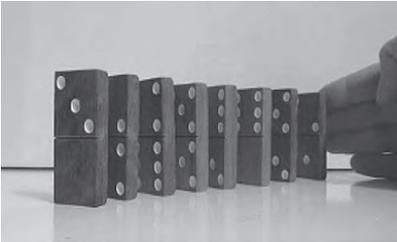


1 A teacher sets up two experiments for her students to complete.

The outcome of each experiment can be explained using Newton's laws.

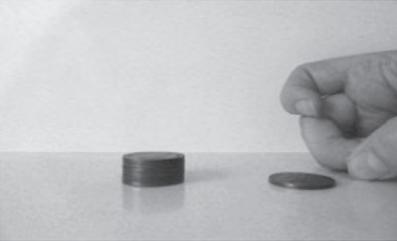
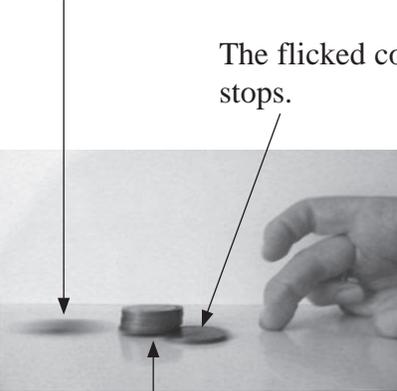
(a) Use Newton's first law of motion to explain the behaviour of the dominoes in experiment 1.

(2)

<b>Experiment 1</b>	<b>Explanation</b>
<p data-bbox="302 404 537 435"><b>Falling dominoes</b></p> <p data-bbox="152 457 589 529">The first domino is given a gentle push.</p>  <p data-bbox="334 870 505 901"><b>Observation</b></p> <p data-bbox="152 923 651 995">The domino falls, knocking the next domino; one by one the dominoes fall.</p> 	

\*(b) Apply Newton's laws of motion to explain the three observations in experiment 2.

(6)

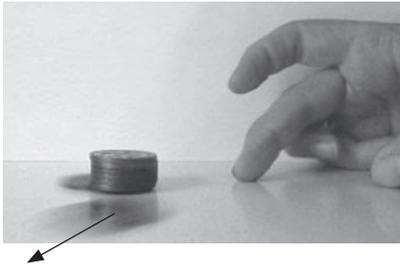
<b>Experiment 2</b>	<b>Explanation</b>
<p data-bbox="321 271 513 302"><b>Stacked coins</b></p> <p data-bbox="152 329 610 396">A coin is flicked towards a stack of coins.</p>  <p data-bbox="326 778 508 809"><b>Observations</b></p> <p data-bbox="152 835 634 903">The bottom coin is knocked out from under the stack.</p>  <p data-bbox="440 962 654 1030">The flicked coin stops.</p> <p data-bbox="224 1467 513 1498">The stack drops down.</p>	

- (c) Whilst carrying out the stacked coins experiment, the student sometimes observed that the flicked coin did not stop but changed its direction of travel.

Suggest a reason for this observation.

(2)

**Observation**



The coin that was flicked changes its direction.

**Reason**

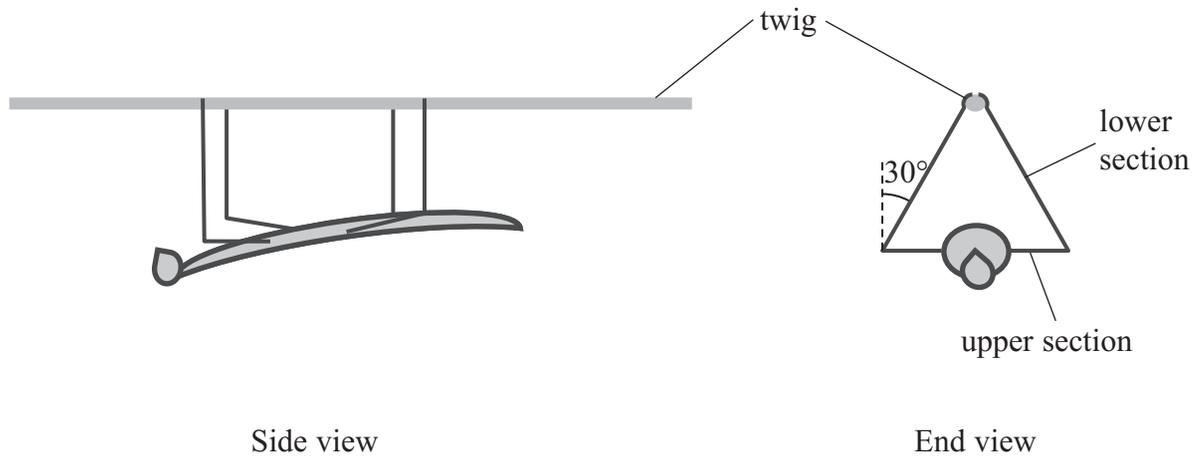
**(Total for Question = 10 marks)**

- 2 The photograph shows a praying mantis hanging from a thin twig. Four of the praying mantis's six legs are in contact with the twig. The tension in the legs balances the weight to keep the praying mantis stationary.



© Robert Clamp

- (a) The diagrams show a simplified model of the situation. For each leg in contact with the twig, the upper section is horizontal and the lower section is at an angle of  $30^\circ$  to the vertical.



- (i) Calculate the tension in the lower section of each leg in contact with the twig assuming that these tensions are all equal.

mass of praying mantis  $5.4 \times 10^{-4}$  kg

(4)

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Tension .....

(ii) A student suggests that the tension in each leg in contact with the twig is 25% of the weight of the praying mantis. State why this is **not** correct.

(1)

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(b) The praying mantis moves around the twig so that it is now standing upright and on top of the twig.

State the difference between the stress in the legs when the praying mantis is beneath the twig and when it is on top of the twig.

(1)

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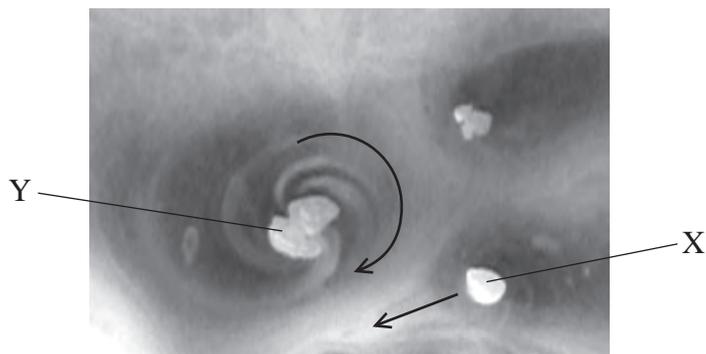
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**(Total for Question 6 marks)**

- 3 Solid carbon dioxide changes state directly from solid to gas. This process is called sublimation. Solid carbon dioxide, when placed on water, will move rapidly across the surface due to jets of ejected gas.

The diagram below shows the direction of movement for two large pieces of solid carbon dioxide placed on water.



- \*(a) When placed at rest on water, piece X begins to move rapidly in the direction shown.

With reference to Newton's laws of motion explain the motion of piece X.

(5)

(b) When placed at rest on water, piece Y remained in one position whilst spinning around.

Suggest why piece Y remains in one position.

(2)

**(Total for Question = 7 marks)**