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/s^2

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

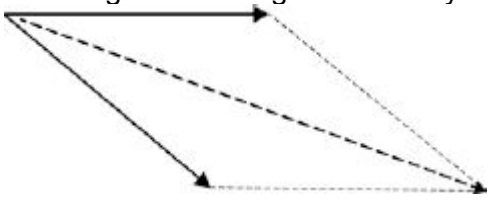
accept forces are equal / balanced

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]