

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

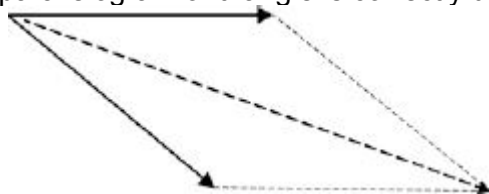
(iii) resultant force is zero
accept forces are equal / balanced

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) $ke = \frac{1}{2} mv^2$
 $ke = \frac{1}{2} 1250.48^2$
 $ke = 1\,440\,000$
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 × 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

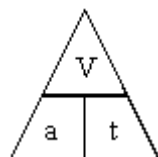
(b) (i) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

accept word speed instead of velocity

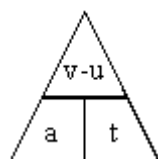
accept $a = \frac{v - u}{t}$

or *correct rearrangement*

do not accept



even if subsequent calculation correct



can gain credit if subsequent calculation correct

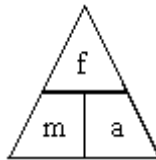
1

(ii) 2
ignore + or – signs

m/s² 1
accept m/s/s or ms⁻²

2

(c) (i) force = mass × acceleration
accept correct rearrangement
accept $F = m \times a$
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 $\frac{1}{2} \times 0.16 \times 35 \times 35$ 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) $\div 0.001$ correctly calculated, unless (b) (i) equals 0*

1

(c) increases the time

1

to reduce/change momentum (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]