Mark Scheme Terminal Velocity Past Paper Questions

Jan 2002 to Jan 2009

5(a) decreases for the first four seconds ✓
zero for the remaining six seconds ✓ (2)

Q5 Jan 2002

(b) $E_k = ½ \times 1.4 \times 10^3 \times 16^2$ ✓
$= 1.8 \times 10^5$ J ✓
(accept $v = 15$ m s^{-1} from misleading graph and $E_k = 1.6 \times 10^5$ J) (2)

(c) (use of $P = Fv$ gives) $20 \times 10^3 = F \times 30$ ✓
$F = 670$ N ✓ (2)
(6)

7(a) ball bearing accelerates at first as resultant force is downwards ✓
resistive force increases with speed ✓
when resultant force on ball is zero, terminal velocity reached ✓ (3)

Q7 Jan 2002

(b) show ball bearing takes same time ✓
to travel equal distances ✓
[or measure velocity at different points ✓with appropriate method ✓] (2)
(5)

6(a)(i) 70 m s^{-1} ✓

Q6 Jan 2003

(a)(ii) $v = 9.81 \times 2.0$ ✓
$= 20$ m s^{-1} ✓ (19.6 m s^{-1})

(a)(iii) $v = \sqrt{(70^2 + 19.62^2)} = 73$ m s^{-1} ✓
direction: $\tan \theta = \dfrac{19.6}{70} = 0.28$
$\theta = 15.6^\circ$ ✓ ($\pm 0.1^\circ$) (to horizontal) ✓
(allow C.E. for values of v from (i) and (ii))
[or use of correct scale drawing] (5)

(b)(i) air resistance is greater than weight ✓
(hence) resultant force is upwards ✓
hence deceleration (Newton's second law) ✓

(b)(ii) air resistance decreases as speed decreases ✓
weight equals air resistance (hence constant speed)
(hence) resultant force is zero (Newton's first law) ✓ max (4)
(9)

3 **Q3 Jun 2003**

(i) weight greater than air resistance
[or (initially only) weight/gravity acting] ✓
hence resultant force downwards or <u>therefore</u> acceleration (2nd law) ✓
air resistance or upward force increases with speed ✓
until air resistance equals weight or resultant force is zero ✓
leaf moves at constant velocity (1st law)
[or 1st law applied correctly] ✓

(ii) air resistance depends on shape
[or other correct statement about air resistance] ✓
air resistance less significant ✓
air resistance less, therefore greater velocity
[or average velocity greater
or accelerates for longer] ✓

max (5)
(5)

Question 3			
(a)		weight/gravity causes raindrop to accelerate/move faster (initially) ✓ resistive forces/friction **increase(s)** with **speed** ✓ resistive force (eventually) equals weight ✓ **Q3 Jun 2005** [or upward forces equal downward forces] resultant force is now zero ✓ [or forces balance or in equilibrium] no more acceleration ✓ [or correct application of Newton's Laws] [if Newton's third law used, then may only score first two marks]	**Max 4**
(b)	(i)	E_k (= ½ mv^2) = ½ × 7.2 × 10^{-9} × 1.8^2 ✓ = 1.2 × 10^{-8} J ✓ (1.17 × 10^{-8} J)	**4**
	(ii)	work done (= mgh) = 7.2 × 10^{-9} × 9.81 × 4.5 ✓ = 3.2 × 10^{-7} J ✓ (3.18 × 10^{-7} J)	
(c)		$v_{resultant}$ = √(1.8^2 + 1.4^2) ✓ = 2.2(8) m s^{-1} ✓ θ = $\tan^{-1}$ (1.4/1.8) = 38° ✓ (37.9°) [or correct scale diagram]	**3**