3. Dynamics

3.2 Non-uniform motion

Paper 2

Marking Scheme

Q1.

(b)	one arrow vertically downward labelled weight to within 10° of the vertical	**B1**
	one arrow vertically upwards labelled drag / drag force / F_D / air resistance / viscous force to within 10° of the vertical	**B1**
(c)	(at terminal velocity) $F_D = mg$	**C1**
	$F_D = 0.049 \times 9.81$ $= 0.48$ N	**A1**
(d)	area = $\pi \times (0.060 / 2)^2$	**C1**
	$0.48 = ½ \times C \times 1.2 \times \pi \times (0.060 / 2)^2 \times 25^2$	**C1**
	$C = 0.45$	**A1**

Q2.

(a)(i)	39 m s^{-1}	**A1**
(c)(i)	drag force decreases (as speed decreases)	**B1**
	(as speed decreases) resultant force decreases so (magnitude of) acceleration decreases (to zero)	**B1**

Q3.

(b)	there is air resistance (which increases with speed)	**B1**
	(average) resultant force is less (than weight)	**B1**
	(average) acceleration is less (than g / 9.81, so speed is less than 100 m s^{-1})	**B1**

Q4.

(b)(ii)	air resistance (acting on sphere) increases	**B1**
	resultant force (on sphere) decreases	**B1**
	(magnitude of) acceleration decreases	**B1**

Q5.

(c)	speed/velocity decreases so viscous force decreases	**B1**
	viscous force decreases (and weight constant) so resultant force decreases	**B1**

Q6.

(c)(ii)	(for the polystyrene ball there is) less (average vertical) acceleration / smaller (average vertical component of) resultant force (so takes longer time to reach ground)	**B1**

Q7.

(c)	(force due to) air resistance increases/changes/not constant **or** air resistance increases with speed	**B1**

Q8.

(e)	air resistance increases	**B1**
	resultant force/acceleration decreases so gradient (of curve) decreases	**B1**

Q9.

(c)(i)	downward pointing arrow labelled weight	**B1**
	upward pointing arrow labelled air resistance	**B1**
(c)(ii)	air resistance increases	**B1**
	weight constant **or** resultant force decreases	**B1**
	(so) acceleration decreases	**B1**

Q10.

(c)	downward sloping line from (0, *g*) to a non-zero value on the time axis	**M1**
	line is curved with a gradient that becomes less negative **and** the line meets *t*-axis at time $t < T$	**A1**

Q11.

(c)(i)	viscous (force)	**B1**
(c)(ii)	viscous force increases (with speed/time/depth)	**B1**
	(so) acceleration decreases	**B1**

Q12.

(c)(iii)	resultant force on ball is less (than that with air resistance) so time (taken) is more (than *T*)	**B1**

Q13.

(d)(ii)	air resistance/drag/viscous (force)	**B1**

Q14.

(b)(i)	weight $\gg$ (force due to) air resistance **or** (force due to) air resistance is negligible compared to weight	**B1**
(c)	(average) resultant force/acceleration/speed/velocity (of low-density ball) is less	**B1**
	(so) time interval is longer	**B1**

Q15.

(a)(i)	(vertically) upwards/up	**B1**
(a)(ii)	increases (with time/velocity/depth)	**B1**

Q16.

(e)	(force due to) air resistance acts in opposite direction to the velocity **or** (with air resistance, average) resultant force is larger (than weight)	**B1**