  Calculate the resultant acceleration due to these forces. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
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|  | (b) |  | F = 12 - 2 = 10 N (1)  F = ma (1)  10 = 50 x a (1)  a = 0·2 m s-2 direction is right (1) | 4 | No attempt to calculate F  => (1) for formula |

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| Int 2 2012 Q 2 | Near the Earth’s surface, a mass of 6 kg is falling with a constant velocity.  The air resistance and the unbalanced force acting on the mass are: | Marks |
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| **Question** | | | **Answer** |
| 2 |  | A | |

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| Int 2 2013 Q 3 | A space probe has a mass of 60 kg. The weight of the space probe at the surface of a planet in our solar system is 660 N.  The planet is | Marks |
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| **Question** | | | **Answer** |
| 3 |  | E | |

**Projectile Motion**

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| Int 2 2012 Q 5 | Two identical balls X and Y are projected horizontally from the edge of a cliff.  The path taken by each ball is shown. | Marks |
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|  | A student makes the following statements about the motion of the two balls. |  |
|  | I They take the same time to reach sea level.  II They have the same vertical acceleration.  III They have the same horizontal velocity.  Which of these statements is/are correct? |  |
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| **Question** | | | **Answer** |
| 5 |  | C | |

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| Int 2 2011 Q 22 (a)ii | | A satellite moves in a circular orbit around a planet. The satellite travels at a constant speed whilst accelerating. | | | Marks |
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|  | |  | | |  |
| (ii) | | Explain how the satellite can be accelerating when it is travelling at a constant speed. | | | 1 |
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| **Question** | | **Expected Answer/s** | | |  |  | |
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| (ii) | Direction of satellite is (continually) changing  **OR**  Velocity of satellite is (continually) changing  **OR**  There is an unbalanced (not ‘resultant’) force on the satellite | | 1 |  | | |

**Cosmology**

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| St Gr. 2012 Q 14 | The Mills Observatory in Dundee and the Yerkes Observatory in Wisconsin, USA both have refracting telescopes. | Marks |
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|  | Mills Observatory Telescope Yerkes Observatory Telescope |  |
|  | Astronomers in both observatories are studying the Andromeda galaxy which is approximately 2·2 million light years away. |  |
| (a) | A light year is defined as “*the distance that light travels in one year*”.  Show by calculation that 1 light year = 9·4608 x 1015 m. | 3 |
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| (b) | Not all telescopes detect visible light.  Why are different kinds of telescope used to detect signals from space? | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **14** | (b) |  | s =   1. + (1)   (1) | 3 | **This is NOT a standard (3)-marker**  (1) mark for initial equation  (1) mark for speed of light  (1) mark for correct substitution of time  **No** marks for final answer (given)  Unit not required but deduct (1) if wrong  Accept the number 31536000s given in place of (1 x 365x 24 x 60 x 60) |
|  | (d) |  | Different frequencies/ wavelengths /signals  require different detectors/telescopes  OR  Certain detectors/telescopes cannot pick up certain frequencies/wavelengths/signals  OR  Different signals have different frequencies/ wavelengths | 1 | Accept:   * Different telescopes detect different signals   Do not accept:   * ‘Different types of signals’- **unless** mentioned along with different wavelengths/frequencies/telescopes/ detectors. * “types of radiation” – ambiguous – could be α or β * Any mention of sound “types of wave” or “wave” – too vague |