Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**2014**

# Physics

## Assessment Unit AS 1

*assessing*

## Module 1: Forces, Energy and Electricity

**[AY111]**

**WEDNESDAY 11 JUNE, AFTERNOON**

# MARK SCHEME

## Subject-specific Instructions

In numerical problems, the marks for the intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the final correct answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote correct units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply for formal proofs and derivations, which must be valid in all stages to obtain full credit.

**Do not reward wrong physics**. No credit is given for consistent substitution of numerical data, or subsequent arithmetic, **in a physically incorrect equation**. However, answers to subsequent stages of questions that are consistent with an earlier incorrect numerical answer, and are based on physically correct equation, must gain full credit. Designate this by writing **ECF** (Error Carried Forward) by your text marks.

The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer marks, but $10^n$ errors (e.g. writing 550 nm as $550 \times 10^{-6}$ m) count only as arithmetical slips and lose the answer mark.

| | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|
| **1** | **(i)** | ohm/Ω | [1] | | |
| | **(ii)** | Unit made up from (combination of two or more) **base** units | [1] | | |
| | **(iii)** | $F = kg\ m\ s^{-2}$ | [1] | | |
| | | $W = kg\ m^2 s^{-2}$ or $P = kg\,m^2 s^{-3}$ **ECF** F | [1] | | |
| | | $R = kg\,m^2 s^{-3} A^{-2}$ **ECF** I | [1] | [3] | |
| | **(iv)** | Scalar<br>Completely expressed as number/no directional sense | [1] | | 6 |
| **2** | **(a)** | $s = \frac{1}{2}(u+v)t$ or equivalent | [1] | | |
| | | $= \frac{1}{2}(72.0 + 8.5)12$ | subs [1] | | |
| | | $= 483.0\,m$ | [1] | [3] | |
| | **(b)** | **(i)** $s = 3333.3\,m$ | [1] | | |
| | | short by 553 m **ECF** s | [1] | [2] | |
| | | **(ii)** (Reduce mass of airliner by) burning off fuel, removing luggage or passengers | [1] | | |
| | | Increased acceleration (inferred from Newton's 2nd) – second mark is dependent on the first | [1] | [2] | 7 |
| **3** | **(i)** | $0 = 13.5 \sin 40 - 9.81\,t$ subs into $v = u + at$ | [1] | | |
| | | $t = 0.89\,s$ | [1] | [2] | |
| | **(ii)** | Height above launch = 3.84 m | [1] | | |
| | | Height above ground = 3.84 + 2.0 = 5.84 m **ECF** s | [1] | [2] | |
| | **(iii)** | $s = ut + \frac{1}{2}at^2 = 5.84 = 0 + \frac{1}{2} \times 9.81 \times t^2$ | [1] | | |
| | | $t = 1.09$ | [1] | | |
| | | Total horizontal time = 1.09 + 0.89 = 1.98 s **ECF** t<br>or correct equivalent for time | [1] | | |
| | | Distance (= velocity × time) = $13.5 \cos 40 \times 1.98$ | [1] | | |
| | | $= 20.5$ m **ECF** | [1] | [5] | 9 |
| | | Uses t = 2(0.89) max [1]/[5] | | | |

| | | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|---|
| **4** | **(a)** | **(i)** | W = KE or F(6.59) = 19.2 eqn or subs | [1] | | |
| | | | F = 2.91 N | [1] | [2] | |
| | | **(ii)** | KE = 2.91(6.59 – 3.00) + 2.91(0.88)(3.00) subs **ECF** F | [1] | | |
| | | | KE = 18.1 J | [1] | [2] | |
| | | | Recognising a split in the motion [1]/[2] | | | |
| | **(b)** | • | The stone will not slow as much **or** goes further | [1] | | |
| | | • | (Curl reduced therefore) stone straightens | [1] | [2] | |
| | | | **Quality of written communication** | | | |
| | | | **2 marks**<br>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**<br>The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas. | | | |
| | | | **0 marks**<br>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] | | 8 |
| **5** | **(a)** | | Moment = force × **perpendicular** distance to pivot | [1] | | |
| | **(b)** | **(i)** | $F_{54cm} = 0.59\ F_{32cm}$ or equivalent | [1] | | |
| | | | 41 % | [1] | [2] | |
| | | **(ii)** | perp distance = 0.32 cos(34°) (= 0.27 m) | [1] | | |
| | | | Force = 62(9.81) = (608 N) | [1] | | |
| | | | Moment = 164 N m | [1] | [3] | 6 |
| **6** | **(a)** | | Rate of doing work, symbols must be defined | [1] | | |
| | **(b)** | | Work done = (76.0 + 28.5) × 9.81 × 2.75 | [1] | | |
| | | | = 2820 J | [1] | | |
| | | | Power = 43 W | [1] | [3] | |
| | | | SE 31.5 W → [2]/[3] | | | |
| | **(c)** | | Correct equation for energy conservation principle ΔGPE = ΔKE | [1] | | |
| | | | Correct mathematical interpretation of friction | [1] | | |
| | | | $v = 8.1\ m\ s^{-1}$ | [1] | [3] | 7 |

| | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|
| **7** | **(a)** | Gradient = 60/0.032 = 1875 (N $m^{-1}$) or Equation $E = \frac{FL}{Ax}$ | [1] | | |
| | | 1875 = EA/L relationship subs | [1] | | |
| | | $E = 2.07 \times 10^{11}$ | [1] | | |
| | | Pa | [1] | [4] | |
| | | Wrong area: max [2]/[4] | | | |
| | **(b)** | Maximum stretching | [1] | | |
| | | force per unit area | [1] | | |
| | | without breaking | [1] | [3] | 7 |
| **8** | **(a)** | **(i)** $12 \times 10^{-3}$ (coulombs of charge pass any point every second) | | [1] | |
| | | **(ii)** E = IVt = QV Eqn or subs **ECF** Q | [1] | | |
| | | Energy = 0.076 (J) | [1] | [2] | |
| | **(b)** | $Q = It = 12 \times 10^{-3} \times 90$ | [1] | | |
| | | Q = ne **ECF** Q | [1] | | |
| | | $n = 12 \times 10^{-3} \times 90/1.6 \times 10^{-19} = 6.75 \times 10^{18}$ | [1] | [3] | 6 |
| **9** | **(a)** | $R = \rho l/A$ | [1] | | |
| | | $A = 1.45 \times 10^{-6} (25.4 \times 10^{-3})/0.19 = 1.94 \times 10^{-7}$ | [1] | | |
| | | $= \pi d^2/4$ | [1] | | |
| | | d = 0.5 (mm) | [1] | [4] | |
| | **(b)** | Thinner, A gets less, diameter smaller | [1] | | |
| | | (If I decreases) R increases | [1] | | |
| | | $I^2R$ constant | [1] | [3] | 7 |
| **10** | **(a)** | Internal resistance = 1.8 (Ω) | [1] | | |
| | | e.m.f. = 4.62 (V) | [1] | [2] | |
| | | Qualitative response max [1]/[2] | | | |
| | **(b)** | **(i)** Ammeter and voltmeter correctly positioned | [1] | | |
| | | Variable resistor and battery (not PSU) | [1] | | |
| | | Correct symbols for components | [1] | [3] | |
| | | **(ii)** Use variable resistor | [1] | | |
| | | to get multiple values of V and I | [1] | [2] | 7 |
| **11** | **(a)** | Resistance of parallel network = 10 kΩ | [1] | | |
| | | Total resistance = 30 kΩ | | | |
| | | Current flowing = $4 \times 10^{-4}$ A | [1] | | |
| | | $V_{out}$ = 4 V | [1] | [3] | |
| | | S.E. 8V → [2]/[3] | | | |
| | **(b)** | • High resistance >> $R_1$ | [1] | | |
| | | • No change in circuit/no current flows through 10 MΩ | [1] | [2] | 5 |
| | | | | **Total** | **75** |