7 **(a) Describe how IT systems can enable the missile to fly close to the ground and hit the intended target.** ***[6 marks]***

Answers may include:

- sensor/altimeter to detect height above ground
- sensor to detect air speed
- sensor to visually detect obstructions
- timer to record time into flight
- GPS system to establish location
- GPS to record target coordinates
- database of terrain
- database of when to make flight adjustments
- software makes flight adjustments based on position and destination
- software compares current terrain with database of terrain
- software compares height of the missile with parameters for safe height
- software makes flight adjustments as necessary.

*Award **[1 mark]** for each way identified up to a maximum of **[6 marks]**.*

OR

*Award [**1 mark**] for each way identified up and [**1 mark**] for a description of the way that has been identified, up to a maximum of [**6 marks**]*

(b) Analyse whether it is acceptable that autonomous machines should be allowed to fight in wars. ***[6 marks]***

Answers may include:

Acceptable

- more accurate so more likely to hit correct target
- can be programmed to make logical decisions about friend or enemy
- more likely to make right assessment of a situation
- no inhibitions about killing
- reacts faster than human
- can be programmed to achieve its objective with the least number of casualties possible
- will lead to fewer soldiers being killed or injured, thus reducing the consequent issues such as additional health care and support

Not acceptable

- may make mistakes
- decisions may be made on an inadequately defined model
- moral objections about machines taking life
- sometimes human judgment/experience may be more reliable
- sometimes need to take into account human/illogical factors
- it may be considered unethical (or immoral) by some groups to use autonomous machines in warfare
- may be seen to trivialise war as no more than a real life computer game

In this case a candidate may approach this from a purely ethical stance (which is likely to happen if they have addressed this through ToK). However, the approach needs to be properly justified (for example, acceptable - based on utilitarian principles, the deployment of the autonomous machine may cause harm to a few, ensuring the majority are not harmed / not acceptable - based on deontological principles, it is morally wrong to use autonomous machines in warfare).

[1–2 marks]

A limited response that demonstrates minimal knowledge and understanding of the topic and uses little or no appropriate ITGS terminology.

[3–4 marks]

A partial analysis, either lacking detail or balance, that demonstrates some knowledge and understanding of the topic. Some relevant examples are used within the response. There is some use of appropriate ITGS terminology in the response.

[5–6 marks]

A balanced and detailed analysis of the issue which demonstrates thorough knowledge and understanding of the topic. Relevant examples are used throughout the response. There is appropriate ITGS terminology throughout the response.

(c) To what extent could a cruise missile be considered a robot? ***[8 marks]***

Answers may include:

- A cruise missile is considered a robot if it has the following:
  - Computer Sensors (e.g. altitude, GPS, etc.)
  - Power sources
  - Structural components (may be fixed or mobile)
  - A mission (e.g. air strike enemy target)
  - A computer program that results in the accomplishment of an objective EITHER autonomously or in coordination with a human through tele-operation.

The balance in the argument comes from the extent to which the above characteristics are considered by the candidate to be a criterion for considering the cruise missile a robot or not.

It is not necessary to address all bullet points to achieve full marks.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 21.