

- 1 **(a)** (density =) mass / volume
- (b)** water used in measuring / graduated cylinder B1
- volume of water known or read / recorded / taken
- place the coins in the water and read / record / take new level of water in cylinder B1
- subtract readings B1
- OR ALTERNATIVE METHOD:
- pour water into displacement can to level of spout (B1)
- place the coins / several coins in the water (B1)
- collect overflow (B1)
- measure volume of overflow water using measuring graduated cylinder (B1)
- measure mass / weigh the coins used with balance / spring balance B1
- (c)** one from:
- read measuring cylinder levels at bottom of meniscus
- repeat volume measurement and find average
- place eye level with surface in measuring cylinder (to avoid parallax error)
- place coins one at a time to avoid air bubbles between coins
- avoid splashing when adding coins to water
- make sure coins are dry / clean
- use narrow / small measuring cylinder
- place containers on horizontal surface
- check zero of balance / spring balance / scales
- displacement can method: make sure dripping finishes before and after adding coins B1

[Total: 7]

- 2 (a) (density =) mass/volume OR mass per unit volume
OR m/V with symbols explained B1
- (b) (vol =) mass/density OR $60.7/2.70$
= 22.48 cm^3 to 2 or more sig. figs C1
A1
- (ii) $V = A \times$ (average) thickness OR thickness = V/A
OR $22.48 / (50 \times 30)$ C1
 0.01499 cm to 2 or more sig. figs. e.c.f. (b)(i) A1
- (c) micrometer/screw gauge / (vernier/digital) callipers B1
- (ii) check zero of device used / cut sheet into several pieces / detail of how to use
device / fold sheet B1
- measure thickness of sheet in different places
OR measure thickness of several pieces together B1
calculate/obtain average thickness OR divide answer by number of measurements/
pieces/places B1
- [Total 9]**
- 3 (a) all points correctly plotted $\pm 1/2$ small square B1
straight line of best fit for candidate's points B1
- (b) candidate's correct value with unit (± 0.2), (expect 1.2 N)
- (ii) remains stationary / nothing happens / no acceleration NOT constant speed B1
- (c) Correct data from candidates graph for ΔF and Δm , used in $\Delta F/\Delta m$ B
- (d) $F = ma$ in any form, letters, words B1
- (ii) gradient = F/a OR gradient = m ignore $m=F/a$ C1
candidate's (c) with correct unit A1
- (e) straight line of positive gradient B1 [9]

4	<p>(a) $\Delta h = 0.068 \text{ m}$ <u>use of mgh</u> 0.054 J/Nm</p>	C1 C1 A1	[3]
	<p>(b) $\frac{1}{2}mv^2 = \text{candidate's (a)}$ 1.2 m/s ecf from (a)</p>	C1 A1	[2]
	<p>(c) (i) <u>use of distance</u> \div time $= 1.1 \text{ m/s}$</p>	C1 A1	
	<p>(ii) air or wind resistance / friction / heat / thermal energy OR correct mention of experimental error e.g. width of cylinder</p>	B1	[3]
5	<p>(a) (i) downward <u>curve</u> initially horizontal at top <u>and</u> not vertical at bottom</p> <p>(ii) force shown vertically down (accept leaning back a <u>small</u> amount)</p>	B1 B1 B1	
	<p>(b) any two from: same (times) / air resistance negligible / same acceleration OR times different one has (more) air resistance</p>	B2 B1 B1	
	<p>(c) (time =) $800/320$ 2.5 (s) $(v =) at$ OR $10 \times \text{candidate's } t \text{ value}$ 25 m/s</p>	C1 C1 C1 A1	[9]

- 6 (a) decreases / braking / decelerating)
constant / steady / nothing) all 3 B1
increases / accelerate)
- (b) speed x time in any form, symbols, numbers or words C1
OR any area under graph used or stated C1
13 (m/s) OR 24 (s) seen or used in correct context A1
312 m
- (c) rate of change of speed OR gradient of graph OR 18/12 C1
18 (m/s) OR 12 (s) seen or used in correct context C1
1.5 m/s² A1
- (d) same gradient / slope OR equal speed changes in equal times OR B1 [8]
allow graph symmetrical
- 7 (a) (i) $(v - u)/t$ OR v/t OR 8/3 C1
2.7 m/s² A1
- (ii) ma OR 42 × answer from (i) OR 42 × 8/3 C1
110/112 N e.c.f. A1
- (iii) (distance in 1st 3 secs =) 12 m OR (dist in last 3 secs =) 88 m C1
use of area of trapezium OR area of “top” triangle C1
7.7 m/s A1
- (b) longer time to top speed)
longer total time)
lower top speed)
lower finishing speed) any 2 B1+B1
specific/all speeds lower (**not** speed decreases))
less slope/less acceleration (in first section))
greater slope/greater deceleration in 2nd section)

[Total: 9]

- B a(i) outline, ruler pivoted (at centre), mass one side, rock other side C1
quality set-up, each mass at (marked) point + labels 2 A1
(ii) ~~rod must be balanced before readings can be taken or record mass as 100 g~~ B1
distances to pivot from rock ~~at mass B1 distance pivot to mass B1~~ B2
mass or 100 x distance to pivot = mass of rock x distance rock to pivot 3 B1 5
- b put water in cylinder, read value B1
insert rock until covered, read value B1
difference in values is volume of rock 2 B1 M2*
- c density = mass/volume or 88/24 C1
= 3.7 g/cm³* (accept 3 2/3 g/cm³) 2 A1 2
QT 9

(accept 3.6)