1. Motion of a ball

(a) the maximum height reached by the ball / the displacement in the first2s / the distance travelled; 1

(b) 30 m; 1

Accept answers in the range.25mto30m

(c) (i) drawing tangent at $t = 1.0$s;

using a sufficiently large triangle □ at least 6 cm hypotenuse;

to get $a = 15 ms^{-2}$; 3

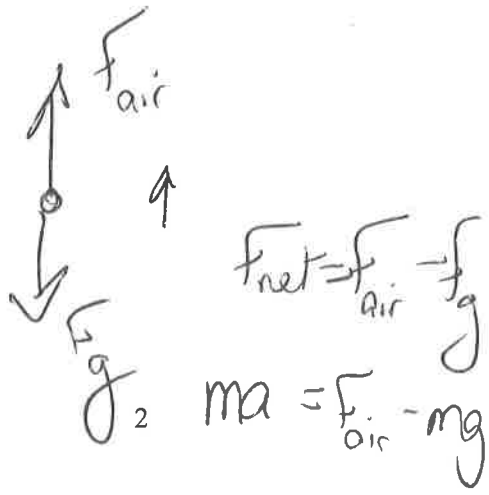
(ii) $R + mg = ma$;

$R = 3.75 - 2.50 = 1.2N$;2

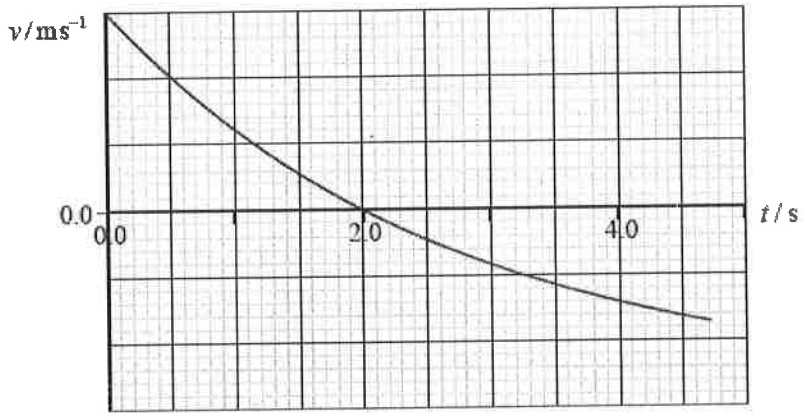
(Watch ecf from (i))

(d) slope of the graph is decreasing;

the force of air resistance must decrease as well; 2



(e)



smooth curve at $t = 2.0$ s;

terminating between 4.25 s and 4.50 s; 2

(Award second marking point only if first is correct)

(f) it will be less;

because mechanical energy / kinetic energy is being transformed into thermal energy (in the particle and air); 2

*Award **[0]** for an answer without justification.*

(g) the areas under the graph for the upward and downward motion must be the same;

from the way the curve slopes it follows that the time must be longer than 2.0s; 2

or

the average speed on the way down is less;

and so the time taken is longer;

[15]

2. (a) (i) horizontal: 24 ms^{-1}; 1

(ii) vertical: 14 ms^{-1}; 1

(b) appropriate use of kinematic equation;

correct substitution;

h = 7.1m; 3

[5]

3. (a) parabola similar to that shown in graph;

starting at (0,0) and ending at $h = 0$; 2

(b) $V_y = 200 \sin\theta$; 1

Accept $u\sin\theta$ and $200\sin\theta - gt$.

(c) time to reach maximum height = 10s;

$200 \sin\theta = gt$;

$200 \sin\theta = 100$;

to give $\theta = 30°$

or

time of flight = 20s;

$200 \sin\theta \times t = \frac{1}{2} gt^2$;

$200 \sin\theta = 100$;

to give $\theta = 30°$

or

measurement of gradient at $t = 0$;

$= 100\ ms^{-1}$;

$= 200 \sin\theta$;

to give $\theta = 30°$ 3

[6]

4. (a) (i) $v_x = \frac{40}{5.0} = 8.0\ m\ s^{-1}$ 1

Accept use of other values leading to the same answer.

(ii) $v_y = 0 = u_{0y} - 10 \times 2.5$;

$u_{0y} = 25\ m\ s^{-1}$; 2

Accept use of other values leading to the same answer.

(iii) the x and y components of displacement at 3.0 s are 24 m, 30 m;

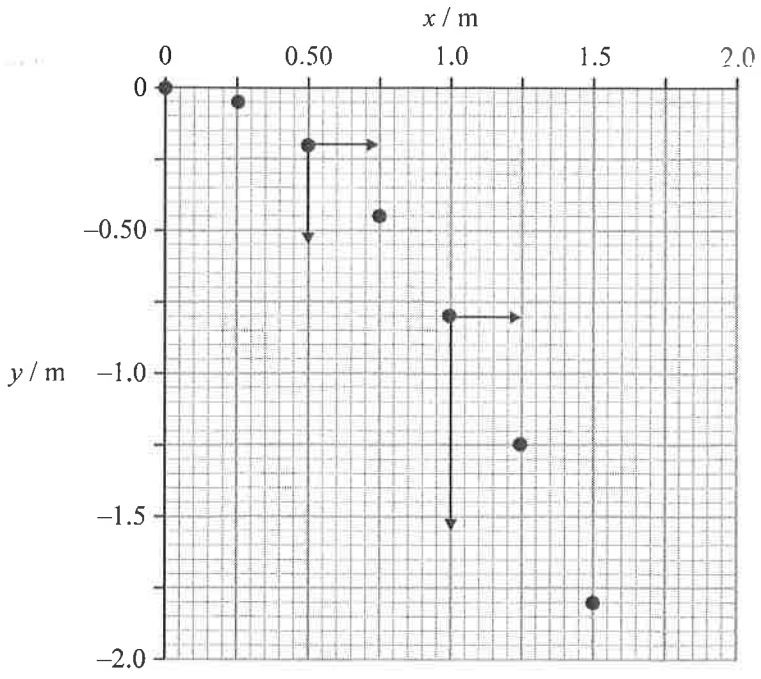
so the magnitude is $\sqrt{24^2 + 30^2} = 38$ m 2

(b) maximum height reached is less;

asymmetric with shorter range; 2

[7]

5. (a)



Mark both together.

V_H : horizontal arrows equal in length;

V_V : two vertical arrows, the one at 1.0 m noticeably longer than the one at 0.5 m; 2

*If arrows correct but wrong point(s) award **[1]**.*

(b) curve that goes through all data points;
stops at $y = 1.8$m as this is the height of the wall;
from graph $d = 1.5(\pm 0.1)$m; 3

(c) travels vertically 1.8m in 0.6s / 1.25m in 0.5s;

$g = \frac{2s}{t^2}$;

to give $g = 10\ (\pm 1)\ \text{m s}^{-2}$; 3

*Award **[2 max]** for any time shorter than 0.5 s.*

[8]