S&C GCSE June 2016 Model Answer

1a)

Reason 1:

- restriction of access for certain vehicles
- access to specific vehicle.
- pedestrian access
- safety
- simplicity of system

Reason 2:

It is a safe system as there are no parts to injure pedestrians as they walk near it.

1b)

Reason 1:

- Warning bus drivers
- Warning other drivers
- Warning pedestrians
- Drawing attention to the bollard
- Indicating the state of the bollard

Reason 2:

- To pre warn the driver of the state of the bollard so they do not drive into it.
- So pedestrians are warned even if they are not looking in that direction.

1c)

Below are examples of systems that could be used:

- Coded wireless
- Keypad
- Magnetic card
- Key
- Swipe card
- Ultrasonic
- Infrared

A waterproof keypad lock could be used with only the drivers knowing the code to allow to bollard to open/lower. This code could be changed regularly to ensure security and the keypad could be placed at the correct level to allow the bus driver to operate it from the driver's seat. Once the correct code has been entered, a further system could be used to detect when the bus has passed to allow it raise the bollard after use.

A waterproof key lock could be used with many sets of the key cut to give to the drivers on the day, this will allow to bollard to open/lower. The key could be fitted to the bus with a safety cable so the bus driver could extend this out the bus window to operate the lock. The lock could be placed at the correct level to allow the bus driver to operate it from the driver's seat. Once the correct key has been used, a further system could be used to detect when the bus has passed to allow it raise the bollard after use.

1d)

The keypad system as this does not require the extra cost of cutting keys. To add to this, if a key is lost or stolen, the entire set of keys would need to be replaced, along with the lock itself, whereas the code could easily be changed at no extra cost.

2a)

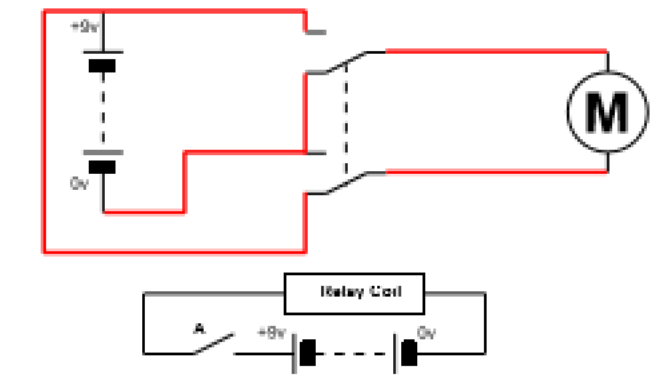
Material: Stainless steel

Reasons:

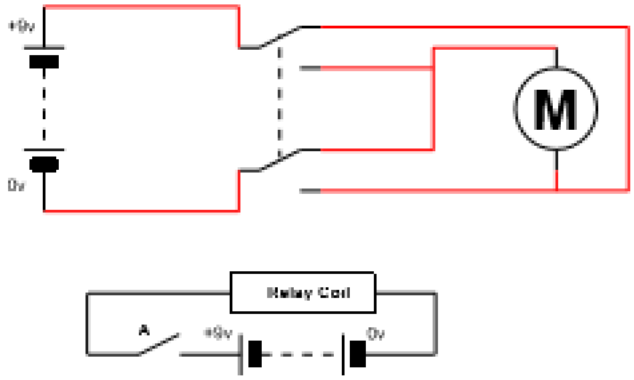
- Does not easily corrode
- Readily available
- Can be easily machined
- Readily available

2b)

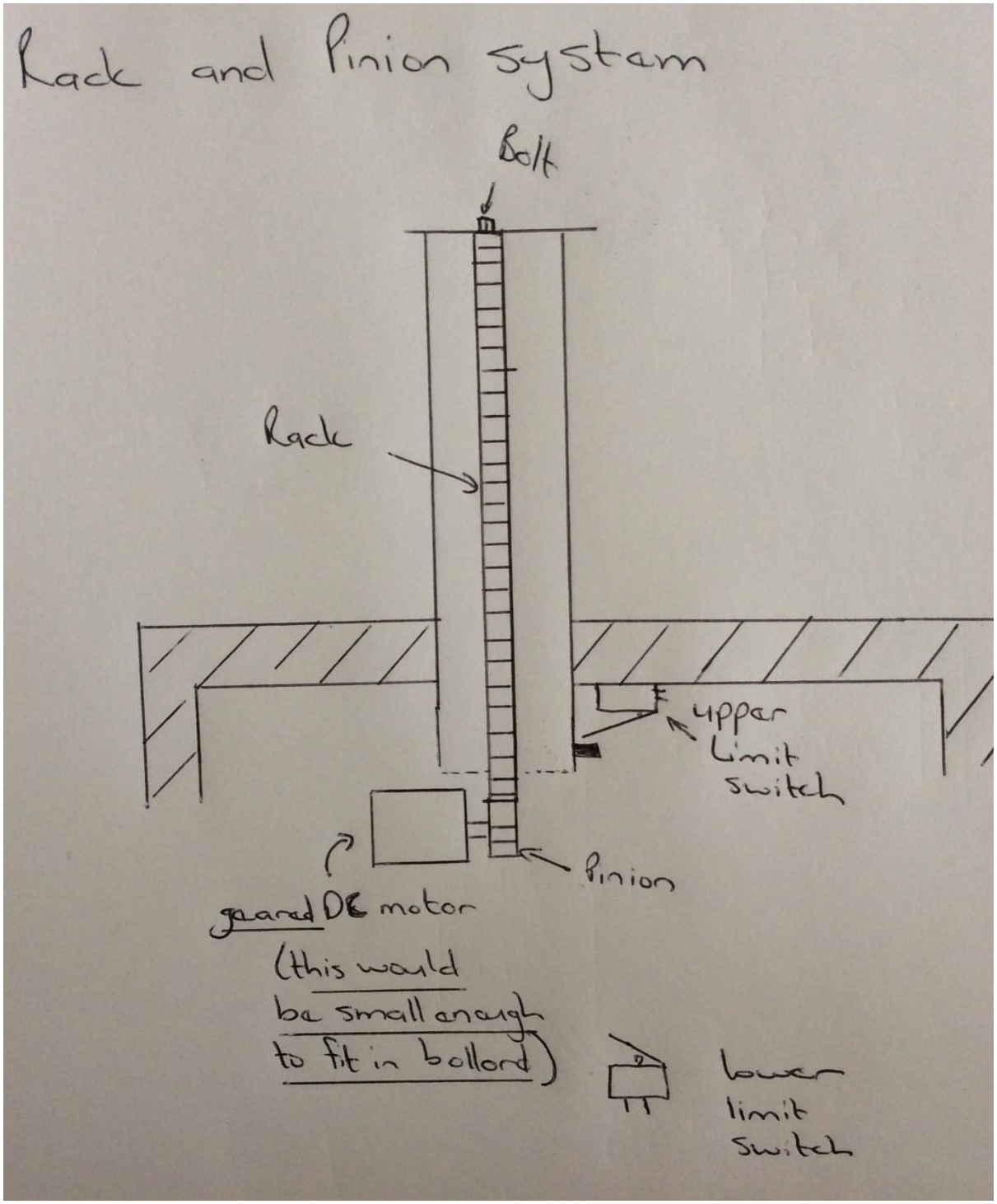
Example 1



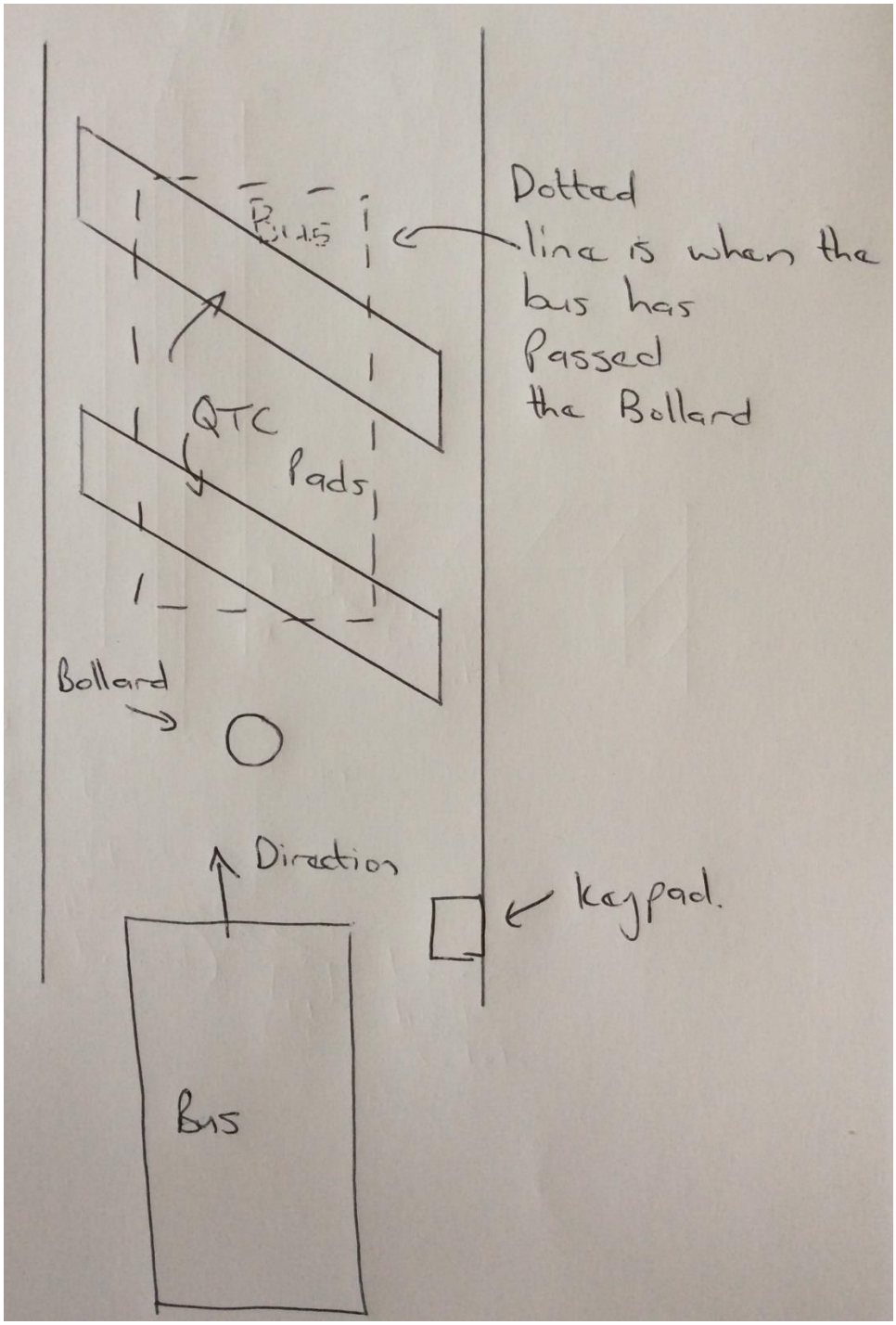
Example 2



2c)

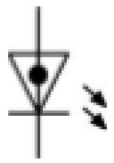
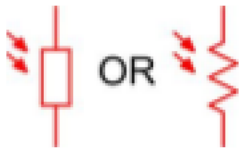
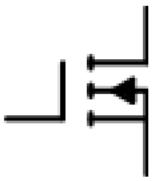
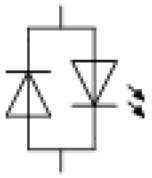

Rack and Pinion system
Bolt
Rack
upper limit switch
Pinion
geared DC motor
(this would be small enough to fit in bollard)
lower limit switch

2d)



Once the bus has passed the bollard, 2 QTC (quantum tunnelling composite) pad could be placed in the road. This could measure when the first and last wheels have passed over due the pressure on the pads from the bus. This could the trigger the system to raise the bollard once the bus has passed the bollard.

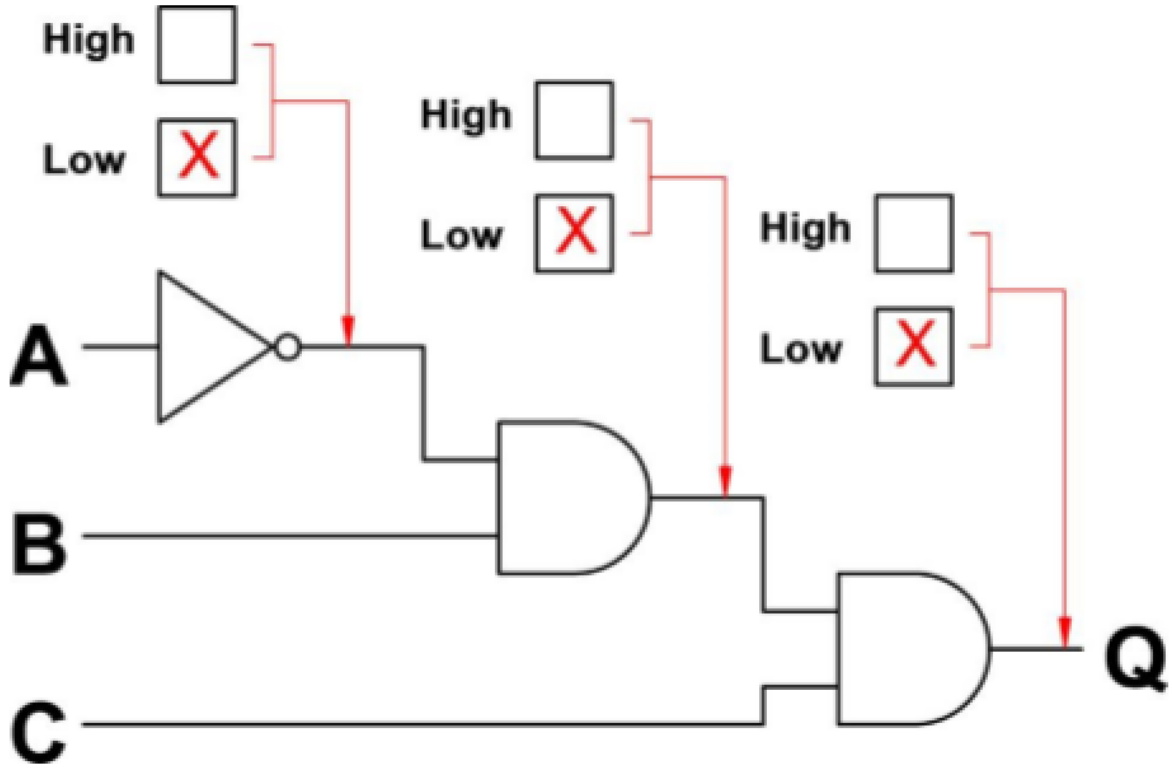
3a)

Component symbol	Component name	Input – Process - Output
	Flashing LED (1 mark)	Output
	OR Gate (1 mark)	Process (1 mark)
 (1 mark)	Light Dependent Resistor	Input (1 mark)
	FET Or Field Effect Transistor (1 mark)	Process (1 mark)
	Bi-colour LED (1 mark)	Output
	Buzzer	Output (1 mark)

3b)

Number 2 = a, b, g, d, e
Number 5 = a, f, g, c, d

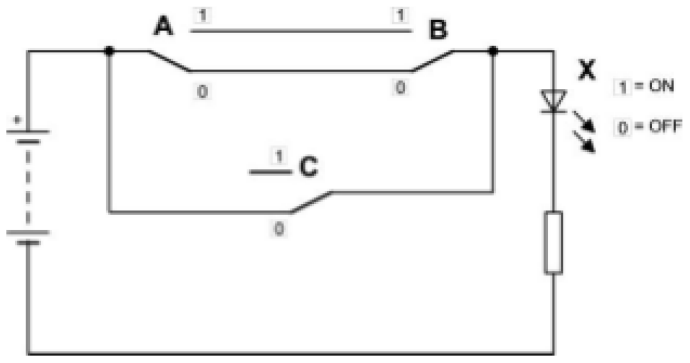
4a)



Each correct response (1 mark)

4b)

Complete the truth table for the following circuit



A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Each correct pair as indicated on truth table (1 mark)

5ai)

Window OR Door

5aii)

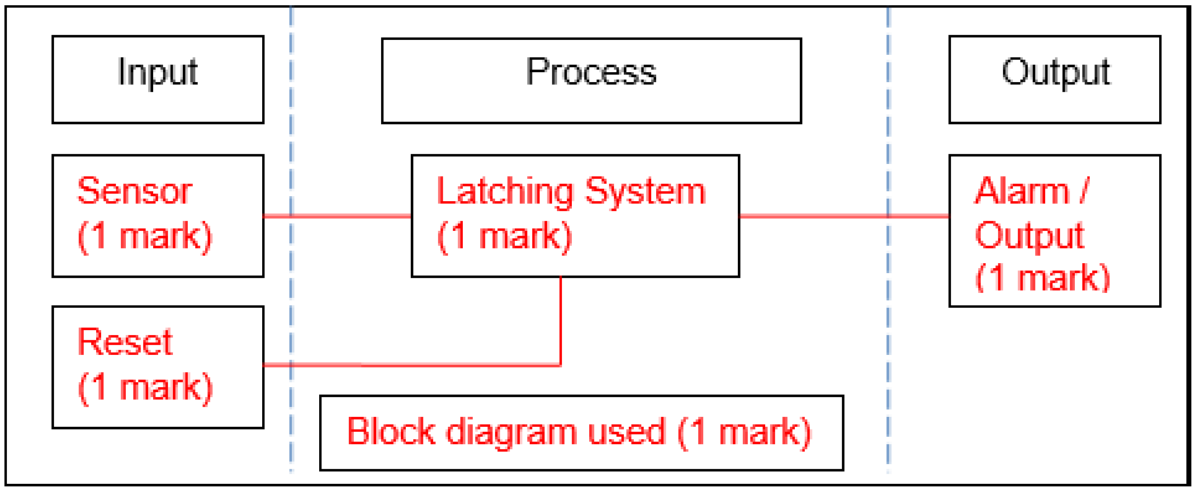
Sensing system 1: Reed switch and magnet

Reason: The magnet can be fitted to the window and the reed switch attached to the frame making it easier to wire up.

Sensing system 2: Light sensor and beam

Reason: The light beam could be positioned so that any intruder had to break it when opening the door.

5b)

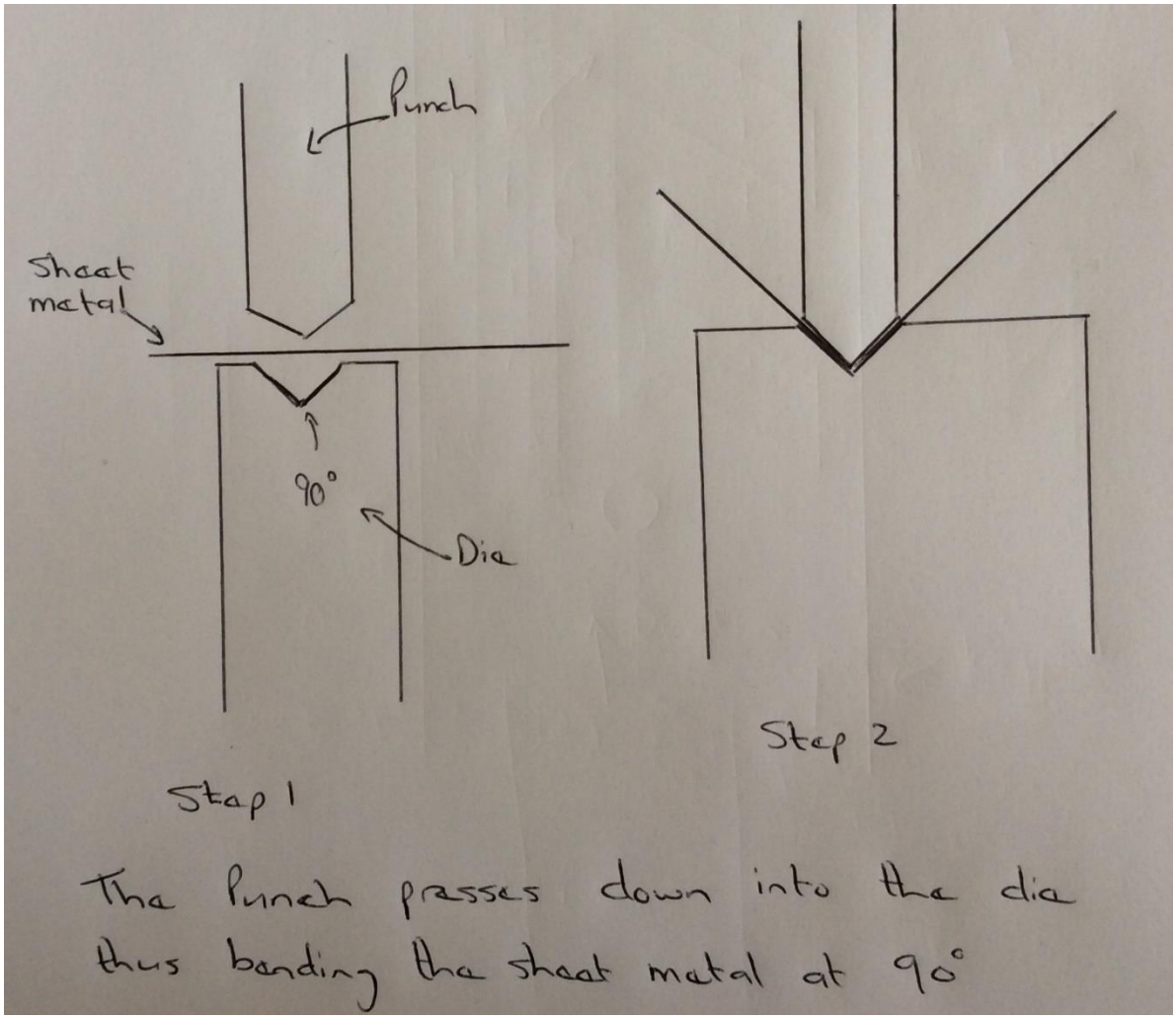


5c)

Point 1: Should be waterproof because it will be outside and needs to protect the siren or electrical circuit

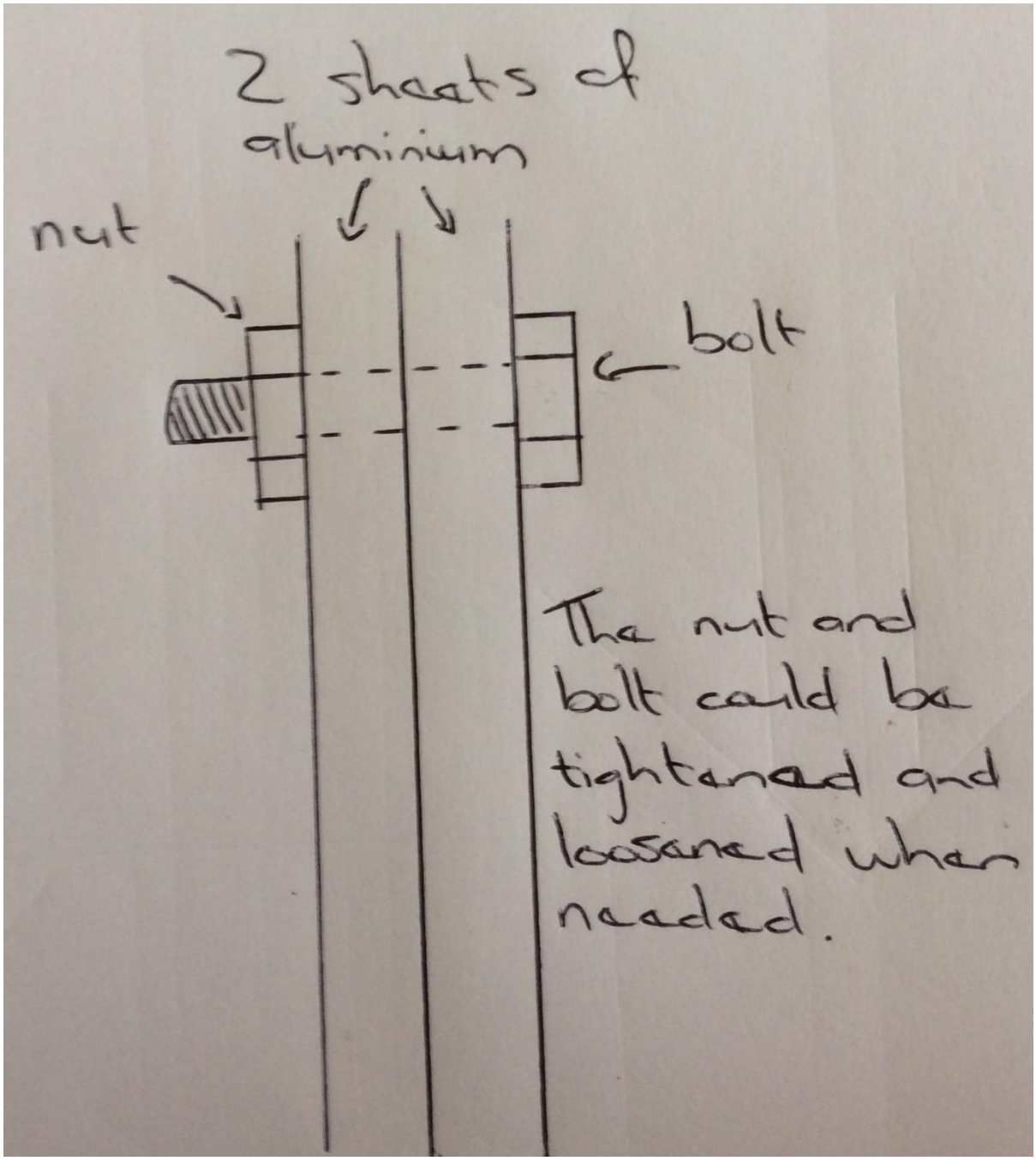
Point 2: Should be difficult for an intruder to smash or damage.

6a)



The Punch presses down into the die thus bending the sheet metal at 90°

6b)



7ai)

Anticlockwise

7aii)

Anticlockwise

7bi)

gear set ratio 30:90

= 1:3

$$rpm = \frac{\text{input rpm}}{\text{ratio}}$$

$$= \frac{12}{3}$$

= 4rpm → = speed of shaft B

7bii)

pulley ratio = 20:40

1:2

$$\text{shaft 'c' rpm} = \frac{\text{input rpm}}{\text{ratio}}$$

$$= \frac{4}{2}$$

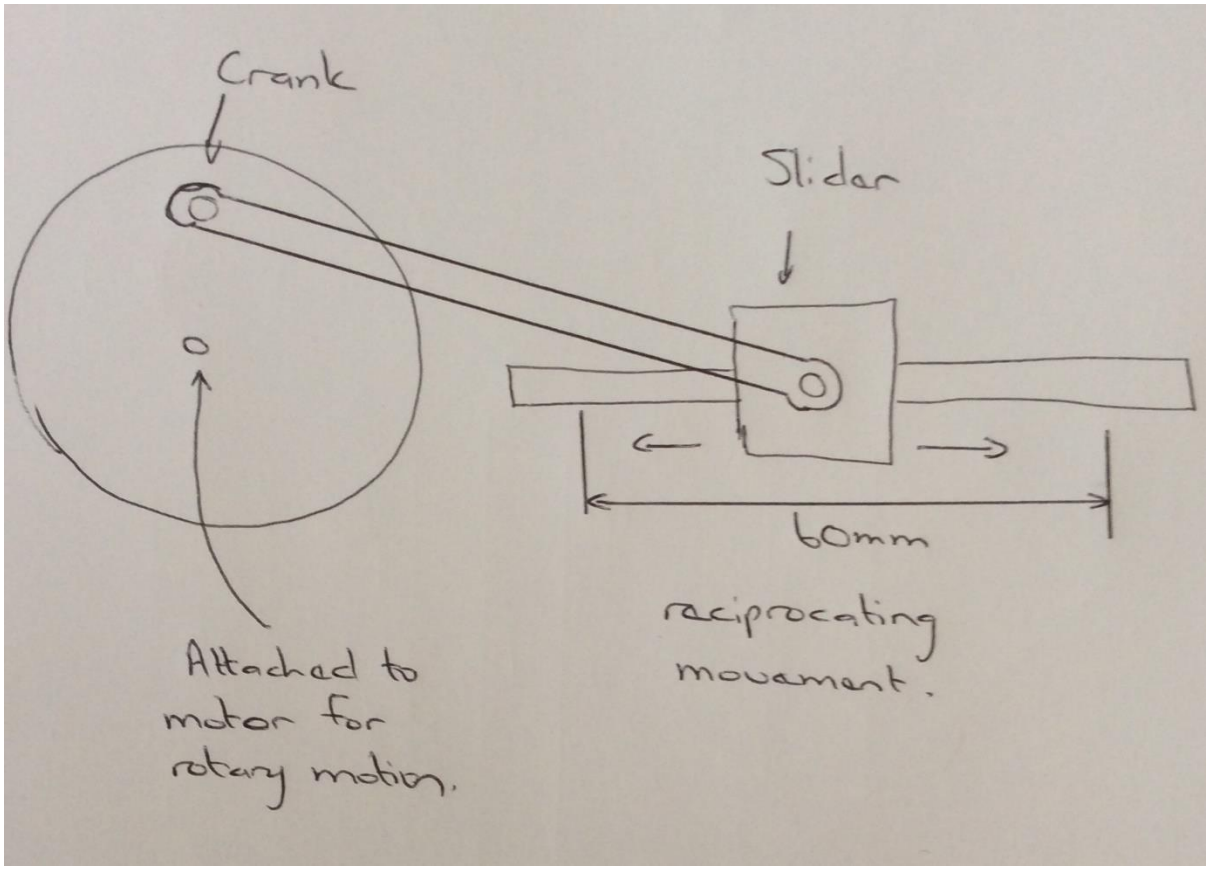
= 2rpm →

7c)

Advantages: Allows transmission over long distances, easily manufactured therefore cheaper, can slip under excessive loads this can be used as a safety feature, tend to be quieter than gear systems.

Disadvantage: Can slip so cannot be used for heavy loads or precise movement, susceptible to dirt and oil, belt needs additional support and tensioning especially if used over long distances, Belts wear and need replacing.

7d)



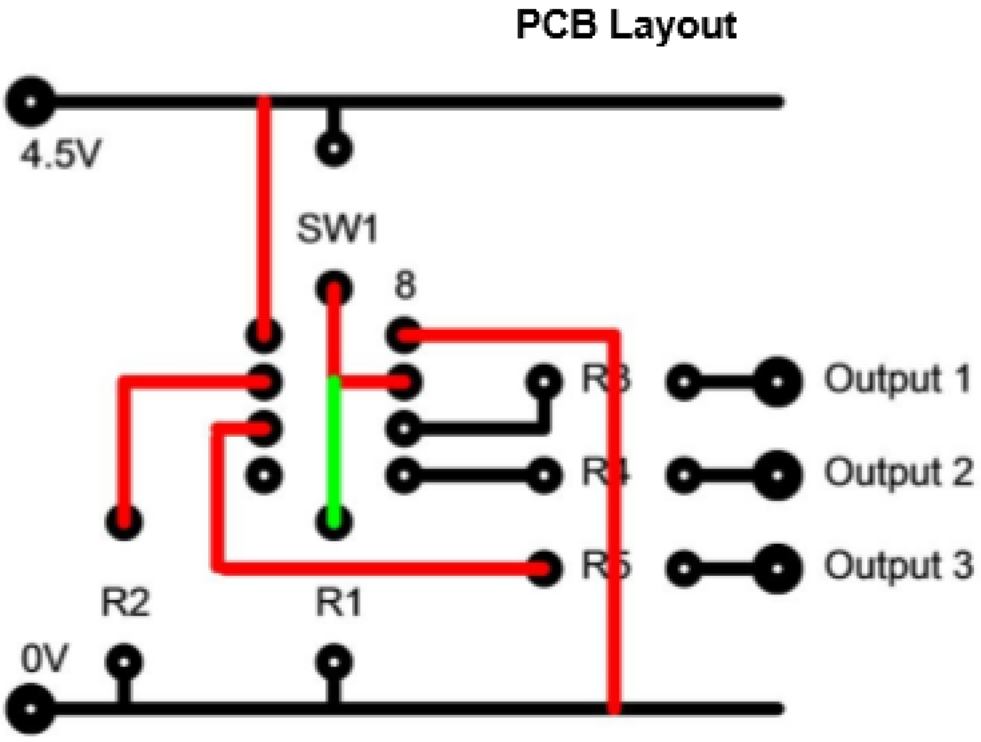
8)

Companies can use CAD software to improve the improve accuracy, quality, speed of production, adapt products more quickly, use machines for more than one product, change production quickly, high initial cost but greater flexibility, lower overall costs, repeatability of products and batches.

- It's easy to develop and edit 2D and 3D images and view them from different angles.
- It’s easy to experiment with different finishes.
- Very realistic designs can be produced to show clients what their product will look like.
- Products can be machined at high speed 24 hours a day - this means lots of products can be made in a short time.
- CAM gives a high quality and more reliable finish - there is no human error.
- You can mass-produce complicated products; each part can be made by a different machine so they can be assembled quickly.

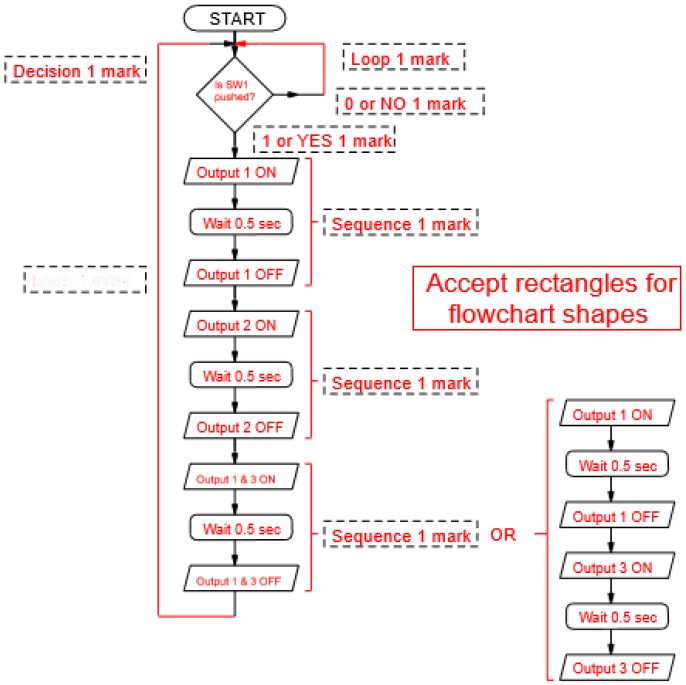
- Labour costs are low
- Designs can be sent around the world.

9a)

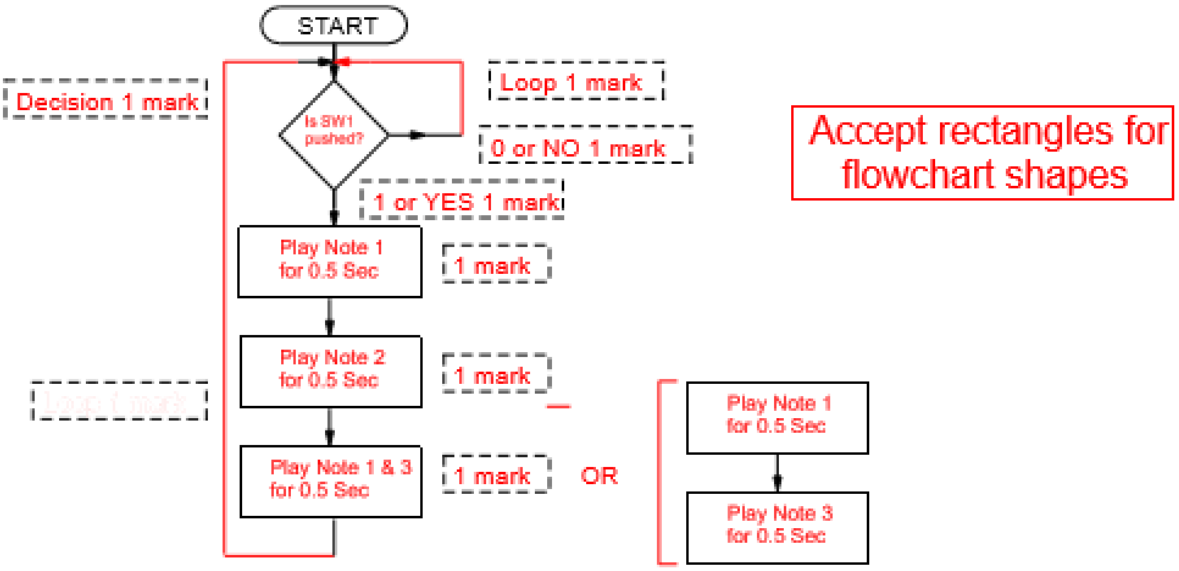


9b)

Example 1



Example 2


START
Is SW1 pushed?
Loop 1 mark
0 or NO 1 mark
1 or YES 1 mark
Decision 1 mark
Play Note 1 for 0.5 Sec
1 mark
Play Note 2 for 0.5 Sec
1 mark
Play Note 1 & 3 for 0.5 Sec
1 mark
OR
Play Note 1 for 0.5 Sec
Play Note 3 for 0.5 Sec
Accept rectangles for flowchart shapes