

- M1.** (i) weight greater than air resistance  
 [or (initially only) weight/gravity acting] (1)  
 hence resultant force downwards or therefore acceleration (2nd law) (1)  
 air resistance or upward force increases with speed (1)  
 until air resistance equals weight or resultant force is zero (1)  
 leaf moves at constant velocity (1st law)  
 [or 1st law applied correctly] (1)
- (ii) air resistance depends on shape  
 [or other correct statement about air resistance] (1)  
 air resistance less significant (1)  
 air resistance less, therefore greater velocity  
 [or average velocity greater or accelerates for longer] (1)

max 5  
 QWC 2

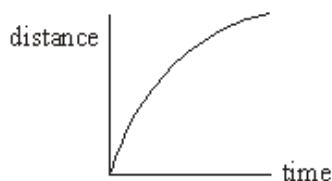
[5]

- M2.** (a) (i) (use of  $a = \frac{\Delta v}{\Delta t}$  gives)  $a = \frac{4.5}{3600}$  (1)  
 $= 1.25 \times 10^{-3} \text{ ms}^{-2}$  (1)
- (ii) (use of  $v^2 = u^2 + 2as$  gives)  $0 = 4.5^2 - 2 \times 1.25 \times 10^{-3} \times s$  (1)

$$s \left( = \frac{20.25}{2.5 \times 10^{-3}} \right) = 8.1 \times 10^3 \text{ m} \quad (1)$$

4

- (b) increasing curve (1)  
 correct curve (1)



1

- (c) gradient (slope) of graph represents speed (1)  
 hence graph has decreasing gradient (1)

2

[8]

**M3.** (a) (i)  $\left(\alpha = \frac{F}{m}\right) = \frac{(-)30(000)}{15100}$  **(1)** = (-)2.0 (= 1.99 m s<sup>-2</sup>) **(1)**

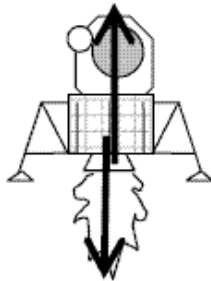
2

(ii)  $(v = u + at) t = \frac{v-u}{a}$  or substitution **(1)**

=  $\left(\frac{150 - 2040}{-1.99}\right) = 950$  (s) **(1)** ecf from (i)

2

(b) (i)



opposing vertical arrows of roughly equal length **or** labelled weight/mg/gravity/W **and** thrust/reaction/R/F/TF/engine force/rocket force/motor force/motive force/driving force **(1)**

correctly labelled

+ arrows vertical

+ not more than 2 mm apart

+ roughly central

+ weight arrow originates within rectangular section and thrust originates within rectangular section or on jet outlet **(1)**

2

(ii) new mass = 15100 × 0.47 = 7097 (kg) **(1)**

(F = mg = 7097 × 16(1)) = 11000 (= 11426 N) **(1)**

2

(c)  $(v^2 = u^2 + 2as) v = \sqrt{0.80^2 + 2 \times 1.61 \times 1.2}$  correct  $u$ ,  $a$  and  $s$  clearly identified **(1)**

= 2.1 (= 2.122 m s<sup>-1</sup>) **(1)**

2

[10]

**M4.** (a) scales **(1)**

six points correctly plotted **(1)**

trendline **(1)**

3

- (b) average acceleration =  $\frac{26}{25}$  (1)  
 = 1.0(4) ms<sup>-2</sup> (1)  
 (allow C.E. for incorrect values used in acceleration calculation) 2
- (c) area under graph (1)  
 = 510 ± 30 m (1) 2
- (d) (graph to show force starting from y-axis)  
 decreasing (not a straight line) (1)  
 to zero (at end of graph) (1) 2
- (e) (since) gradient of a velocity-time graph gives acceleration (1)  
 first graph shows acceleration is decreasing (1) 2

[11]

- M5.** (a) any **two** from  
 freefall is too quick (any indication of slower motion) (1)  
 (Galileo had) no (accurate) method to **time** freefall (or valid  
 comment regarding timing of freefall or inclined plane) (1)  
 correct reference to **air** resistance or **drag** (not 'wind') (1) max 2
- (b) (i)  $0.20 \times 9.81 = 1.962$  (N) (1)  
 (1.962 sin 1.8 =) 0.0616 or 0.062 seen (1) (allow 0.061)  
 (0.0628 for use of g = 10 gets 1 mark) 2

(ii)  $0.06(16)/0.20$

**or** use of  $a = F/m$  with a clearly identified force but not the weight

**or**  $g \sin\theta = g \sin 1.8^\circ$  **(1)**

$0.31 \text{ (m s}^{-2}\text{)} \text{ (1) (0.308)}$

*accept 0.3 or 0.30 correct answer only for second mark*

**or**  $(a = 2s/l^2)$

$= 2 \times 0.29/1.4^2 \text{ (1)} = 0.31 \text{ (1)}$  or use of other values from table

2

- (c) accelerating
- (1)**
- (accept increasing speed, etc but not increasing acceleration/quicker motion, etc)

greater distance for each additional swing ('per unit time' must be implied)  
or gradient/ steepness/ slope increasing **(1)** (accept curves upwards)

2

- (d)
- tangent used:**

tangent drawn at  $3.0 \text{ m} \pm 0.3$  on graph **(1)**their time from graph  $\times 1.4$  **(1)**

$= 1.28 \text{ to } 1.44 \text{ (m s}^{-1}\text{)} \text{ (1)}$

**or suvat used:**

use of  $v = \frac{2s}{t}$  or  $v = (u) + at$  with  $a$  from (b) (ii) **(1)**

(t =)  $4.4 \text{ to } 4.5 \text{ (s)} \text{ (1)}$

(speed =)  $1.3 \text{ to } 1.4 \text{ (m s}^{-1}\text{)} \text{ (1)}$

3

**[11]**

- M6.**
- (a) scales
- (1)(1)**
- (one mark for each scale)

six points correctly plotted **(1)(1)**  
(ignore 0,0 and lose one mark for each error)trend line **(1)** (if misses more than two points then lose mark)

5

- (b) average acceleration =  $26/25$  **(1)**  
=  $1.0(4) \text{ m s}^{-2}$  **(1)** e.c.f. from correct values used 2
- (c) area under graph **(1)** =  $510 \pm 30\text{m}$  **(1)** 2
- (d) curve decreasing **(1)**  
to zero at end of graph **(1)** and starting from vertical axis within 1mm **(1)** 3
- (e) (since) gradient of a velocity-time graph gives acceleration **(1)**  
(first graph shows) acceleration is decreasing **(1)**  
**or** resistive force increases (with speed) **(1)**  
so resultant force (or acceleration) decreases **(1)** 2

[14]