Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**January 2011**

# Physics

## Assessment Unit AS 1

*assessing*

Module 1: Forces, Energy and Electricity

**[AY111]**

**WEDNESDAY 12 JANUARY, MORNING**

# MARK SCHEME

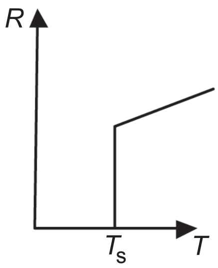
| | | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|---|
| 1 | (a) | (i) | Scalars have magnitude (only) [1] | | | |
| | | (ii) | Vectors have magnitude and direction | | [2] | |
| | (b) | | Velocity | [1] | | |
| | | | Force | [1] | [2] | |
| | | | [–1] per omission/error | | | |
| | (c) | (i) | Horizontal component = 9.8(2) N | [1] | | |
| | | | Vertical component = 6.88 N | [1] | [2] | |
| | | (ii) | Weight (29.4 N) – vertical component (6.88 N) ecf | [1] | | |
| | | | Force = 22.5 N (231 N if g = 10 N $kg^{-1}$) | [1] | [2] | 8 |
| 2 | (a) | (i) | Eqn. $v^2 = u^2 + 2as$ and subs | [1] | | |
| | | | Maximum height = 1.27 m | [1] | [2] | |
| | | (ii) | Eqn. $s = ut + \frac{1}{2}at^2$ and subs | [1] | | |
| | | | Flight time = 1.02 s | [1] | [2] | |
| | | | S.E. 0.51 s → [1] | | | |
| | (b) | (i) | $t_1$ to $t_2$ *constant* (positive) acceleration | | | |
| | | | $t_2$ to $t_3$ zero or constant velocity | | | |
| | | | $t_3$ to $t_4$ *constant* retardation or deceleration or negative acceleration | | | |
| | | | All three correct | | [2] | |
| | | | [–1] per omission/error | | | |
| | | (ii) | (Area under the curve) [1] (from $t = 0$ to $t = t_4$) [1] | | [2] | 8 |
| 3 | (a) | | The rate of change of momentum of a body is directly proportional to the (applied) force and acts in the *direction* of the force | | [2] | |
| | | | **or** $a \propto F$ and $a \propto \frac{1}{m}$ with symbols defined. | | | |
| | (b) | (i) | Eqn. $R - mg = ma$ and subs | [1] | | |
| | | | Reading = 622 N | [1] | [2] | |
| | | (ii) | Reading = 540 N | | [1] | |
| | | (iii) | Eqn. $mg - R = ma$ and subs | [1] | | |
| | | | Reading = 485 N | [1] | [2] | 7 |

| | | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|---|
| **4** | **(a)** | | X + Y = 48 N | [1] | | |
| | | | 18 × 0.5 + 1.5 Y = 30 × 1.0 (or equivalent) | [1] | | |
| | | | Y = 14 N and X = 34 N | [1] | [3] | |
| | **(b)** | | Takes moments about X with Y = 0 | | | |
| | | | 30 × 1 = ? × 0.5 | [1] | | |
| | | | Increase in weight = 60 – 18 = 42 N (ecf **(a)**) | [1] | [2] | 5 |
| **5** | **(a)** | **(i)** | KE = $\frac{1}{2}mv^2$ = 309 000 (J) | | [1] | |
| | | **(ii)** | Power = KE/time = 22 900 (W) (ecf **(i)**) | | [1] | |
| | | **(iii)** | Chemical energy × 0.29 = KE | [1] | | |
| | | | Chemical energy = 1 066 000 (J) (ecf **(i)**) | [1] | [2] | |
| | **(b)** | | Uses $v^2$ = 2 gh to find vertical height risen | [1] | | |
| | | | h = 39.4 m | [1] | | |
| | | | Distance up slope = h/sin (8) = 283 m | [1] | | |
| | | | [ **or** Work done = change in KE | [1] ] | | |
| | | | (800 × 9.81 × sin 8°) S = 309 000 (ecf (a)(i)) | [1] | | |
| | | | S = 283 (m) | [1] | | |
| | | | [ **or** $v^2 = u^2 + 2as$ | [1] ] | | |
| | | | $o^2 = 27.8^2 + 2 (-9.81 \sin 8°)s$ | [1] | | |
| | | | s = 283 | [1] | [3] | 7 |
| **6** | **(a)** | **(i)** | Vertical arrangement:<br>• ceiling<br>• 2 wires (If single wire, scores [0]/[3])<br>• Load on one wire<br>• Tensioner (load) on other wire<br>• Vernier scale or scale and pointer<br>• ruler<br>[½] each, round up | | [3] | |
| | | **(ii)** | Thickness or diameter + micrometer (screw gauge)<br>(Initial) length + *metre* rule<br>Extension + suitable instrument (marker may be on diagram)<br>[½] each and round down | | [3] | |
| | **(b)** | **(i)** | Extension = 1.95 (mm) | | [1] | |
| | | **(ii)** | Area = Force /(Young modulus × strain) | [1] | | |
| | | | $5.5/(1.2 \times 10^{11} \times 7.8 \times 10^{-4})$ | [1] | | |
| | | | $= 5.88 \times 10^{-2}$ mm$^2$ | [1] | [3] | 10 |

AVAILABLE MARKS

**7** **(a)** e.g. any metal *at constant temperature* or named metal at constant temperature [1]
Straight line through origin [1] [2]

**(b)** **(i)** The (abrupt) drop of the resistivity of a conductor to zero when a material is cooled below its critical or transition temperature, $T_s$ [1]




Zero between $T = 0$ and $T = T_s$ [1]

Step and linear, positive gradient [1] [3]

**(ii)** (Production of) (powerful) (electro)*magnets* (with no generation of heat energy)
Allow mag-lev not MRI [1] 6

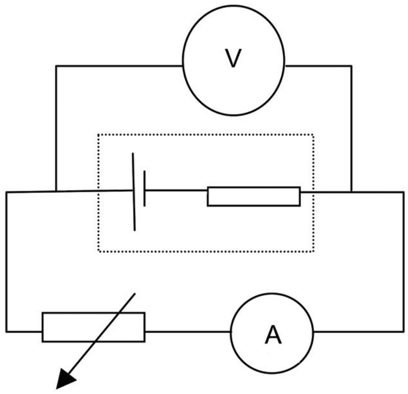
**8** **(a)** **(i)** Charge = 43.2 (C) [1]

**(ii)** Number of electrons = $2.7 \times 10^{20}$ (ecf **(i)**) [1]

**(b)** **(i)** Potential difference = 4.8 (V) [1]

**(ii)** E = Vit = $i^2$ Rt [1]
Energy = 207 (J) (ecf **(b)(i)** or **(a)(i)** or 60 *m*A) [1] [2] 5

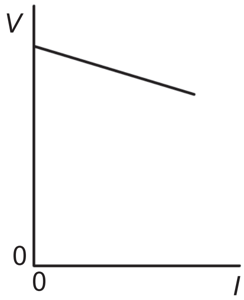
| | | | | | |
|---|---|---|---|---|---|
| **9** | **(a)** | Working circuit diagram: Cell, (load) variable resistor | [1] | | **AVAILABLE MARKS** |
| | | Ammeter, voltmeter | [1] | [2] | |




| | | | |
|---|---|---|---|
| Experiment: independent marks | | | |
| Vary load | [1] | | |
| Read V, A | [1] | [2] | |

**(b)** **(i)** Analysis: Graph of $V$ against $I$ [1]

Sketch [1]




**(ii)** $r$ = –gradient (negative essential) [1] [3]

($r$ from one set of values, [1] only)

**Quality of written communication**

**2 marks**
The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling.

**1 mark**
The candidate expresses ideas clearly, if not always fluently. There are some errors in grammar, punctuation and spelling, but not such as to suggest weakness in these areas.

**0 marks**
The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2]

**(c)** "lost volts" = 0.02 × 145 = 2.9 V **or** V = 12.6 – 145 (0.02) [1]

Terminal p.d. = 12.6 – 2.9 = 9.7 (V) [1] [2]

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| | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|
| **10** | **(i)** | Total circuit resistance = 720 Ω | [1] | | |
| | | hence current = (18/720 = 0.025 A) = 25 (mA) | [1] | [2] | |
| | **(ii)** | Potential difference = 0.025 × 120 = 3 (V) (ecf) | | [1] | |
| | **(iii)** | PD between B & D = 9.0 V | | | |
| | | PD between C & B = 1.5 V | [1] | | |
| | | hence PD between C and D = 10.5 (V) | [1] | [2] | |
| | **(iv)** | Resistance between C & D becomes | | | |
| | | 420 × 210/630 = 140 Ω | [1] | | |
| | | Total circuit resistance = 240 + 60 + 140 = 440 Ω | [1] | | |
| | | Hence PD = 140 × 18/440 = 5.72 (V) | [1] | [3] | 8 |
| | | | | **Total** | **75** |