2022 Ph H2 Q4
Section: Our Dynamic Universe
Topic: Motion, Energy and Risk

Question Summary

A skydiver jumps from a helicopter 730 m above the ground, flying in a wing suit for nearly 1.5 km at speeds up to 130 km/h, before landing safely on cardboard boxes without using a parachute.
Task: Use your knowledge of physics to comment on the challenges involved in successfully performing this stunt.

Worked Response (3 marks)

This question is marked holistically, so here is a **structured response** that demonstrates full understanding:

- The skydiver must **control speed and direction** using aerodynamic forces generated by the wing suit. The suit increases surface area, providing lift to reduce downward acceleration and enable horizontal travel.
- At 130 km/h (~36 m/s), **kinetic energy** is significant. For a mass of around 80 kg, $E_k = \frac{1}{2}mv^2 = \frac{1}{2} \times 80 \times 36^2 = 51\,840 \text{ J}$, so managing this energy safely on landing is critical.
- The **landing boxes** must extend the deceleration time and distance to reduce the **impact force** using the impulse relationship $F = \frac{\Delta p}{\Delta t}$. A longer contact time lowers the force, helping avoid injury.
- **Air resistance** is crucial throughout the descent. The suit must be designed to optimise drag and stability, and the flyer must adopt the correct posture to maintain control and prevent tumbling.
- Small errors in judgement or wind conditions could cause **horizontal displacement** errors, missing the landing zone.

Final Answer (Summary of Key Points):

- Aerodynamic control is needed to travel horizontally and reduce vertical speed.
- A safe landing requires reducing impact force by increasing deceleration time.
- The challenge lies in controlling motion precisely and managing large kinetic energy without a parachute.

Revision Tips

- In 3-mark "comment" or "explain" questions, show **understanding**, not just facts.
- Mention relevant **principles**: forces, energy, momentum, air resistance.
- Use specific vocabulary (e.g. *impulse*, *lift*, *drag*, *impact force*) correctly.