

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)	$s = ut + \frac{1}{2}at^2$ $s = \frac{1}{2} \times 9.81 \times 0.53^2$	C1
	$h = 1.4$ m	A1

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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)	(displacement) ² = $3.5^2 + 1.4^2$	C1
	displacement = 3.8 m	A1

Question	Answer	Marks
3(a)	$v^2 = u^2 + 2as$ $s = 5.6^2 / (2 \times 9.81)$	C1
	(max height =) $3.1 + 5.6^2 / (2 \times 9.81) = 4.7$ (m)	A1
3(b)	$s = ut + \frac{1}{2}at^2$ $4.7 = \frac{1}{2} \times 9.81 \times t^2$	C1
	$t = 0.98$ s	A1
3(c)	line drawn from a non-zero speed at $t = 0$ to a greater speed at $t = T$	B1
	a single sloping straight line drawn from $t = 0$ to $t = T$	B1
	line starts with a positive non-zero value of v and ends with a negative non-zero value of v	B1
3(d)	acceleration (of the ball)	B1
3(e)(i)	(magnitudes of accelerations are) equal / same	B1
3(e)(ii)	(speeds are) equal / same	B1

Question	Answer	Marks
1(a)	force \times displacement in the direction of the force	B1
1(b)	$P = Fs / t$ $= (\text{kg m s}^{-2} \times \text{m}) / \text{s}$	C1
	$= \text{kg m}^2 \text{s}^{-3}$	A1
1(c)(i)	$84 \times 10^3 = v^3 \times 0.56$	C1
	$v = 53 \text{ m s}^{-1}$	A1
1(c)(ii)	percentage uncertainty = $(5\% + 7\%) / 3 (= 4\%)$ or fractional uncertainty = $(0.05 + 0.07) / 3 (= 0.04)$	C1
	absolute uncertainty = 0.04×53 $= (\pm) 2 \text{ m s}^{-1}$	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)	$f_o = f_s v / (v - v_s)$	C1
	$543 = f \times 334 / (334 - 13)$	
	$f = 522 \text{ Hz}$	A1
5(b)(ii)	(the speed is) decreasing	B1
5(c)(i)	$I \propto A^2$	B1
	$I_T / I_o = \cos^2 20^\circ$ or $A_T / A_o = \cos 20^\circ$	C1
	ratio = 0.94	A1
5(c)(ii)	angle = 140°	A1

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

Question	Answer	Marks
4(a)	$E = \frac{1}{2}mv^2$	C1
	$= \frac{1}{2} \times 0.25 \times 2.3^2$	A1
	$= 0.66 \text{ J}$	
4(b)	$E = \frac{1}{2}kx^2$ or $E = \frac{1}{2}Fx$ and $F = kx$	C1
	$x = [(2 \times 0.66) / 420]^{0.5}$	A1
	$= 0.056 \text{ m}$	
	or	
	$E = \frac{1}{2}kx^2$	(C1)
	$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$	(A1)
	$x = (0.25 \times 2.3^2 / 420)^{0.5}$	
	$= 0.056 \text{ m}$	
4(c)(i)	$(p =) 0.25 \times 2.3$ or 0.25×1.5	C1
	change in momentum = $0.25 (2.3 + 1.5)$ $= 0.95 \text{ N s}$	A1
4(c)(ii)	resultant force = $0.95 / 0.086$ or $0.25 \times (2.3 + 1.5) / 0.086$ $= 11 \text{ N}$	A1
4(d)	curved line from the origin with an increasing gradient	B1

Question	Answer	Marks
2(a)	$F = \rho gV$	C1
	$0.071 = 1.2 \times 9.81 \times V$	
	$(V = 6.03 \times 10^{-3} \text{ m}^3)$ $\frac{4}{3} \times \pi \times r^3 = 6.03 \times 10^{-3}$ $r = 0.11 \text{ m}$	A1
2(b)	$m = 0.053 / 9.81$ $(= 5.4 \times 10^{-3} \text{ kg})$	C1
	$F = 0.071 - 0.053$ $(= 0.018 \text{ N})$	C1
	$a = (0.071 - 0.053) / (0.053 / 9.81)$ $= 3.3 \text{ m s}^{-2}$	A1
2(c)(i)	$v^2 = u^2 + 2as$	C1
	$3.6^2 = (-1.4)^2 + 2 \times 9.81 \times s$ or $3.6^2 = 1.4^2 + 2 \times 9.81 \times s$ $s = 0.56 \text{ m}$	A1
2(c)(ii)	single straight line from any positive non-zero value of v at $t = 0$ to any negative non-zero value of v at $t = T$	B1
	line starting at $(0, 1.4)$ and ending at $(T, -3.6)$	B1