Questions 5 and 6 refer to the information below.

Two groups of students were asked to perform an experiment to determine the acceleration of free-fall. Each group repeated their experiment three times to check their results. In each experiment a steel ball fell through a height of just under 1 m and the time for the ball to fall was measured.

- **Group 1** used a stopwatch to measure the time.
- **Group 2** used light gates connected to a data logger to measure the time.

5 The students measured the height the ball fell using a metre rule.

The height should be recorded as

- ☒ **A** 85 cm
- ☒ **B** 0.85 m
- ☒ **C** 0.850 m
- ☒ **D** 8.5×10^{-1} m

(Total for Question 5 = 1 mark)

8 A ball is thrown vertically upwards with a velocity of $+3.0\,m\,s^{-1}$.

Which of the following is the acceleration of the ball at its maximum height?

- **A** $0\,m\,s^{-2}$
- **B** $-3.0\,m\,s^{-2}$
- **C** $+9.8\,m\,s^{-2}$
- **D** $-9.8\,m\,s^{-2}$

(Total for Question 8 = 1 mark)

3 Which of the following is **always** true of the forces in a Newton's third law pair?

- ☒ **A** The forces act on the same object.
- ☒ **B** The forces act in the same direction.
- ☒ **C** The forces cause acceleration.
- ☒ **D** The forces have the same magnitude.

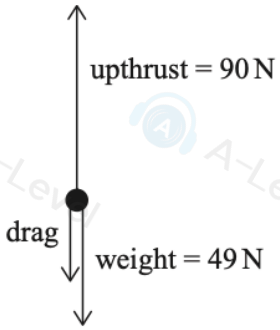
(Total for Question 3 = 1 mark)

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9 A free-body force diagram for an object moving through a fluid is shown.



Not to scale

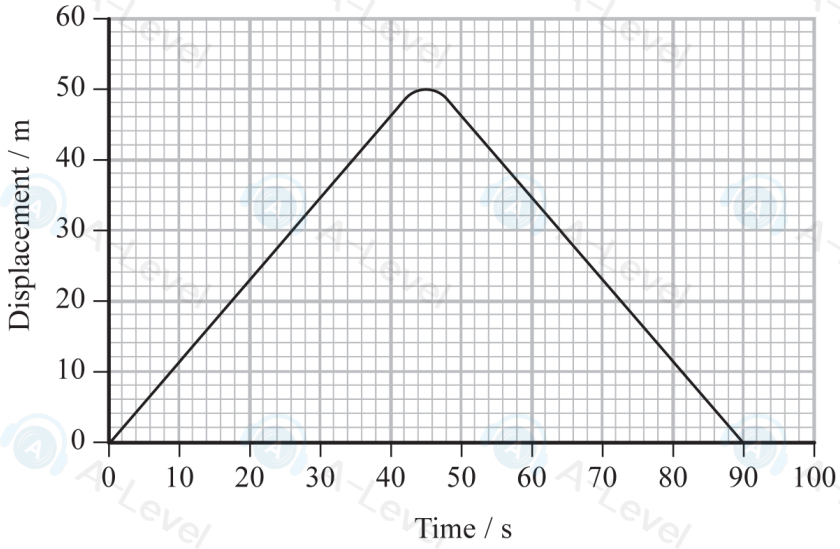
The mass of the object is 5 kg.
The object is accelerating upwards at $4\,m\,s^{-2}$.

Which of the following gives the magnitude of the drag force in newtons?

- ☒ **A** 5×4
- ☒ **B** $90 - 49$
- ☒ **C** $90 - 49 - (5 \times 4)$
- ☒ **D** $90 - 49 + (5 \times 4)$

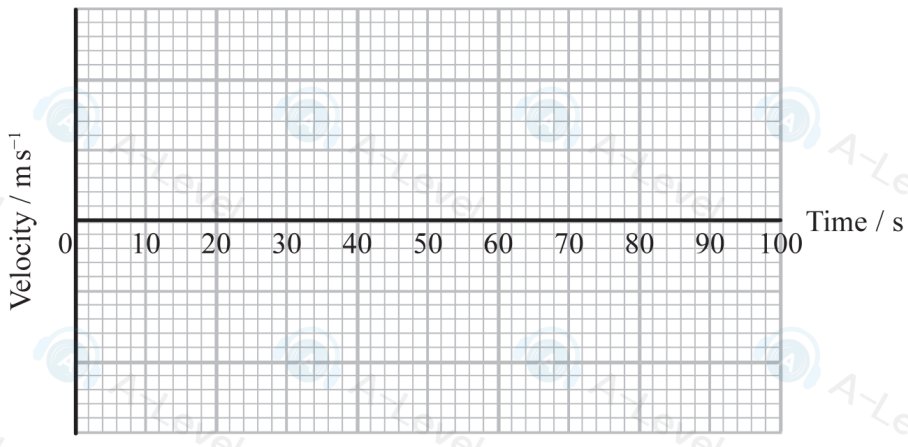
(Total for Question 9 = 1 mark)

13 A swimmer swims a 100 m race. A simplified displacement-time graph for the swimmer is shown.



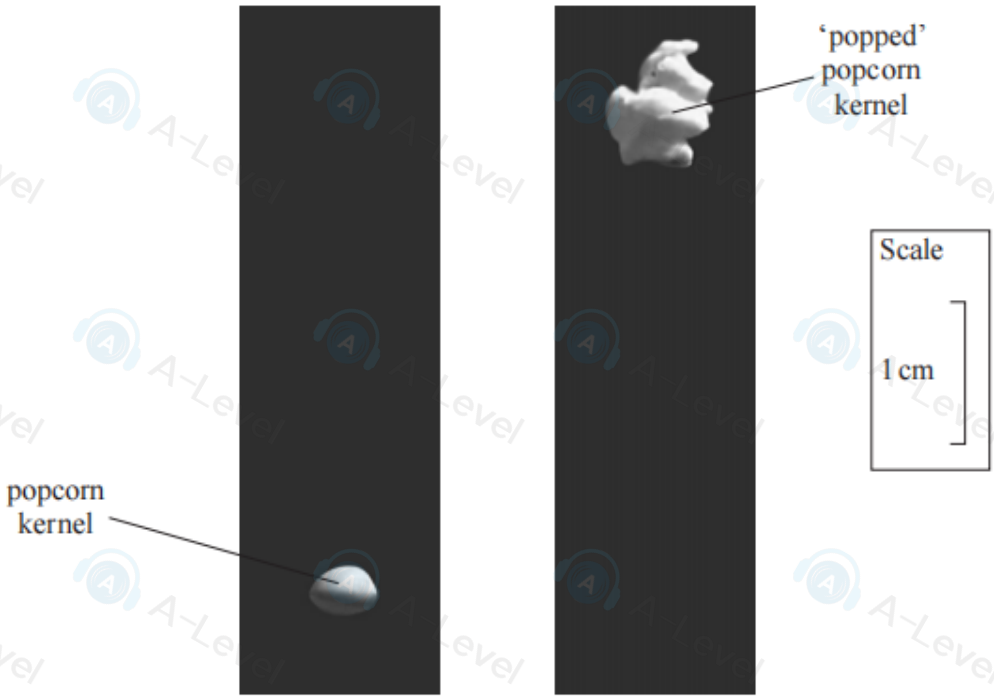
(a) Draw a corresponding velocity-time graph for the motion of the swimmer on the axes below. Show all working in the space below.

(4)



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16 Popcorn kernels contain water. When heated, the water turns to steam. The kernel 'pops' and moves upwards.



(a) The photographs above show a popcorn kernel just before popping and at the maximum height after popping. The time between the two photographs was 83 ms.

(i) Determine the maximum height after popping.

(2)

.....

.....

Maximum height = ...

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(ii) Calculate the initial speed of the 'popped' popcorn kernel.

(3)

Initial speed = ...

(b) The average water content in a popcorn kernel is 14% of the total mass of the kernel.

A kernel is heated until it pops. Steam is ejected downwards, and the popped kernel moves upwards with an initial speed of $1.5\,m\,s^{-1}$.

Calculate the speed at which the steam is ejected.

total mass of unpopped kernel = 0.11 g

(4)

Speed = ...

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