Created by Paris — a former homeschool student in Hong Kong and a current 18-year-old final-year university student majoring in Physics and AI (hsa.hk)

IGCSE Physics Worksheet – Centre of Mass

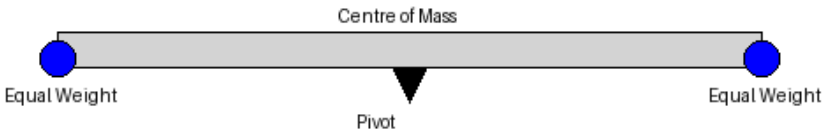
Section 1: Reading Passage

The centre of mass of an object is the point where its mass can be considered to be concentrated. If you support an object exactly at this point, it will balance. For simple, uniform objects such as a ruler or a metal bar, the centre of mass lies at the geometric centre. For irregular objects, the centre of mass may not be in the middle, and it may even lie outside the object.

The centre of mass is important because it determines how an object behaves when forces act on it. When an object is suspended from any point, its centre of mass will always lie directly below the suspension point. This is why hanging an irregular shape from different points and drawing vertical lines helps locate its centre of mass.

The diagram below shows a uniform ruler balanced on a pivot at its centre of mass. Because the ruler is uniform, the mass is evenly distributed, so the centre of mass is at the midpoint. Equal weights on both sides create equal moments, keeping the ruler in equilibrium.

Understanding centre of mass helps explain why tightrope walkers use long poles, why racing cars are designed with low centres of mass, and why some objects topple easily while others remain stable.



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Section 2: Questions

A. Understanding the Concept

1. What is the centre of mass of an object?

2. Where is the centre of mass located in a uniform ruler?

3. Why does an object balance when supported at its centre of mass?

4. Can the centre of mass lie outside an object? Give an example.

B. Application

5. A uniform 1-metre ruler balances at the 50 cm mark. Explain why.

6. An irregular cardboard shape is hung from three different points, and three vertical lines are drawn. What does the intersection of these lines represent?

C. Reasoning

7. A tall, narrow object topples more easily than a wide, low object. Explain this using the idea of centre of mass.

8. A tightrope walker carries a long pole. How does this help them maintain balance?

Section 3: Answer Key

A. Understanding the Concept

1. It is the point where the mass of an object appears to be concentrated.

2. At the midpoint, because the mass is evenly distributed.

3. Because the moments on either side are equal, so there is no turning effect.

4. Yes. For example, the centre of mass of a ring lies in the empty space at its centre.

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B. Application

5. The ruler is uniform, so its mass is evenly distributed. The centre of mass is at the 50 cm mark, so it balances there.

6. The intersection is the centre of mass of the shape.

C. Reasoning

7. A tall, narrow object has a high centre of mass. When it tilts, the vertical line from the centre of mass quickly falls outside its base, creating a turning moment that causes it to topple. A wide, low object has a lower centre of mass and a larger base, so the vertical line stays within the base for longer, making it more stable.

8. The long pole increases the tightrope walker's moment of inertia and lowers their overall centre of mass. This makes it harder for them to rotate or tip over, helping them stay balanced.