

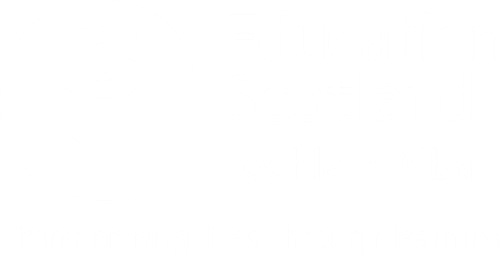
**National 5 Physics**

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

**and Intermediate 2 papers**

**Unit 1: Energy and Electricity**

**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 Energy and Electricity Unit for National 5 Physics and have been taken from the 2011, 2012 and 2013 Standard Grade and Intermediate 2 Past Papers.

For Energy and Electricity (Unit 1), the mandatory course key areas are as follows:

* Conservation of energy
* Electrical charge carriers and electric fields
* Potential difference (voltage)
* Ohm’s law
* Practical electrical and electronic circuits
* Electrical power
* Specific heat capacity

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, Waves and Radiation and Dynamics and Space, 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.

Conservation of Energy

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| 2011 C 12  (a) | A small submersible pump is used in a garden water fountain. The pump raises 25 kg of water each minute from a reservoir at ground level.  The water travels through a plastic tube and reaches a height of 1.2m above ground level. | Marks |
|  |  | 3 |
|  | Calculate how much gravitational potential energy the water gains each minute. |  |

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| Answers | Expected Answer/s | Max Mark | Additional Guidance |
|  | Ep = m g h (1)  = 25 x 9.8 x 1.2 (1)  = 290 J (1) | 3 | Sf, accept  300, 294 |

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| 2013 C 10 (a) + (b) | A child of mass 42 kg is playing on a water slide at a water park. | Marks |
|  | (a) The child climbs 7·5 m to the top of the slide.  Calculate the gain in potential energy of the child. | 3 |
|  | (b) When sliding down, an average frictional force of 15 N acts on the child. This causes 1050 J of heat energy to be produced.  Calculate the length of the slide. | 3 |

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| Answers | | | Expected Answer/s | Max Mark | Additional Guidance |
|  | (a) |  | Ep = mgh (1)  = 42 x 9.8 x 7·5 (1)  = 3100 J (1) | 3 | sig. fig. 1–3  3000, 3100, 3090  Deduct (1) for wrong/missing unit |
|  | (b) |  | Ew = Fd (1)  1050 = 15 x d (1)  d = 70 m (1) | 3 |  |

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| 2012 Int 2 7 | An electrical motor raises a crate of mass 500 kg through a height of 12 m in 4 s.  The minimum power rating of the motor is | Marks |
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| **Question** | | | **Answer** |
| 7 |  | C | |

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| 2012 Int 2 23 | A student reproduces Galilleo’s famous experiment by dropping a solid copper ball of mass 0·50 kg from a balcony on the Leaning Tower of Pisa. | Marks |
|  |  |  |
| (a) | The ball is released from a height of 19·3 m.  Calculate the gravitational potential energy lost by the ball. | 3 |

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| Question | | | Expected Answer/s | Max Mark | Additional Guidance |
|  | (a) |  | Ep = m g h (1)  = 0.50 x 9.8 x 19.3 (1)  = 95 J (1) | 3 |  |

**Electrical charge carriers and electric fields**

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| 2013 C 4 (c) | A student has designed a simple electric cart. The cart uses 2 large 12 V rechargeable batteries to drive an electric motor. The speed of the cart is controlled by adjusting a variable resistor.  The circuit diagram for the cart is shown. | Marks |
|  |  |  |
|  | The batteries take 10 hours to fully recharge using a constant charging current of 3·2 A.  Calculate how much charge is transferred to the batteries in this time. | 3 |

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| Answer | Expected Answer | Max Mark | Additional Guidance |
| (c) | Q = I x t (1)  = 3.2 x (10 x 60 x 60) (1)  = 115 200 C (1) | 3 | Accept:  100000C,  120 000C,  115 000C,  115200C.  If wrong or no conversion into seconds then deduct (1) mark. |

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| Int 2 2012 14 | The current in an 8 Ω resistor is 2 A.  The charge passing through the resistor in 10 s is | Marks |
|  |  | 1 |

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| **Question** | | | **Answer** |
| 14 |  | D | |

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| Int 2 2012 15 | Which of the following statements is/ are correct?  I In an a.c. circuit the direction of the current changes regularly.  II In a d.c. circuit positive charges flow in one direction only.  III In an a.c. circuit the size of the current varies with time. | Marks |
|  |  |  |

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| **Question** | | | **Answer** |
| 15 |  | D | |

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| Int 2 2011 8 | A student makes the following statements about electrical supplies.  I The frequency of the mains supply is 50 Hz.  II The quoted value of an alternating voltage is less than its peak value.  III A d.c supply and an a.c. supply of the same quoted value will supply the same power to a given resistor.  Which of the following statements is/are correct? | Marks |
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| **Question** | | | **Answer** |
| 8 |  | E | |
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| Int 2 2011  26 a | A student has two electrical power supplies. One is an a.c. supply and the other is a d.c. supply. | Marks |
|  |  | 2 |
|  | Explain a.c and d.c. in terms of electron flow in a circuit. |  |

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| **Answer** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **26** |  |  | dc – electrons\* flow around a circuit in one direction only (1)  ac – electrons’\* direction changes/reverses after a set time (1)  \*Accept ‘current’ Some indication needed eg (repeatedly) | 2 |  |

**Ohm’s Law**

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| St Gr 2013 Q4(b) | A student has designed a simple electric cart. The cart uses 2 large 12 V rechargeable batteries to drive an electric motor. The speed of the cart is controlled by adjusting a variable resistor.  The circuit diagram for the cart is shown. | Marks |
|  |  |  |
|  | When the cart is moving at a certain speed the voltage across the motor is 18 V and the resistance of the variable resistor is 2·1 Ω.  Calculate the current in the motor. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | Vr = Vs - Vmotor  = 24 = 18  = 6(V) (1)  Vr = I R (1)  6 = I x 2.1 (1)  I = 2.9 A (1) | 4 | If arithmetic error can be seen in subtraction to get VR then deduct (1) mark. Candidate can still get next (3) marks.  **If no subtraction** and 24 V or 18 V used in calculation for V then (1) MAX for equation.  Deduct (1) for wrong/missing unit  V = I x R sig. fig. range: 1–4  3A  2·9A  2·86A  2·857A |

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| Int 2 2011 Q6 | Which graph shows how the potential difference *V* across a resistor varies with the current *I* in the resistor? |  |
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| **Question** | | | **Answer** |
| 6 |  | B | |

**Practical electrical and electronic circuits**

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| St Gr  2011 Q 7 (b)& (c) | An automatic hand dryer used in a washroom is shown in the diagram below. | Marks |
|  |  |  |
|  | Inserting hands into the dryer breaks a light beam, this is detected using a light dependent resistor (LDR). The LDR is part of a switching circuit which activates the dryer when hands are inserted.  Part of the circuit for the hand dryer is shown. |  |
|  |  |  |
| (b) | Name component **X** in the circuit diagram. | 1 |
| (c) | Explain how this circuit operates to activate the motor in the dryer when the light level falls below a certain value. | 2 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | Transistor (switch) | 1 | Ignore any reference to pnp or npn  NOT:   * Phototransistor * MOSFET transistor * Switch alone |
|  | (c) |  | * R of LDR increases * V across LDR increases   (above 0·7V)   * Transistor switches ON * Relay coil is energised   (which closes the relay switch and activates the motor) | 2 | All 4 bullet points needed for (2)  Must clearly identify:   * the resistance of LDR increasing * the voltage across LDR increasing * transistor on * relay coil operates/is switched on/ * activated/magnetised |

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| St Gr  2011 Q 3 (b)i | A mains electric fire has two heating elements which can be switched on and off separately. The heating elements can be switched on to produce three different heat settings: LOW, MEDIUM and HIGH. The fire also has an interior lamp which can be switched on to give a log-burning effect. | Marks |
|  |  |  |
|  | The circuit diagram for the fire is shown. |  |
|  |  |  |
| (b) | Switch **S1** is opened and switches **S2** and **S3** are closed. |  |
| (i) | Calculate the combined resistance of both heating elements. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) | (i) | (1)  (1)  (1) | 3 | Accept *imprecise* working towards a final  Answer.  Sig. fig. Range: 30, 31, 30·7, 30·67  If answer left as 30 ⅔ then (-1) (sig fig error)  If intermediate rounding of 1/46 and 1/92 then  deduct (1) for arith error. |

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| St Gr 2012 Q 3 (b)i | The student sets up a second circuit using a 12 V supply and the same lamps. Each lamp has a resistance of 4 Ω. The resistance of the variable resistor is set to 6 Ω. | Marks |
|  |  |  |
|  | Calculate the total resistance of this circuit. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) | (i) | (1)  (1) | 3 | If wrong equation used eg  Rt= 1 + 1  *R*1 *R2*  then zero marks  Accept *imprecise* working towards a final  answer    deduct (1) for wrong/missing unit  Can be answered by applying product over sum method. If applied twice.  Accept 3/2 and 1 ½ Ω as final answer. |

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| St Gr 2013 Q3 | A house owner installs a heating system under the floor of a new conservatory.  Three heating mats are fitted. The mats contain resistance wires and are laid underneath the floor.  Each mat is designed to operate at 230 V and has a power of 300 W. | Marks |
|  |  |  |
| (a) | State how the three heating mats are connected together to operate at their correct voltage. | 1 |
| (b) | Calculate the current in each heating mat when switched on. | 3 |
| (c) | Calculate the total resistance of the heating system when all three mats are switched on. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **3** | (a) |  | Parallel | 1 | Only answer ignore spelling |
|  | (b) |  | P = I V (1)  300 = I x 230 (1)  I = 1.3 A (1)  OR  P = I V (1)  900 = I x 230  I = 3.9 A  Current in one mat= 3.9/3 (1)  I = 1.3A (1) | 3 | sig. fig. range: 1–3  1A  1·3A  1·30A |
|  | (c) |  | P total = 3 x 300W = 900W (1)  P = V2 / R (1)  900 = 2302 / R (1)  R = 59 Ω (1)  Or  Itotal = 3 x 1.3 = 3.9 A (1)  P = I2 R (1)  900 = 3.92 x R (1)  R = 59 Ω (1) | 4 | sig. fig. 1–3  range:  60Ω  59Ω  58·8Ω  sig. fig. 1–3  range:  60Ω  59Ω  59·2Ω |

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| St Gr 2013 Q4(a) | A student has designed a simple electric cart. The cart uses 2 large 12 V rechargeable batteries to drive an electric motor. The speed of the cart is controlled by adjusting a variable resistor.  The circuit diagram for the cart is shown. | Marks |
|  |  |  |
| (a) | The circuit contains two voltmeters and an ammeter.  Complete the diagram by labelling the meters. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **4** | (a) |  |  | 1 | Must have **all** labels correctly positioned .  (1) or (0) only |

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| St Gr 2013 Q8(b) &(c) | A student designs a circuit to act as a high temperature warning device. | Marks |
|  |  |  |
| (b) | Explain how the circuit operates to sound the bell when the temperature of the thermocouple reaches a certain value. | 2 |
| (c) | The student also plays an electric guitar. The guitar is connected to a different amplifier and two loudspeakers as shown. |  |
|  |  |  |
|  | Each loudspeaker has a resistance of 16 Ω.  Calculate the combined resistance of the two loudspeakers when connected as shown. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | * (As temp increases,) input voltage to transistor increases * (above 0·7V) switching transistor on * Current in the (relay) coil (producing magnetic field). * (Relay) switch closes / activates, (completing the bell circuit/ operating the bell). | 2 | First bullet point may refer to voltage (output) from thermocouple or amplifier increasing but do not accept  ‘voltage’ alone.  Do not accept:  ‘transistor is saturated’ |
|  | (c) |  | 1 = 1 + 1 (1)  Rt R1 R2  1 = 1 + 1 (1)  Rt 16 16  Rt = 8 Ω (1) | 3 | If wrong equation used eg  Rt = 1 + 1  R1 R2  then zero marks  Accept *imprecise* working towards a final answer  1 = 1 + 1 = 8 Ω  Rt 16 16  Accept  Deduct (1) for wrong/missing unit  Can be answered by applying product over sum method  Can be answered using ‘identical value’ parallel resistors method:  R = value for single resistor  total no. of resistors in parallel |

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| Int 2 2011 Q5 | Which row in the table identifies the following circuit symbols? | Marks |
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| **Question** | | | **Answer** |
| 5 |  | E | |

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| Int 2 2011 Q10 | Which of the following is the circuit symbol for an NPN transistor? | Marks |
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| **Question** | | | **Answer** |
| 10 |  | A | |

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| Int 2 2011 Q25 (a) + (b) | Part of a circuit is shown below. | Marks |
|  |  |  |
| (a) | Calculate the total resistance between points Y and Z. | 3 |
| (b) | Calculate the total resistance between points W and X. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **25** | (a) |  | (1)  (1)  (1) | 3 | Accept 1 Ω, 1·33 Ω, 1·333 Ω |
|  | (b) |  | RT = R1 + R2 (1)  = 1·3 + 6 (1)  = 7·3 Ω (1) | 3 | Consistent with (a) (1) **2**  Accept 7·3 Ω, 7·33 Ω, 7·333 Ω |

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| Int 2 2011 Q27(a) | Light emitting diodes (LEDs) are often used as on/off indicators on televisions and computers.  An LED is connected in a circuit with a resistor R. | Marks |
|  |  |  |
| (a) | State the purpose of resistor R. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (a) |  | To reduce current in LED  **OR**  To reduce voltage across LED  **OR**  To reduce power to LED | 1 |  |

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| Int 2 2012  Q11 | A student sets up the circuits shown.  In which circuit will both LEDs be lit? | Marks |
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| **Question** | | | **Answer** |
| 11 |  | D | |

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| Int 2 2012 Q24 | A resistor is labelled: “10 Ω ± 10%, 3 W”. | Marks |
|  |  |  |
|  | This means that the resistance value could actually be between 9 Ω and 11 Ω. |  |
| (a) | A student decides to check the value of the resistance.  Draw a circuit diagram, including a 6 V battery, a voltmeter and an ammeter, for a circuit that could be used to determine the resistance. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **24** | (a) |  |  | 3 | **Must draw battery, not single cell.** |

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| Int 2 2012 Q 25 (a) | The circuit shown switches a warning lamp on or off depending on the temperature. | Marks |
|  |  |  |
| (a) | Name component P. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **25** | (a) |  | MOSFET | 1 | Transistor on its own = 0  Correct spelling required |

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| Int2 2013 Q8 | A circuit with three gaps is shown below. | Marks |
|  |  |  |
|  | Which row in the table shows the combination of conductors and insulators that should be placed in the gaps to allow the lamp to light? | 1 |
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| **Question** | | | **Answer** |
| **8** |  |  | A |

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| Int 2 2013 Q9 | In which circuit below would the meter readings allow the resistance of R2 to be calculated? | Marks |
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| **Question** | | | **Answer** |
| 9 |  | A | |

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| Int 2 2013 Q12 | Which of the following devices converts heat energy into electrical energy? | Marks |
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| **Question** | | | **Answer** |
| 12 |  | C | |
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| Int 2 2013 Q 26 (c), (d)ii &(e) | An overhead projector contains a lamp and a motor that operates a cooling fan.  A technician has a choice of two lamps to fit in the projector. | Marks |
|  |  |  |
| (c) | The overhead projector plug contains a fuse.  Draw the circuit symbol for a fuse. | 1 |
| (d) | The technician builds a test circuit containing a resistor and a motor, as shown in **Circuit 1**. |  |
|  |  |  |
| (ii) | Calculate the combined resistance of the resistor and the motor. | 3 |
| (e) | The resistor and the motor are now connected in series, as shown in **Circuit 2**. |  |
|  |  |  |
| (ii) | Explain your answer to (e) (i). | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (c) |  |  | 1 |  |
|  | (d) | (ii) | 1/Rp = 1/R1 + 1/R2 (1)  = 1/8 + 1/24 (1)  Rp = 6 Ω (1) | 3 |  |
|  | (e) | (i) | The motor speed will reduce | 1 |  |
|  |  | (ii) | The (combined) resistance (of the circuit) is now higher/current is lower.  Voltage across motor is less  Motor has less power | 1 | any one of four |

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| Int 2 2013 Q 28 (a) i &ii, (b) & (d) | A photographic darkroom has a buzzer that sounds when the light level in the room is too high. The circuit diagram for the buzzer system is shown below. | Marks |
|  |  |  |
| (a) (i) | Name component X. | 1 |
| (ii) | Explain the purpose of component X in the circuit | 1 |
| (b) | The darkroom door is opened and the light level increases.  Explain how the circuit operates to sound the buzzer. | 3 |
| (d) | State the purpose of the variable resistor R in this circuit. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **28** | (a) | (i) | X = (NPN) transistor | 1 | 0 marks for MOSFET or PNP transistor |
|  |  | (ii) | To act as a switch | 1 | To turn on the buzzer 0 marks  To operate the buzzer 0 marks |
|  | (b) |  | Resistance of LDR reduces  so voltage across LDR reduces  Voltage across variable resistor/R increases  When voltage across variable resistor/R reaches (0·7 V) transistor switches buzzer on. | 3 | Accept ‘when voltage is high enough’ |
|  | (d) |  | The variable resistor is to set the light level at which the transistor will switch on or to set the level at which the buzzer will sound | 1 |  |

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|  | Electrical Power |  |
| St Gr.  2011 Q 3 (a) & (b)ii | A mains electric fire has two heating elements which can be switched on and off separately. The heating elements can be switched on to produce three different heat settings: LOW, MEDIUM and HIGH. The fire also has an interior lamp which can be switched on to give a log-burning effect. | Marks |
|  |  |  |
|  | The circuit diagram for the fire is shown. |  |
|  |  |  |
| (a) | When switch **S1** is closed, the lamp operates at its stated rating of 60W.  Calculate the current in the lamp. | 3 |
| (b)(ii) | Calculate the total power developed in the heating elements when **S2** and **S3** are closed. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **3** | (a) |  | (1)  (1)  (1) | 3 | Sig. fig. Range: 0·3, 0·26, 0·261 |
|  | (b) | (ii) | Or calculate individual power of each heating element and add together  (1)  (1)  (1) | 3 | Must use value for *R*T from 3(b)(i) or fresh  start with **correct** value.  Alternative solution:  Award (1) for both equations  Award (1) for all substitutions  Award (1) for final answer  *P* = I2*R* Award (1) mark for  = 7·52 × 30·67 final answer  = 1725 W  If *R* = 138 Ω from b(i) then *P* = 383W  Sig figs depend on candidates answer to  (b) part (i) |
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| St Gr 2011 Q7(a) | An automatic hand dryer used in a washroom is shown in the diagram below. | Marks |
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|  | Inserting hands into the dryer breaks a light beam, this is detected using a light dependent resistor (LDR). The LDR is part of a switching circuit which activates the dryer when hands are inserted.  Part of the circuit for the hand dryer is shown. |  |
|  |  |  |
| (a) | The variable resistor RV is set to a resistance of 60 kΩ.  Calculate the voltage across the LDR when its resistance is 4 kΩ. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **7** | (a) |  | Award (1) for both formulae  Award (1) mark for all substitutions correct  Award (1) mark for final answer | 3 | Alternatives:    OR    Only accept this method if the substitutions are for: the supply voltage, the **total** resistance, and the resistance of the LDR.  Award zero marks if this relationship is stated alone or implied by any other  substitutions |

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| St Gr 2012 Q3(a) | A student sets up a circuit to operate two identical 12 V, 36 W lamps from a 48 V supply. | Marks |
|  |  |  |
| (a) | When the switch is closed, the lamps operate at their correct power rating.  Calculate: |  |
| (i) | the reading on the ammeter; | 3 |
| (ii) | the reading on the voltmeter; | 1 |
| (iii) | the resistance of the variable resistor. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **3** | (a) | (i) | P = I V (1)  36 = I x 12 (1)  I = 3 A (1) | 3 | Deduct (1) for wrong/missing unit |
|  |  | (ii) | 48 = 12 + 12 + VR  VR = 24 V (1) | 1 | Deduct (1) for wrong/missing unit |
|  |  | (iii) | V = I R (1)  24 = 3 x R (1)  R = 8 Ω (1) | 3 | Must use answers from 3 (a)(i) and (ii) or  correct answers  Deduct (1) for wrong/missing unit |

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| St Gr  2012 Q 7 (a) + (b) iii | A bank has an alarm system which can be triggered by the cashiers who work behind the counter. | Marks |
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|  | The alarm is triggered when the cashier removes an imitation £20 note from a cash drawer.  A circuit, inside the cash drawer, contains an LED which is directed at an LDR as shown. When the cashier removes the imitation £20 note the alarm is triggered. |  |
|  |  |  |
|  | The table shows the resistance of the LDR in different light conditions. |  |
|  |  |  |
|  | Part of the cash drawer circuit is shown below. |  |
|  |  |  |
| (a) | When the imitation £20 note is removed from the drawer, the voltage across the LDR is 0·36 V.  Calculate the voltage across R. | 3 |
| (b) | The alarm has a loudspeaker as an output device, which emits a sound when the alarm is triggered. The loudspeaker has a resistance of 48 Ω and a power of 3·0 W.  Calculate the voltage across the loudspeaker when it sounds. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **7** | (a) |  | Use Ohm’s Law twice.  Once to calculate the current, then once to find VR.  V = I R (1) for both equations  0.36 = I x 2000 (1) for both substitutions  I = 0.00018 (A)  V = I R  = 0.00018 x 4800  = 8.64 V (1) for final answer | 3 | (1)  (1)  (1) |
|  | (b) |  | (1)  (1)  (1) | 3 | Do NOT accept V2 =144 = 12V  (max 1 mark) |
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| St Gr  2012 Q11 c | Model power transmission lines are set up to demonstrate how electricity is distributed from a power station to consumers. | Marks |
|  |  |  |
|  | The current in the transmission lines is 200 mA. The transmission lines have a total resistance of 20 Ω.  Calculate the total power loss in these transmission lines. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **11** |  |  | (1)  (1)  (1) | 3 | deduct (1) for wrong/missing unit  Watch for unit conversion errors – penalise unit error only once |

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| St Gr 2012 Q 13 (a) | A manufacturer has developed an iron with an aluminium sole plate. A technician has been asked to test the iron. | Marks |
|  |  |  |
|  | The technician obtains the following data for one setting of the iron.  Starting temperature of sole plate: 24 °C  Operating temperature of the sole plate: 200 °C  Time for iron to reach the operating temperature: 35 s  Power rating of the iron: 1·5 kW  Operating voltage: 230 V  Specific Heat Capacity of Aluminium: 902 J kg-1 °C-1 |  |
| (a) | Calculate how much electrical energy is supplied to the iron in this time. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **13** | (a) |  | (1)  (1)  (1) | 3 | Deduct (1) for wrong/missing unit  Watch for unit conversion errors – penalise unit error only once |

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| St Gr 2013 Q5(c) |  | Marks |
|  | The photographer has laser eye surgery. The laser used in the procedure produces 250 pulses of light per second. Each light pulse transfers 60 mJ of energy.  Calculate the average power produced by each pulse of light. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **5** |  |  | Method 1  t = 1/250 = 0·004(s) (1)  E = P t (1)  60 x 10-3 = P x 0.004 (1)  P = 15 W (1)  Method 2  ETotal = 250 × 60 × 10–3 (J) (1)  E = P t (1)  15 = P x 1 (1)  P = 15 W (1) | 4 | If correct time correctly calculated or stated award (1) mark (this may appear anywhere in the answer).   * If time is stated or calculated wrongly and no calculation shown then (1) mark maximum for the power equation. * If calculation for the time / energy is shown and calculation contains an arithmetic error then deduct (1) mark |

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| St Gr 2013  Q8(c)ii | The student also plays an electric guitar. The guitar is connected to a different amplifier and two loudspeakers as shown. | Marks |
|  |  |  |
|  | Each loudspeaker has a resistance of 16 Ω.  Calculate the combined resistance of the two loudspeakers when connected as shown. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (c) |  | 1 = 1 + 1 (1)  Rt R1 R2  1 = 1 + 1 (1)  Rt 16 16  Rt = 8 Ω (1) | 3 | If wrong equation used eg  Rt = 1 + 1  R1 R2  then zero marks  Accept *imprecise* working towards a final answer  1 = 1 + 1 = 8 Ω  Rt 16 16  Accept  Deduct (1) for wrong/missing unit  Can be answered by applying product over sum method  Can be answered using ‘identical value’ parallel resistors method:  R = value for single resistor  total no. of resistors in parallel |
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| Int 2 2011 Q4 | 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** |
| 4 |  | D | |

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| Int 2 2011 Q7 | A circuit is set up as shown. | Marks |
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|  | The potential difference across the 2 W resistor is |  |
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| **Question** | | | **Answer** |
| 7 |  | A | |

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| Int 2 2011 Q 24 (c) | An experiment was carried out to determine the specific heat capacity of water.  The energy supplied to the water was measured by a joulemeter. | Marks |
|  |  |  |
|  | The following data was recorded.  Initial temperature of the water = 21 °C.  Final temperature of the water = 33 °C.  Initial reading on the joulemeter = 12 kJ.  Final reading on the joulemeter = 120 kJ.  Mass of water = 2·0 kg.  Time = 5 minutes. |  |
| (c) | Calculate the power rating of the immersion heater. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (c) |  | E = P t (1)  108,000 = P x (5 x 60) (1)  P = 360 W (1) | 3 | If no conversions answer is 21,600. Also accept 22,000, Max (2)  must be consistent with (a) (ii) or wrong physics |
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| Int 2 2011 Q25 (c) | Part of a circuit is shown below. | Marks |
|  |  |  |
| (c) | Calculate the voltage across the 2·0 Ω resistor when the current in the 4·0 Ω resistor is 0·10 A. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (c) |  | (Voltage across 2 Ω resistor = Voltage across 4 Ω resistor)  V = IR (1)  = 0·1 × 4 (or 0·2 × 2) (1)  = 0·4 V (1) | 3 | (2) max, if divide final answer by 2 |

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| Int 2 2011 27 (b) & (c) | Light emitting diodes (LEDs) are often used as on/off indicators on televisions and computers.  An LED is connected in a circuit with a resistor R. | Marks |
|  |  |  |
| (b) | The LED is rated at 2 V, 100 mA.  Calculate the resistance of resistor R. | 4 |
| (c) | Calculate the power developed by resistor R when the LED is working normally. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | V = 6 – 2 = 4 V (1)  V = IR (1)  4= 0.1 x R (1)  R = 40 Ω (1) | 4 |  |
|  | (c) |  | P = I2R (1) P = V2/R  = (0·1)2 × 40 (1) = 42/40  = 0·4 W (1) = 0·4 W    P = IV (1)  = 0·1 × 4 (1)  = 0·4 W (1) | 3 | Must be consistent with (b) |

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| Int 2 2012 Q7 | An electrical motor raises a crate of mass 500 kg through a height of 12 m in 4 s.  The minimum power rating of the motor is | Marks |
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| **Question** | | | **Answer** |
| 7 |  | C | |

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| Int 2 2012 Q24 (b) | A resistor is labelled: “10 Ω ± 10%, 3 W”. | Marks |
|  | This means that the resistance value could actually be between 9 Ω and 11 Ω. |  |
| (b) | Readings from the circuit give the voltage across the resistor as 5·7 V and the current in the resistor as 0·60 A.  Use these values to calculate the resistance. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | (1)  (1)  (1) | 3 |  |

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| Int 2 2012 25(b) | The circuit shown switches a warning lamp on or off depending on the temperature. | Marks |
|  |  |  |
| (b) | As the temperature increases the resistance of thermistor RT decreases.  State what happens to the voltage across RT as the temperature increases? | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | (Voltage) falls/decreases | 1 | Or equivalent  Arrows not allowed |
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| 2013 Int 2 Q10 | A circuit is set up as shown. | Marks |
|  |  |  |
|  | The reading on the ammeter is 3·0 A. The reading on the voltmeter is 4·0 V.  Which row in the table shows the current in resistor R2 and the voltage across resistor R2? |  |
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| **Question** | | | **Answer** |
| 10 |  | C | |
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| Int 2 2013 Q11 | A circuit is set up as shown. | Marks |
|  |  |  |
|  | The current in the lamp is 1·5 A. The reading on the voltmeter is 6·0 V.  The power developed in the lamp is |  |
|  |  |  |

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| **Question** | | | **Answer** |
| 11 |  | B | |
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| Int 2 2013 Q26 | An overhead projector contains a lamp and a motor that operates a cooling fan.  A technician has a choice of two lamps to fit in the projector. | Marks |
| (b) & (d) i |  |  |
| (b) | Calculate the power developed by lamp A when it is operating normally. | 3 |
| (d) | The technician builds a test circuit containing a resistor and a motor, as shown in **Circuit 1**. |  |
|  |  |  |
| (i) | State the voltage across the motor. | 1 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | P = V2/R (1)  = 242/2·5 (1)  = 230 W (1) | 3 |  |
|  | (d) | (i) | 12 V | 1 | unit required |

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| Int 2 2013 Q 28 | A photographic darkroom has a buzzer that sounds when the light level in the room is too high. The circuit diagram for the buzzer system is shown below. | Marks |
| (c) |  |  |
|  | The table shows how the resistance of the LDR varies with light level. |  |
|  |  |  |
|  | The variable resistor has a resistance of 570 Ω.  The light level increases to 80 units.  Calculate the current in the LDR. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (c) |  | 80 units: resistance of LDR = 2500 (Ω)  Total resistance = 2500 + 570  = 3070 (Ω) (1)  --------------------------------------------------------  I = V/R (1)  = 5/3070 (1)  = 1·63 × 10-3 A or 1·63 mA (1)  Specific heat capacity | 4 | 1·6 mA  1·63 mA  1·629 mA |

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| St Gr 2011 Q 11(a) | A steam cleaner is used to clean a carpet. The water tank is filled with 1.6 kg of water at 20 °C. This water is heated until it boils and produces steam. The brush head is pushed across the surface of the carpet and steam is released. | Marks |
|  |  |  |
|  | Calculate how much heat energy is needed to bring this water to its boiling point of 100 °C. | 4 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **11** |  |  | c = 4180 (J Kg -1 C-1) (1)  Eh = c m ΔT (1)  = 4180 x 1.6 x 80 (1)  = 535040 J (1) | 4 | 1. data mark for correct selection of **c** from ‘Specific heat capacity of materials’ table.   If **any other value from this table** is used, then lose data mark but can still get (3) marks max if rest of calculation is correctly executed using this value.  If any value of ***c*** used **not from this table**  (including 4200) then only (1) max possible for correct selection of relationship.  No s.f. issue (exact answer) |

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| Int 2 2011 Q24 (a) | An experiment was carried out to determine the specific heat capacity of water.  The energy supplied to the water was measured by a joulemeter. | Marks |
|  |  |  |
|  | The following data was recorded.  Initial temperature of the water = 21 °C.  Final temperature of the water = 33 °C.  Initial reading on the joulemeter = 12 kJ.  Final reading on the joulemeter = 120 kJ.  Mass of water = 2·0 kg.  Time = 5 minutes. |  |
| (i) | Calculate the change in temperature of the water. | 1 |
| (ii) | Calculate the energy supplied by the immersion heater. | 1 |
| (iii) | Calculate the value for the specific heat capacity of water obtained from this experiment. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
| **24** | (a) | (i) | (33-21) = 12 °C | 1 |  |
|  |  | (ii) | (120,000-12,000) = 108,000 J | 1 |  |
|  |  | (iii) | Eh = cmΔT (1)  108,000 = c x 2.0 x 12 (1)  c = 4,500 J kg-1 °C-1 (1) | 3 | Must be consistent with parts (i) + (ii) |

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| Int 2 2012 Q23 (a) ii | A student reproduces Galilleo’s famous experiment by dropping a solid copper ball of mass 0·50 kg from a balcony on the Leaning Tower of Pisa. | Marks |
|  |  |  |
| (b) | Assuming that all of this gravitational potential energy is converted into heat energy **in the ball**, calculate the increase in the temperature of the ball on impact with the ground. | 3 |

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| **Question** | | | **Expected Answer/s** | **Max Mark** | **Additional Guidance** |
|  | (b) |  | Ec = c m ΔT (1)  95 = 386 x 0.50 x ΔT (1)  ΔT = 0.5 °C (1) | 3 | Eh must be consistent with (a). If any other value of ‘c’ used, only (1) for formula. |