

- M1.** (a) the distance travelled under the braking force 1
- (b) the reaction time will increase 1
- increasing the thinking distance (and so increasing stopping distance)
(increases stopping distance is insufficient) 1
- (c) No, because although when the speed increases the thinking distance increases by the same factor the braking distance does not. 1
- eg
- increasing from 10 m / s to 20 m / s increases thinking distance from 6 m to 12 m
 but the braking distance increases from 6 m to 24 m 1
- (d) If the sled accelerates the value for the constant of friction will be wrong. 1
- (e) only a (the horizontal) component of the force would be pulling the sled forward 1
- the vertical component of the force (effectively) lifts the sled reducing the force of the surface on the sled 1
- (f) $-u^2 = 2 \times -7.2 \times 22$
award this mark even with 0^2 and / or the negative sign missing

1

$$u = 17.7(99)$$

1

18

1

allow 18 with no working shown for 3 marks

allow 17.7(99) then incorrectly rounded to 17 for 2 marks

[11]

M2. (a) 4 (m/s)

1 mark for correct transformation of either equation
1 mark for correct substitution with or without transformation
1 mark for correct use of 0.6N
max score of 2 if answer is incorrect

3

(b) **greater** change in momentum

or greater mass of air (each second)

or increase in velocity of air

accept speed for velocity

force upwards increased

lift force is increased

do not accept upthrust

1

or force up greater than force down

accept weight for force down

1

(c) • increase the time **to stop**

1

• decrease rate of change in momentum or same momentum change

accept reduced deceleration/ acceleration

1

• reducing the force on the toy

do not accept answers in terms of the impact/ force being absorbed

do not accept answers in terms of energy transfer

do not credit impact is reduced

1

[8]

M3. (a) *idea that* balanced by friction force* / pushing force equals friction force (*note "balanced" by unspecified force)
or
specification of relevant force but no reference to balancing in both 1(a) and 1(b) gains 1 mark overall
for 1 mark

1

(b) balanced by upwards force of table*
for 1 mark

1

(c) makes it (slightly) warm / hot
or
wears it away (slightly) / damages surface
for 1 mark

1

[3]

- M4.** (a) (i) a single force that has the same effect as all the forces combined
accept all the forces added / the sum of the forces / overall force 1
- (ii) constant speed (in a straight line)
do not accept stationary
 or constant velocity 1
- (b) 3
allow 1 mark for correct substitution into transformed equation
accept answer 0.003 gains 1 mark
answer = 0.75 gains 1 mark 2
- m/s² 1
- (c) as speed increases air resistance increases
accept drag / friction for air resistance 1
- reducing the resultant force 1

[7]

M5. (a) the forces are equal in size and act in opposite directions 1

(b) (i) forwards / to the right / in the direction of the 300 N force
answers in either order 1

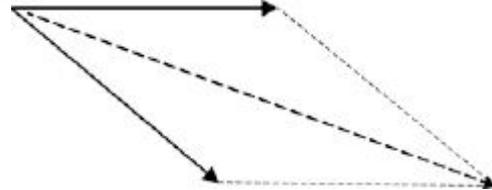
accelerating 1

(ii) constant velocity to the right 1

(iii) resultant force is zero
accept forces are equal / balanced 1

so boat continues in the same direction at the same speed 1

(iv) parallelogram or triangle is correctly drawn with resultant 3



value of resultant in the range 545 N – 595 N
parallelogram drawn without resultant gains 1 mark
If no triangle or parallelogram drawn:
*drawn resultant line is **between** the two 300 N forces gains 1 mark*
drawn resultant line is between and longer than the two 300 N forces gains 2 marks 1

[10]

M6. (a) more streamlined
accept decrease surface area 1

air resistance is smaller (for same speed)
accept drag for air resistance
friction is insufficient 1

so reaches a higher speed (before resultant force is 0)
ignore reference to mass 1

(b) (i) 1.7
allow 1 mark for correct method, ie $\frac{5}{3}$
or allow 1 mark for an answer with more than 2 sig figs that rounds to 1.7
or allow 1 mark for an answer of 17 2

(ii) 7.5
allow 1 mark for correct use of graph, eg $\frac{1}{2} \times 5 \times 3$ 2

(iii) air (resistance)
accept wind (resistance)
drag is insufficient
friction is insufficient 1

[8]