M1. (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]

M2. (a) there is a (maximum) forward force
drag/friction/resistance (**opposes** motion) (**not** pressure)
increases with speed
till forward and backward forces equal
so no net force/acceleration

any 4 for 1 mark each

4

(b) (i) F = ma
10 000 = 1250a
a = 8
m/s^2

for 1 mark each

4

(ii) ke = 1/2 mv^2
ke = 1/2 1250.48^2
ke = 1 440 000
J

for 1 mark each

4

(iii) W = Fd
W = 10 000.144
W = 1 440 000
J

for 1 mark each

4

[16]

M3. 12 100

correct answer with no working = 3
if answer incorrect, allow 1 mark for force = mass ×
acceleration
1210 × 10 = 2 force / weight = mass × gravity is neutral

N.B. no marks for correct answers with incorrectly recalled
relationship

[3]

M4. (i) force = mass $\times$ acceleration

accept F = m $\times$ a
*accept upper **or** lower case letters*
accept equation using correct units
accept

if subsequent method correct

1

(ii) 0.007

*allow **1** mark for correct transformation or substitution*

2

[3]

M5. (a) (i) gravity/weight

1

(ii) 2193750000000 or 2.19×10^{12}

not 2.19^{12}
allow 1 mark for the correct conversion to 7500 (m/s)
allow one mark for answer 2193750(J)

2

transferred to heat
ignore extras of sound and light
accept changed to heat
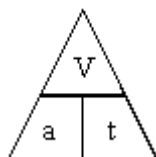*accept lost due to friction*

1

(b) (i) acceleration = $\dfrac{\text{change in velocity}}{\text{time (taken)}}$
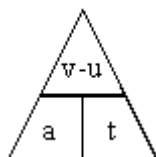
accept word speed instead of velocity

accept a = $\dfrac{v - u}{t}$

or correct rearrangement
do not accept

even if subsequent calculation correct

can gain credit if subsequent calculation correct

1

Page 5

(ii) 2

ignore + or – signs

m/s^2 1

accept m/s/s or ms^{-2}

2
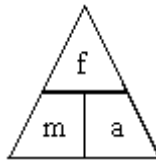
(c) (i) force = mass × acceleration

accept correct rearrangement

accept F = m × a

do not accept

unless subsequent calculation correct

1

(ii) 156 000

accept 78 000 × their (b)(ii)(only if (b)(i) correct)

1

[9]

M6. (a) 98

> *allow **1** mark for correct substitution*
> *ie ½ × 0.16 × 35 × 35 provided no subsequent step shown*
> *an answer of 98 000 scores 0*

2

(b) (i) 9.6

> *allow **1** mark for (change in velocity =) 60*
> *ignore negative sign*

2

(ii) 9600

> *ignore negative sign*
> **or** *their (b)(i) ÷ 0.001 correctly calculated, unless (b) (i) equals 0*

1

(c) increases the time

1

to reduce/change <u>momentum</u> (to zero)

> *only scores if 1ˢᵗ mark scored*
> *decreases rate of change of momentum scores both marks provided there are no contradictions*
> *accept decreased acceleration/deceleration*
> *equations on their own are insufficient*

1

[7]

M7. (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]