

Question	Answer	Marks
1(a)	density and temperature indicated as scalars	**B1**
	acceleration and momentum indicated as vectors	**B1**
1(b)(i)	decelerates **or** speed/velocity decreases	**B1**
1(b)(ii)	speed = $(\Delta)d / (\Delta)t$ **or** gradient	**C1**
	= e.g. $(0.56 - 0.20) / 1.5$ $= 0.24\ \text{m s}^{-1}$	**A1**
1(c)	displacement is zero (so) average velocity is zero	**B1**

Question	Answer	Marks
2(a)(i)	$(\Delta)p = \rho g(\Delta)h$ $520 = 1000 \times 9.81 \times h$	**C1**
	$h = 0.053$ m	**A1**
2(a)(ii)	(upthrust =) $(\Delta)p \times \text{A}$	**C1**
	$= (\Delta)p \times \pi(d / 2)^2$ **or** $(\Delta)p \times \pi r^2$	
	$= 520 \times \pi(0.031 / 2)^2 = 0.39$ (N)	**A1**
2(a)(iii)	$T = 0.84 - 0.39$ $= 0.45$ N	**A1**

Question	Answer	Marks
2(b)(i)	$a = (v - u) / t$ **or** $(\Delta)v / (\Delta)t$ **or** gradient	**C1**
	= e.g. $8.0 \times 10^{-2} / 2.0$ $= 4.0 \times 10^{-2}$ m s^{-2}	**A1**
2(b)(ii)	distance = $(½ \times 2.5 \times 0.10) + (½ \times 1.5 \times 0.10)$ **or** $(½ \times 4.0 \times 0.10)$ (= 0.20 (m))	**C1**
	depth = 0.32 – 0.20 = 0.12 m	**A1**
2(c)(i)	viscous (force)	**B1**
2(c)(ii)	viscous force increases (with speed/time/depth)	**B1**
	(so) acceleration decreases	**B1**

Question	Answer	Marks
3(a)(i)	$F = kx$	**C1**
	$F_1 = 800 \times 0.045$ $= 36$ N	**A1**
3(a)(ii)	(E =) $\frac{1}{2}kx^2$ **or** $\frac{1}{2}Fx$ **or** area under graph	**C1**
	$\frac{1}{2} \times 800 \times (0.045)^2$ **or** $\frac{1}{2} \times 36 \times 0.045 = 0.81$ (J)	**A1**
3(b)(i)	efficiency = $(0.72 / 0.81) \times 100$ $= 89\%$	**A1**
3(b)(ii)	$E = \frac{1}{2}mv^2$	**C1**
	$p = mv$	**C1**
	$0.72 = \frac{1}{2} \times 0.020 \times v^2$ and $p = 0.020 \times v$ $p = 0.17$ N s	**A1**
3(c)(i)	$(\Delta)E = mg(\Delta)h$	**C1**
	$h = 0.60 / (0.020 \times 9.81) = 3.1$ m	**A1**
3(c)(ii)	$F = (0.72 - 0.60) / 3.1$	**C1**
	$= 0.039$ N	**A1**
3(c)(iii)	resultant force on ball is less (than that with air resistance) so time (taken) is more (than T)	**B1**

Question	Answer	Marks
4(a)	(component =) 96 sin 38° = 59 (N) **or** 96 cos 52° = 59 (N)	**A1**
4(b)	(45×2.9) **or** $(T \times 1.8)$ **or** (59×1.5)	**C1**
	$(45 \times 2.9) = (T \times 1.8) + (59 \times 1.5)$	**C1**
	$T = 23$ N	**A1**

Question	Answer	Marks
5(a)	$v = f\lambda$ **or** $c = f\lambda$	**C1**
	$f = 3.0 \times 10^8 / 0.040$	**C1**
	$= 7.5 \times 10^9$ (Hz) = 7.5 GHz	**A1**
5(b)(i)	path difference = 0.020 m	**A1**
5(b)(ii)	phase difference = 180°	**A1**
5(c)	(intensity) increases	**C1**
	(intensity) increases by a factor of 4	**A1**
5(d)(i)	minimum moves closer to the maximum **or** decrease in separation of maximum and minimum	**B1**
5(d)(ii)	the maximum and minimum exchange places **or** the maximum becomes a minimum **and** the minimum becomes a maximum	**B1**

Question	Answer	Marks
6(a)	$I = I_1 + I_2 + I_3$	**B1**
	$(V / R) = (V / R_1) + (V / R_2) + (V / R_3)$ **or** $(I / V) = (I_1 / V) + (I_2 / V) + (I_3 / V)$ **and** $1 / R = 1 / R_1 + 1 / R_2 + 1 / R_3$	**B1**
6(b)(i)	current = 0.49 + 0.45 = 0.94 A	**A1**
6(b)(ii)	$8.0 = (0.94 \times r) + (0.45 \times 16)$	**C1**
	$r = 0.85\ \Omega$	**A1**
6(c)	$I = Anvq$ $v = (0.45 / 0.49) \times 2.1 \times 10^{-4}$	**C1**
	$= 1.9 \times 10^{-4}\ \text{m s}^{-1}$	**A1**
6(d)	total/combined resistance decreases	**B1**
	(current in battery increases so terminal) potential difference decreases	**B1**

Question	Answer	Marks
7(a)	similarity: same/equal mass **or** same/equal (magnitude of) charge **or** both fundamental (particles)	**B1**
	difference: opposite (sign of) charge **or** one is matter and the other is antimatter	**B1**
7(b)(i)	arrow points to the right	**B1**
7(b)(ii)	(electric) field strength increases **or** (electric) force increases	**B1**
	acceleration increases	**B1**
7(b)(iii)	force (on α-particle) has twice the magnitude (of force on electron)	**B1**
	force (on α-particle) is in opposite direction (to force on electron)	**B1**

