**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge International Advanced Subsidiary and Advanced Level**

# MARK SCHEME for the October/November 2014 series

## 9702 PHYSICS

**9702/22** Paper 2 (AS Structured Questions), maximum raw mark 60

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| | | | | |
|---|---|---|---|---|
| **1** | **(a)** | stress = Young modulus × strain | | |
| | | = $1.8 \times 10^{11} \times 8.2 \times 10^{-4}$ *or* $1.476 \times 10^{8}$ | C1 | |
| | | = 0.15 (0.148) GPa | A1 | [2] |
| | **(b) (i)** | wavelength = $3 \times 10^{8} / 12 \times 10^{12}$<br>= 25 μm | C1<br>A1 | [2] |
| | **(ii)** | infra-red / IR | B1 | [1] |
| | **(c) (i)** | arrow drawn up to the left of 7.5 N force<br>approximately 5° to 40° to west of north | A1 | [1] |
| | **(ii)** | **1.** correct vector triangle or working to show<br>magnitude of resultant force = 6.6 N<br>allow 6.5 to 6.7 N if scale diagram | M1 | [1] |
| | | **2.** magnitude of acceleration = 6.6 / 0.75<br>[scale diagram: (6.5 to 6.7) / 0.75] | C1 | |
| | | = 8.8 m s$^{-2}$ [scale diagram: 8.7 – 8.9 m s$^{-2}$] | A1 | [2] |
| | **(iii)** | 19° [<u>use of scale diagram</u> allow 17° to 21° (a diagram must be seen)] | B1 | [1] |
| **2** | **(a) (i)** | straight line from $t$ = 0.60 s to $t$ = 1.2 s and $\lvert V_v \rvert$ = 5.9 at $t$ = 1.2 s<br>$V_v$ = – 5.9 at $t$ = 1.2 s i.e. line is for negative values of $V_v$ | M1<br>A1 | [2] |
| | **(ii)** | $s = 0 + ½ \times 9.81 \times (0.6)^2$ *or* area of graph = (5.9 × 0.6) / 2 | C1 | |
| | | = 1.8 (1.77) m = 1.8 (1.77) m | A1 | [2] |
| | **(iii)** | $V_h = V \cos 60°$ <u>and</u> $V_v = V \sin 60°$ *or* $V_h$ = 5.9 / tan 60° *or* $V_h$ = 5.9 tan 30° | C1 | |
| | | $V_h$ = 3.4 m s$^{-1}$ | A1 | [2] |
| | **(iv)** | horizontal line at 3.4 from $t$ = 0 to $t$ = 1.2 s [to half a small square] | B1 | [1] |
| | **(b) (i)** | KE = $½mv^2$ | C1 | |
| | | = $½ \times 0.65 \times (6.81)^2$ [allow if valid method to find $v$] | C1 | |
| | | = 15 (15.1) J | A1 | [3] |
| | **(ii)** | PE = 0.65 × 9.81 × 1.77 | C1 | |
| | | = 11(11.3) J | A1 | [2] |

| | | | | | |
|---|---|---|---|---|---|
| **3** | **(a)** | | electric field strength is force per unit positive charge | B1 | [1] |
| | **(b)** | | mass = volume × density (any subject, allow usual symbols or defined symbols) | C1 | |
| | | | = $4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930$ (= $6.73 \times 10^{-15}$) | | |
| | | | weight = $4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \times 9.81 = 6.6 \times 10^{-14}$ N | M1 | [2] |
| | **(c)** | **(i)** | $E = 1.9 \times 10^3 / 14 \times 10^{-3}$ | C1 | |
| | | | $= 1.4\ (1.36) \times 10^5\ \mathrm{V\,m^{-1}}$ | A1 | [2] |
| | | **(ii)** | $F = QE$ | | |
| | | | $Q = 6.6 \times 10^{-14} / 1.36 \times 10^5$ | C1 | |
| | | | $= 4.9\ (4.86) \times 10^{-19}$ C [allow $4.7 \times 10^{-19}$ C if $1.4 \times 10^5$ used] | A1 | [2] |
| | | **(iii)** | electric force increases / is greater (than weight) | B1 | |
| | | | charge (on S) is negative to give resultant / net / sum / total force up | B1 | [2] |
| **4** | **(a)** | **(i)** | solid: (molecules) vibrate | B1 | |
| | | | no translational motion / fixed position, liquid: translational motion | B1 | [2] |
| | | **(ii)** | gas: molecules have random (and translational) motion | B1 | [1] |
| | **(b)** | **(i)** | ductile: straight line through origin then curving towards *x*-axis | B1 | [1] |
| | | **(ii)** | brittle: straight line through origin with no or negligible curved region | B1 | [1] |
| | **(c)** | | similarity: obey Hooke's law / $F \propto x$ or have elastic regions | B1 | |
| | | | difference: brittle no or (very) little plastic region<br>ductile has (large(r)) plastic region | B1 | [2] |
| **5** | **(a)** | **(i)** | in series 2*X* or in parallel X / 2 | M1 | |
| | | | other relationship given and 4× greater in series (than in parallel) | A1 | [2] |
| | | **(ii)** | due to the internal resistance | B1 | |
| | | | total resistance for series circuit is not four times greater than resistance for parallel circuit | B1 | [2] |
| | | **(iii)** | **1.** $E = I_1(2X + r)$ or $12 = 1.2(2X + r)$ | A1 | |
| | | | **2.** $E = I_2(X/2 + r)$ or $12 = 3.0(X/2 + r)$ | A1 | [2] |
| | | **(iv)** | $2X + r = 10$ and $X/2 + r = 4$ | | |
| | | | $X = 4.0\ \Omega$ | A1 | [1] |

**(b)** $P = I^2R$ or $V^2/R$ or $VI$ C1

ratio = $[(1.2)^2 \times 4] / [(1.5)^2 \times 4]$
= 0.64 A1 [2]

**(c)** the resistance (of a lamp) changes with $V$ or $I$ B1

$V$ or $I$ is greater in parallel circuit or circuit 2
*or* $V$ or $I$ is less in series circuit or circuit 1 B1 [2]

**6 (a)** difference: vibration / oscillation (of particles) / displacement of particles is parallel to energy transfer / wavefronts in longitudinal and perpendicular for transverse B1
*or*
transverse can be polarised, longitudinal cannot be polarised

similarity: both transfer / propagate energy B1 [2]

**(b) (i)** waves from slits are coherent / constant phase relationship (B1)
waves overlap (at screen) with a phase difference or have a path difference (B1)
maxima where phase difference is integer $\times 360°$ (or $\times 2\pi$ rad)
*or* path difference is integer $\times\lambda$
*or* equivalent explanation of minima e.g. $(n+½)\times 360°$ (B1)
max. 2 [2]

**(ii)** maxima spacing = $\lambda D / a$ C1
= $(6.3 \times 10^{-7} \times 2.5) / 0.35 \times 10^{-3}$
= $4.5 \times 10^{-3}$ m A1 [2]

**(c)** (ultra-violet has) shorter wavelength, hence smaller separation / distance A1 [1]

**7 (a) (i)** A: 206, nucleon(s) or neutron(s) **and** proton(s) }
B: 82, proton(s) } all correct A1 [1]

**(ii)** kinetic / $E_K$ / KE B1 [1]

**(b)** energy = $5.3 \times 1.6 \times 10^{-13}$ (J) [= $8.48 \times 10^{-3}$ (J)] C1

power = $(7.1 \times 10^{18} \times 5.3 \times 1.6 \times 10^{-13}) / (3600 \times 24)$

= 70 (69.7) W A1 [2]