Question	Answer	Marks
1(a)	Fv: kg m s^{-2} k: kg m s^{-2} / m × m s^{-1}	**C1**
	= kg m^{-1} s^{-1}	**A1**
1(b)	$F = \rho g V$ $V = 4 / 3 \times \pi \times (2.1 \times 10^{-3})^3$ (=3.88 × 10^{-8} m^3)	**C1**
	ρ = 4.8 × 10^{-4} / 9.81 × V	**C1**
	= 1300 kg m^{-3}	**A1**
1(c)(i)	W downwards, U upwards, Fv upwards	**B1**
1(c)(ii)	F_V = 7.2 × 10^{-4} – 4.8 × 10^{-4} = 2.4 × 10^{-4} (N)	**C1**
	velocity = 2.4 × 10^{-4} / (17 × 2.1 × 10^{-3}) = 6.7 × 10^{-3} m s^{-1}	**A1**

Question	Answer	Marks
2(a)	force (on droplet of water) in horizontal direction is zero.	**B1**
2(b)	(time taken =) 3.5 / 6.6 = 0.53 (s)	**A1**
2(c)	$s = ut + ½at^2$ $s = ½ \times 9.81 \times 0.53^2$	**C1**
	h = 1.4 m	**A1**

Question	Answer	Marks
2(d)	displacement is straight-line distance (from P to Q) so less (than distance along path) or displacement is the shortest distance (from P to Q).	**B1**
2(e)	$(\text{displacement})^2 = 3.5^2 + 1.4^2$	**C1**
	displacement = 3.8 m	**A1**

Question	Answer	Marks
3(a)	$(m =) \rho V$	**C1**
	$= 1.0 \times 10^3 \times 1.5 \times 10^{-4} \times 5.0 \times 1.6 = 1.2$ (kg)	**A1**
3(b)(i)	$(\Delta)p = 1.2 \times 5.0$ $= 6.0$ N s	**A1**
3(b)(ii)	$F = 6.0 / 1.6$ or $1.2 \times 5.0/1.6$ $= 3.8$ N	**A1**
3(c)	Newton's third law applies (so) 3.8 N.	**B1**
3(d)	$p = F / A$ $= 3.8 / 1.5 \times 10^{-4}$	**C1**
	$= 2.5 \times 10^4$ Pa	**A1**

Question	Answer	Marks
4(a)	ratio = 300 / 3200 = 0.094	**A1**
4(b)	$E = ½mv^2$ or $E \propto v^2$	**C1**
	ratio = $(0.094)^{0.5}$ = 0.31	**A1**
4(c)	work (done against frictional force) = 3200 – 300 (=2900)	**C1**
	length = 2900 / 76 = 38 m	**A1**
4(d)(i)	$E = ½kx^2$ or $E = ½Fx$ and $F = kx$ $140 = ½ \times 63 \times x^2$ or $140 = ½Fx$ and $F = 63x$	**C1**
	x = 2.1 m	**A1**
4(d)(ii)	percentage efficiency = (140 / 300) × 100 = 47%	**A1**
4(d)(iii)	curved line from the origin	**M1**
	gradient of line increases	**A1**

Question	Answer	Marks
5(a)(i)	(two) waves travelling (at same speed) in opposite directions overlap	**B1**
	waves (of the same type) have same frequency/wavelength	**B1**
5(a)(ii)	phase difference = 0	**A1**

Question	Answer	Marks
5(b)(i)	$f_O = f_S\ v / v – v_S$ $543 = f \times 334 / (334 – 13)$	**C1**
	$f = 522$ Hz	**A1**
5(b)(ii)	(the speed is) decreasing	**B1**
5(c)(i)	$I \propto A^2$	**B1**
	$I_T / I_0 = \cos^2 20°$ or $A_T / A_0 = \cos 20°$	**C1**
	ratio = 0.94	**A1**
5(c)(ii)	angle = 140°	**A1**

Question	Answer	Marks
6(a)(i)	$P = VI$	**C1**
	$I = 36 / 8.0$ $= 4.5$ A	**A1**
6(a)(ii)	charge $= 4.5 \times 50$ $= 225$	**C1**
	number $= 225 / 1.6 \times 10^{-19}$ $= 1.4 \times 10^{21}$	**A1**
6(a)(iii)	$R = V^2 / P$ or $R = V / I$ or $R = P / I^2$ $= 8.0^2 / 36$ or $= 8.0 / 4.5$ or $= 36 / 4.5^2$	**C1**
	$= 1.8\ \Omega$	**A1**

Question	Answer	Marks
6(b)	$R = \rho L / A$	**C1**
	$L = (1.8 \times 0.25 \times 10^{-6}) / 1.4 \times 10^{-6}$ $= 0.32$ m	**A1**
6(c)	(larger cross-sectional area, same length, same resistivity and so) less resistance	**M1**
	(same p.d. and more current so) more power (dissipated)	**A1**
6(d)	current (in wire) is the same	**M1**
	(same p.d. across wire so) power stays the same	**A1**

Question	Answer	Marks
7(a)(i)	(electron) neutrino	**B1**
7(a)(ii)	nucleon number = 22	**A1**
	proton number = 10	**A1**
7(a)(iii)	up up down changes to up down down or up changes to down	**B1**
7(b)(i)	charge = $-\frac{2}{3}e$	**A1**
7(b)(ii)	antiup / anticharm / antitop	**B1**