**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

GCE Advanced Level

# MARK SCHEME for the June 2005 question paper

## 9702 PHYSICS

**9702/04** **Paper 4 (Core), maximum raw mark 60**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. This shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the June 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

**Grade thresholds** for Syllabus 9702 (Physics) in the June 2005 examination.

| | maximum mark available | minimum mark required for grade: | | |
|---|---|---|---|---|
| | | A | B | E |
| Component 4 | 60 | 41 | 35 | 19 |

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

**June 2005**

GCE A LEVEL

| |
|---|
| MARK SCHEME |
| MAXIMUM MARK: 60 |
| SYLLABUS/COMPONENT: 9702/04<br><br>PHYSICS<br>Paper 4 (Core) |

UNIVERSITY of CAMBRIDGE
International Examinations

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|---|---|---|---|---|---|
| **1** | **(a)** | **(i)** | angular speed = $2\pi/T$<br>$= 2\pi/(3.2 \times 10^7)$<br>$= 1.96 \times 10^{-7}$ rad s$^{-1}$ | **C1**<br><br>**A1** | <br><br>**[2]** |
| | | **(ii)** | force = $mr\omega^2$ <u>or</u> force = $mv^2/r$ and $v = r\omega$<br>$= 6.0 \times 10^{24} \times 1.5 \times 10^{11} \times (1.96 \times 10^{-7})^2$<br>$= 3.46 \times 10^{22}$ N | **C1**<br><br>**A1** | <br><br>**[2]** |
| | **(b)** | **(i)** | gravitation/gravity/gravitational field (strength) | **B1** | **[1]** |
| | | **(ii)** | $F = GMm/x^2$ <u>or</u> $GM = r^3\omega^2$<br>$3.46 \times 10^{22} = (6.67 \times 10^{-11} \times M \times 6.0 \times 10^{24})/(1.5 \times 10^{11})^2$<br>$M = 1.95 \times 10^{30}$ kg | **C1**<br>**C1**<br>**A1** | <br><br>**[3]** |
| **2** | **(a)** | | obeys the law $pV/T$ = constant <u>or</u> any <u>two</u> named gas laws<br>at all values of $p$, $V$ and $T$<br><u>or</u> two correct assumptions of kinetic theory of ideal gas **(B1)**<br>third correct assumption **(B1)** | **M1**<br>**A1** | <br>**[2]** |
| | **(b)** | **(i)** | mean square speed | **B1** | **[1]** |
| | | **(ii)** | mean kinetic energy = $\frac{1}{2}m\langle c^2\rangle$<br>$\rho = Nm/V$ and algebra leading to [do not allow if takes $N$ = 1]<br>$\frac{1}{2}m\langle c^2\rangle = 3/2\ kT$ | **M1**<br>**M1**<br>**A0** | <br><br>**[2]** |
| | **(c)** | **(i)** | $\frac{1}{2} \times 6.6 \times 10^{-27} \times (1.1 \times 10^4)^2 = 3/2 \times 1.38 \times 10^{-23} \times T$<br>$T = 1.9 \times 10^4$ K | **C1**<br>**A1** | <br>**[2]** |
| | | **(ii)** | Not all atoms have same speed/kinetic energy | **B1** | **[1]** |
| **3** | **(a)** | | (thermal) energy/heat required to convert unit mass/1 kg of<br>solid to liquid<br>with no change in temperature/at melting point | <br>**M1**<br>**A1** | <br><br>**[2]** |
| | **(b)** | **(i)** | energy required to warm ice = $24 \times 10^{-3} \times 2.1 \times 10^3 \times 15$ (= 756 J)<br>energy required to melt ice at 0 °C = $24 \times 10^{-3} \times 330 \times 10^3$ (= 7920 J)<br>total energy = 8700 J | **C1**<br>**C1**<br>**A1** | <br><br>**[3]** |
| | | **(ii)** | energy lost by warm water = $200 \times 10^{-3} \times 4.2 \times 10^3 \times (28 - T)$<br>$200 \times 4.2 \times (28 - T) = 24 \times 4.2 \times T + 8676$<br>$T$ = 16 °C<br>[allow 2 marks if $\Delta T$ calculated]<br>[allow 2 marks if (24 x 4.2 x $T$) omitted]<br>[allow 1 mark for 224 x 4.2 x (28 - $T$) = 8676, $T$ - 19 °C] | **C1**<br>**C1**<br>**A1** | <br><br>**[3]** |

| | | | | | |
|---|---|---|---|---|---|
| **4** | **(a)** | | acceleration proportional to displacement (from a fixed point)<br><u>or</u> a = - $\omega^2 x$ with *a*, $\omega$ and *x* explained | **M1** | |
| | | | and directed towards a fixed point<br><u>or</u> negative sign explained | **A1** | **[2]** |
| | **(b)** | | for s.h.m., $a = (-)\omega^2 x$ | **B1** | |
| | | | identifies $\omega^2$ as $A\rho g/M$ and therefore s.h.m. (may be implied) | **B1** | |
| | | | $2\pi f = \omega$ | **B1** | |
| | | | hence $f = \frac{1}{2\pi}\sqrt{\frac{Apg}{M}}$ | **A0** | **[3]** |
| | **(c)** | **(i)** | *T* = 0.60 s <u>or</u> *f* = 1.7 Hz | **C1** | |
| | | | $0.60 = (2\pi\sqrt{M})/\sqrt{(\pi \times \{1.2 \times 10^{-2}\}^2 \times 950 \times 9.81)}$ | **C1** | |
| | | | *M* = 0.0384 kg | **A1** | **[3]** |
| | | **(ii)** | <u>decreasing</u> peak height/amplitude | **B1** | **[1]** |
| **5** | **(a)** | | field strength = potential gradient [- sign not required]<br>[allow $E = \Delta V/\Delta x$ but not $E = V/d$] | **B1** | **[1]** |
| | **(b)** | | No field for $x < r$ | **B1** | |
| | | | for $x > r$, curve in correct direction, not going to zero | **B1** | |
| | | | discontinuity at $x = r$ (vertical line required) | **B1** | **[3]** |
| **6** | **(a)** | **(i)** | flux/field in core must be changing | **M1** | |
| | | | so that an e.m.f./current is induced in the secondary | **A1** | **[2]** |
| | | **(ii)** | power = *VI* | **M1** | |
| | | | <u>output</u> power is constant so if $V_S$ increases, $I_S$ decreases | **A1** | **[2]** |
| | **(b)** | **(i)** | same shape and phase as $I_P$ graph | **B1** | **[1]** |
| | | **(ii)** | same frequency | **M1** | |
| | | | correct phase w.r.t. Fig. 6.3 | **A1** | **[2]** |
| | | **(iii)** | ½π <u>rad</u> or 90° | **B1** | **[1]** |
| **7** | **(a)** | | curve levelling out (at 1.4 μg) | **M1** | |
| | | | correct shape judged by masses at $nT_{½}$<br>[for second mark, values must be marked on *y*-axis) | **A1** | **[2]** |
| | **(b)** | **(i)** | $N_0 = (1.4 \times 10^{-6} \times 6.02 \times 10^{23})/56$ | **C1** | |
| | | | $= 1.5 \times 10^{16}$ | **A1** | **[2]** |
| | | **(ii)** | $A = \lambda N$ | **C1** | |
| | | | $\lambda = \ln 2/(2.6 \times 3600)$ (= $7.4 \times 10^{-5}$ s$^{-1}$) | **C1** | |
| | | | $A = 1.11 \times 10^{12}$ Bq | **A1** | **[3]** |
| | **(c)** | | 1/10 of original mass of Manganese remains | **C1** | |
| | | | $0.10 = \exp(-\ln 2 \times t/2.6)$ | | |
| | | | *t* = 8.63 hours<br>[use of 1/9, giving answer 8.24 hrs scores 1 mark] | **A1** | **[2]** |

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| --- | --- | --- | --- | --- |
| **8 (a)** | | $Q/V$, with symbols explained [do not allow in terms of units] | **B1** | **[1]** |
| **(b)** | **(i)** | on a capacitor, there is charge separation/there are + and - charges | **M1** | |
| | | either to separate charges, work must be done | | |
| | | or energy released when charges 'come together' | **A1** | **[2]** |
| | **(ii)** | either energy = $\frac{1}{2}CV^2$ or energy = $\frac{1}{2}QV$ and $C = Q/V$ | **C1** | |
| | | change = $\frac{1}{2} \times 1200 \times 10^{-6} (50^2 - 15^2)$ | **C1** | |
| | | change = 1.4 J (1.37) | **A1** | **[3]** |
| | | [allow 2 marks for $\frac{1}{2}C(\Delta V)^2$, giving energy = 0.74 J) | | |