Multiple Choice Answers

Q8: C
Q9: C
Q10: D
Q11: A
Q12: A

1(a)	air temperature: K **and** air pressure: kg m^{-1} s^{-2}
	scalar only ticked for both air temperature and air pressure
1(b)(i)	upthrust $= 1.1 \times 9.81 \times (4\pi \times 0.90^3 / 3)$
	$= 33$ N
1(b)(ii)	(due to difference in height / depth there is a) difference in pressure between top and bottom (of balloon)
	(due to pressure difference, upwards) force on bottom of balloon is greater (than downwards force on top of balloon, so resultant force is upwards)
1(b)(iii)	$(\Sigma)F = 33 - 19$ $(= 14$ N)
	$m = 19 / 9.81$ $(= 1.94$ kg)
	$a = (33 - 19) / (19 / 9.81)$ $= 7.2$ m s^{-2}
1(c)	$5 + 3 + (2 \times 4)$ (= 16%)
	absolute uncertainty in $c = 1.8 \times 0.16$ $= (\pm) 0.3$

2(a)(i)	(normal) force per (unit cross-sectional) area
2(a)(ii)	(due to difference in depth there is a) difference in pressure between top and bottom (of ball)
	(due to pressure difference, upwards) force on bottom of ball is greater (than downwards force on top of ball, so resultant force is upwards)
2(b)(i)	arrow vertically downwards labelled 'weight'
	arrow vertically upwards labelled 'upthrust'
	arrow vertically upwards labelled '(viscous) drag'
2(b)(ii)	SI base units of D: kg m s^{-2}
	base units of η: kg m s^{-2} / (m × m s^{-1}) $=$ kg m^{-1} s^{-1}
2(c)(i)	upthrust $= 920 \times (4 / 3) \times \pi \times (4.2 \times 10^{-3})^3 \times 9.81 = 2.8 \times 10^{-3}$ (N)
2(c)(ii)	weight = drag + upthrust
	$(2.4 \times 10^{-3} \times 9.81) = (2.8 \times 10^{-3}) + (6\pi \times 4.7 \times 4.2 \times 10^{-3} \times v)$
	$v = 0.056$ m s^{-1}

2(a)	product of mass and velocity
2(b)(i)	maximum speed $= 7.2 \times 10^4 / 1800$ $= 40$ m s^{-1}
2(b)(ii)	kinetic energy $= \frac{1}{2} mv^2$
	$= \frac{1}{2} \times 1800 \times 40^2$ $= 1.4 \times 10^6$ J
2(b)(iii)	a = gradient of line / mass **or** $a = (v - u) / t$ **or** $a = \Delta v / t$
	a = e.g. $(3.6 \times 10^4) / (4.0 \times 1800) = 5.0$ m s^{-2} **or** a = e.g. $20 (- 0) / 4 = 5.0$ m s^{-2} **or** F = e.g. $3.6 \times 10^4 / 4.0 = 9.0 \times 10^3$ **and** $a = 9.0 \times 10^3 / 1800 = 5.0$ m s^{-2}
2(b)(iv)	distance $= \frac{1}{2} \times 40 \times (8 + 4)$ **or** distance $= \frac{1}{2} \times 72\,000 \times (8 + 4) / 1800$ **or** distance $= [40^2 / (2 \times 5)] + [40^2 / (2 \times 10)]$ **or** distance $= \frac{1}{2} \times 5 \times 8^2 + (40 \times 4 - \frac{1}{2} \times 10 \times 4^2)$
	distance = 240 m
2(c)	stepped shape, showing one constant value up to 8.0 s then stepping to a different constant value from 8.0 s with no time delay
	horizontal straight line from (0, 5.0) to (8.0, 5.0)
	horizontal straight line from (8.0, –10.0) to (12.0, –10.0)