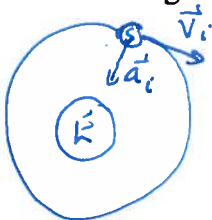## Part A: Multiple Choice [10 marks]

Write the letter representing your answer for each question in the table below:

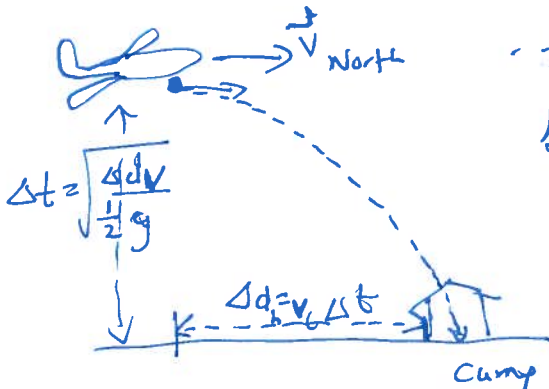| 1	2	3	4	5	6	7	8	9	10
B	B	A	E	D	A	C	A	D	D

Part B: Making Connections [10 marks]

1. A satellite orbits the Earth in a circular path at constant speed. Describe the nature of the acceleration that the satellite is undergoing and why the speed of the satellite can remain constant while still accelerating. [3]

- Although the speed is constant the satellite is accelerating as the direction of the velocity is constantly changing
- this is possible as the acceleration acts radially - it is constant in magnitude and directed toward the centre of the circular orbit.
- there is no component of acceleration acting tangentially so the tangential speed is constant

2. An emergency relief plane needs to air-drop a package of aid supplies in a refugee camp 100.0 kilometres due north of the plane's starting location. The plane begins the journey north and the co-pilot determines the release point of the package. Ignoring air resistance, explain the position, relative to the camp, where the package should be released so that it lands in the camp. Draw a sketch to support your explanation.   (NO calculations are required-provide a qualitative description.) [3]

$$\Delta t = \sqrt{\frac{\Delta d_y}{\frac{1}{2}g}}$$

$$\Delta d = v_x \Delta t$$

- the package should be released at a position before the plane is above the camp since the package will continue to move forward at the same velocity as the plane
- the overall path of the package will be parabolic as shown.
- the exact position can be found by calculating the time to drop (given the plane altitude) and multiplying this time by the horizontal plane velocity.

b) If the effect of air resistance is now considered, how would the release point change? [1]

Horizontal air resistance will slow down the rate at which objects fall. The release point should be moved closer to the camp to account for air drag.

3. A boat with an engine speed of 5 m/s needs to cross a river with a current travelling at 3 m/s [East] to reach a point that is directly North from where it starts.

a) State the relative velocity vector equation appropriate for this situation (Make sure to use proper vector notation.) [2]

b) Draw a fully labeled vector diagram illustrating the situation. (No calculations required) [2]

$V_{BW} = 5 m/s$

$V_{WG} = 3 m/s$

$V_{BG} = ?$

B - boat, W - water, G - ground

$\vec{V}_{WG} = 3m/s$

$\vec{V}_{BG} = \vec{V}_{BW} + \vec{V}_{WG}$

$\vec{V}_{BW} = 5m/s$

$\vec{V}_{BG}$