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MARK SCHEME for the October/November 2014 series

9702 PHYSICS

9702/23 Paper 2 (AS Structured Questions), maximum raw mark 60

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1 **(a)** ampere B1
kelvin B1 [2]
(allow mole and candela)

(b) **(i)** stress: N m^{-2} C1
$kg\,m\,s^{-2}/m^2 = kg\,m^{-1}\,s^{-2}$ A1 [2]

(ii) Young modulus = stress / strain and <u>strain has no units</u>
hence units: $kg\,m^{-1}\,s^{-2}$ B1 [1]

2 **(a)** **(i)** amplitude scale reading 2.2 (cm) C1
amplitude = $2.2 \times 2.5 = 5.5$ mV A1 [2]

(ii) time period scale reading = 3.8 (cm) C1
time period = $3.8 \times 0.5 \times 10^{-3} = 0.0019$ (s) C1

frequency $f = 1 / 0.0019 = 530$ (526) Hz A1 [3]

(iii) uncertainty in reading = ± 0.2 in 3.8 (cm) or 5.3% or 0.2 in 7.6 (cm)
or 2.6% [allow other variations of the distance on the *x*-axis] M1

actual uncertainty = 5.3% of 526 = 27.7 or 28 Hz
or 2.6% of 526 = 13 or 14 A1 [2]

(b) frequency = 530 ± 30 Hz or 530 ± 10 Hz A1 [1]

3 **(a)** displacement / velocity / acceleration / momentum / etc.
three correct (none wrong) 2, two correct (none or one wrong) 1 A2 [2]

(b) **(i)** $Y = 70$ N [allow 71 N as +½ small square on graph] A1 [1]

(ii) $\theta = 90°$ M1

(for equilibrium) the direction of Y must be <u>opposite</u> to Z

or using $Y \sin\theta = Z$, hence $\sin\theta = 70 / 70 = 1$, $\theta = 90°$ A1 [2]

(iii) **1.** $Y\cos\theta = 160$ and $Y\sin\theta = 70$ C1

$\tan\theta = 70/160$ hence $\theta = 23.6°$ (24°) A1 [2]

2. $Y = 160 / \cos 23.6°$ or $70 / \sin 23.6°$ C1
$= 174.6$ or 175 or 170 N A1 [2]

or:

$160^2 + 70^2 = Y^2$ (C1)
$Y = 174.6$ or 175 or 170 N (A1)

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(c) (equilibrium not possible as) there is no vertical component from *Y* to balance *Z* B1 [1]

4 **(a)** for a system (of interacting bodies) the <u>total</u> momentum remains constant M1
provided there is no <u>resultant</u> force acting (on the system) A1 [2]

(b) **(i)** total momentum = $m_1v_1 + m_2v_2$ C1
= $0.4 \times 0.65 + 0.6 \times 0.45$ C1
= $0.26 + 0.27 = 0.53\,\text{N s}$ A1 [3]

(ii) $0.53 = 0.4 \times 0.41 + 0.6 \times v$ C1

$v = 0.366 / 0.6 = 0.61\,\text{m s}^{-1}$ A1 [2]

(iii) KE = $\frac{1}{2}mv^2$ C1
total initial KE = $\frac{1}{2} \times 0.4 \times (0.65)^2 + \frac{1}{2} \times 0.6 \times (0.45)^2$ C1
= $0.0845 + 0.06075 = 0.15\,(0.145)\,\text{J}$ A1 [3]

(c) check relative speed of approach equals relative speed of separation
or:
total final kinetic energy equals the total initial kinetic energy B1 [1]

(d) the forces on the two bodies (or on X and Y) are equal and opposite B1
time same for both forces <u>and</u> force is change in momentum / time B1 [2]

5 evaporation: molecules escape from the surface B1
at all temperatures B1

boiling: takes place throughout / in the liquid B1
at the boiling point / at specific temperatures B1 [4]

6 **(a)** $R = \rho l / A$ C1

$A = [\pi \times (0.38 \times 10^{-3})^2] / 4 \quad (= 0.113 \times 10^{-6}\ \text{m}^2)$ C1

$R = (4.5 \times 10^{-7} \times 1.00) / ([\pi \times (0.38 \times 10^{-3})^2] / 4) = 4.0\,(3.97)\,\Omega$ M1 [3]

(b) **(i)** $I = V / R$ C1
= $2.0 / 5.0 = 0.4(0)\,\text{A}$ A1 [2]

(ii) p.d. across BD = $4 \times 0.4 = 1.6\,\text{V}$ A1 [1]

(iii) p.d. across BC (l) = 1.5 (V) C1

BC (l) = $(1.5 / 1.6) \times 100 = 94\,(93.75)\,\text{cm}$ A1 [2]

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(c) p.d. across wire not balancing e.m.f. of cell OR cell Y has current — B1
energy lost or lost volts due to internal resistance — B1 [2]

7 **(a)** **(i)** progressive: energy is moved / transferred / propagated from one place to another (without the bulk movement of the medium) — B1

transverse: (particles) oscillate / vibrate at right angles to the direction of travel of the energy / wavefront — B1 [2]

(ii) number of oscillations per unit time / number of wavefronts passing a point per unit time — B1 [1]

(b) **(i)** P and T — B1 [1]

(ii) P and S or Q and T — B1 [1]

(c) $\lambda = 1.2 \times 10^{-2}$ (m) — C1

$v = f\lambda$
$= 15 \times 1.2 \times 10^{-2}$ — C1
$= 0.18\,\text{m s}^{-1}$ — A1 [3]

(d) ratio $= (1.4)^2 / (2.1)^2$ — C1
$= 0.44$ — A1 [2]

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