Name: Form:

BALANCING ACT – Mystery Box Assignment

Go to <https://phet.colorado.edu>

If necessary register…its free.

Go to PHYSICS, BALANCING ACT

Once in the programme you need to click on BALANCE LAB

**Aim:** To determine the mass of each mystery box using the principle of moments

**Apparatus:** Balancing Act simulation, set of masses (5kg, 10kg, 15kg, 20kg) and mystery boxes (A, B, C, D, E, F, G and H)

**Method**:

Turn on FORCES from Objects, LEVEL and RULER

When adding objects to your see saw SELECT button to the LHS.

When ready to test your hypothesis SELECT the button to the RHS

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Place the mystery box on the left of the see saw at a distance of 1m initially.

Place only one of the brick masses (5kg, 10kg, 15kg or 20kg) on the right of the see-saw.

Move around the mystery box and brick until the see-saw is balanced.

If the brick you selected does not balance the see-saw, select another brick.

Repeat for next mystery box

Complete the Results table when you have reached balance or equilibrium state.

Calculate the weight of the mystery box using the principle of moments.

Note you only have to show one sample calculation (Mystery box to be set by teacher)

State the mass of the mystery box in the Conclusion table.

Tes

Theory:

The principle of moments

When an object is in equilibrium (balanced and not moving), the sum of the clockwise moments about any point (acting as a pivot) equals the sum of the anticlockwise moments about the same point.

To calculate the force due to weight of brick use W = mg.

Acceleration due to gravity = 10N/kg

Example: If mass, m = 0.2 kg

W = 0.2 kg x 10 N/kg = 2.0 N

Results: Balance Table

|  |  |  |  |
| --- | --- | --- | --- |
| Anticlockwise Moment (Nm) | | Clockwise Moment (Nm) | |
| Mystery Box | DISTANCE from PIVOT (m) | FORCE of BRICK (N) | DISTANCE from PIVOT (m) |
| A |  |  |  |
| B |  |  |  |
| C |  |  |  |
| D |  |  |  |
| E |  |  |  |
| F |  |  |  |
| G |  |  |  |
| H |  |  |  |
|  |  |  | *(12-marks)* |

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Calculation:

Worked Example

A boy of weight 500 N sits on the left side of a see-saw at a distance of 2.4 metres from its pivot

If a girl can balance the see-saw by sitting 3.0 metres from the pivot on the right side, what is her weight?



Using the law of moments when the see-saw is balanced:

anticlockwise moment of the boy's weight = clockwise moment of the girl's weight

*W1 × d1* = W2 × d2

500N × 2.4m = W2 × 3.0m

Complete your sample mystery box calculation here:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mystery box, W1 | | = | |  | | Distance, d1(m) | | = | |  | Weight of brick, W2(N) | | = |  | | Distance, d1(m) | = |  |
|  | |  | |  |  | | |  | | |  | | |  | |  | | |
| W1 | | × | | d1 | | | | = | | | W2 | | | × | | d2 | | |
|  | |  | |  | | | |  | |  |  | | |  | |  | | |
| W1 | | × | |  | | | | = | |  |  | | | × | |  | | |
|  |  | |  | | | | | | | | |  | | |  | | | |
| W1 | = | |  | | | | × | |  | | | = | | |  | | | |
|  | | | | | | | | |

(5-marks)

**Conclusion**:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mystery box | A | B | C | D | E | F | G | H |
| Mass(kg) |  |  |  |  |  |  |  |  |