Investigation of Newton's 2nd Law

Specification reference: AS Unit 1.3 — Dynamics

THEORY

The gravitational force of the slotted masses attached via the pulley causes the entire mass of the system to accelerate. That is the mass of the rider, M, and the total mass of the slotted masses, m. Newton's second law, therefore, can be written as:

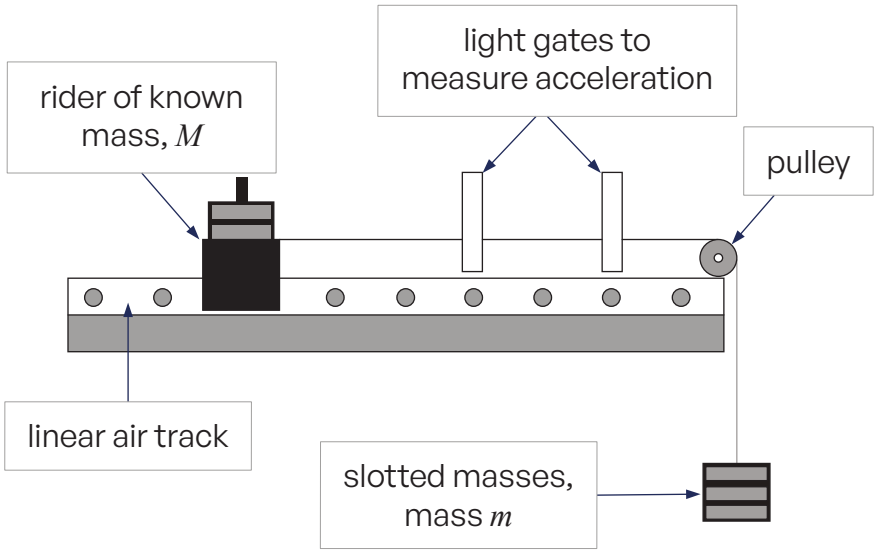
$$mg = (M + m)a$$

and so the acceleration of the system is:

$$a = \frac{mg}{(M + m)}$$

We can use this to test Newton's second law. If the total mass of the system $(M + m)$ remains constant then the acceleration, a, should be proportional to the gravitational force, mg.

APPARATUS



EXPERIMENTAL METHOD

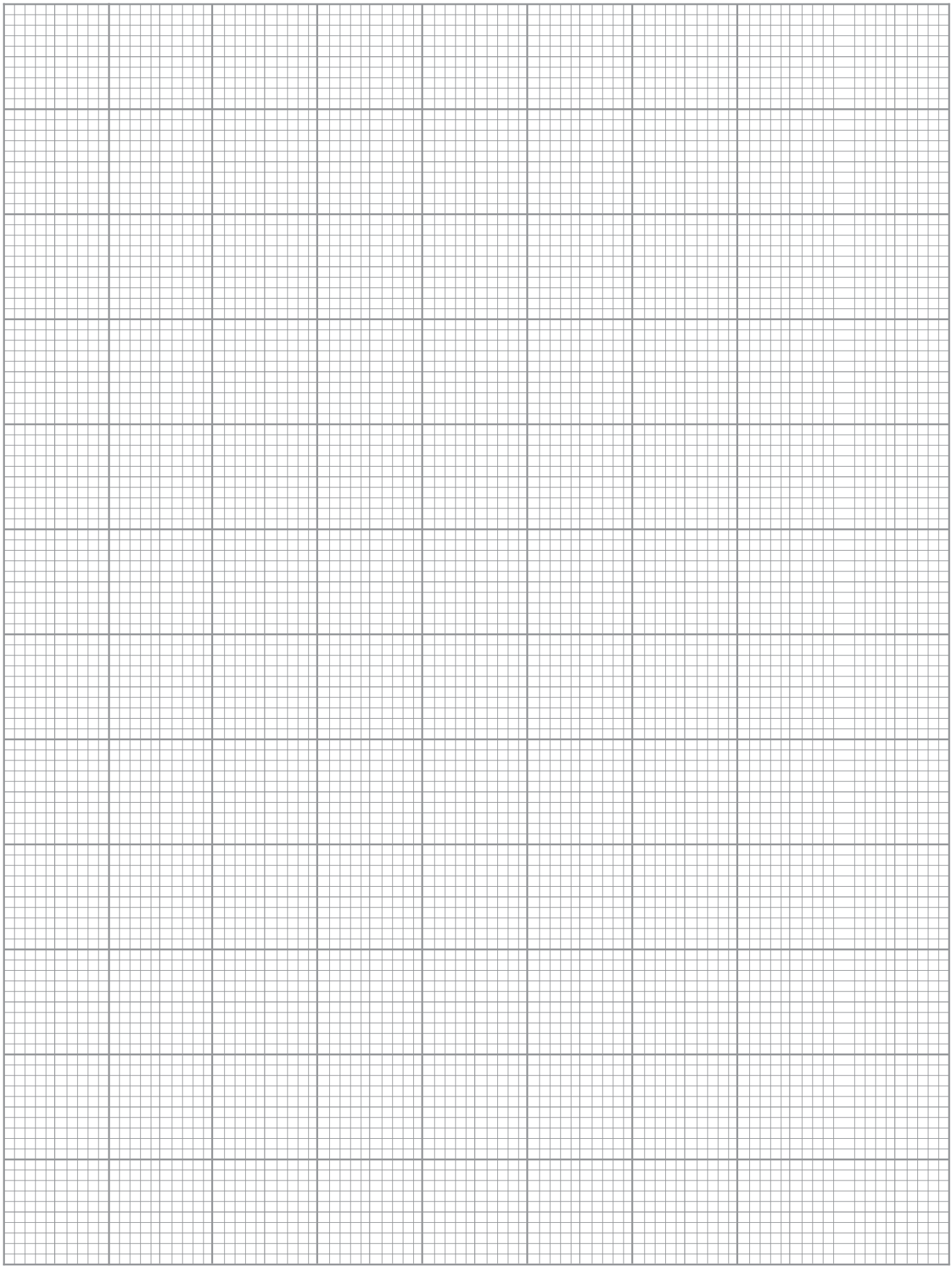
Fix the thread to the rider and attach five slotted 5 gram masses to the other end as shown in the diagram. Set the light gates to record the acceleration and allow the slotted masses to fall to the ground. Record the gravitational force, mg and the acceleration, a. Remove one of the slotted masses and place it on the rider (so keeping the total mass of the system constant).

Repeat the experiment until all the different accelerating masses have been removed. Plot a graph of acceleration (y-axis) against gravitational force, mg (x-axis). This should be a straight line through the origin.

SPACE FOR NOTES

TABLE OF RESULTS

GRAPH



QUESTIONS

1. What is the advantage of using an air-track in this experiment?

2. What assumptions are being made in this experiment?

3. If an air-track is unavailable, how could the friction of the slope be compensated for?

4. How can the acceleration of the rider be measured in this experiment?

5. What safety precautions should be taken in this experiment?

6. Why should you place any masses removed from the hanger onto the ride?

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