T-LEVELS | IfATE Institute for Apprenticeships and Technical Education

T Level Technical Qualification in Design and Development for Engineering and Manufacturing (8730-14)

8730-035 Employer-Set Project Exemplar – A Grade

Summer 2025

City & Guilds | eal

Contents

Introduction **2**

Task 1 Research **5**

Task 2 Design **29**

Task 3 Plan **47**

Task 4 Present **61**

Introduction

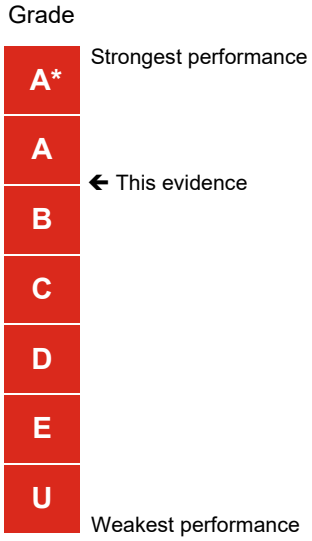
Summer 2025 Results

This document is aimed at providers and learners to help understand the standard that was required in the summer 2025 assessment series to achieve an A grade for the 8730-035 Design and Development for Engineering and Manufacturing Employer-Set Project (ESP).

Providers and learners may wish to use it to benchmark the performance in formative assessment against this to help understand a potential grade that may be achieved if a learner was to attempt the next summative assessment series.

The Employer-Set Project is graded A* to E and Unclassified.

The exemplar evidence provided for the A grade displays the holistic standard required across the tasks to achieve the A grade boundary for the summer 2025 series.



The Employer-Set Project brief and tasks can be downloaded from here.

Important things to note:

- We discussed the approach to standard setting/maintaining with Ofqual and the other awarding organisations before awarding this year. As in 2024, we have agreed to take account of the newness of T Level qualifications in how we award, to recognise that students and teachers are less familiar with the assessments in the first years of awards, whilst also recognising the standards required for these qualifications (https://www.gov.uk/government/publications/ofqual-guide-for-schools-and-colleges-2025/ofqual-guide-…).
- The exemplar evidence presented, as a whole, was sufficient to achieve the A grade. However, performance across the tasks may vary (i.e. some tasks completed to a higher/lower standard than an A grade).

Marking of this Employer-Set Project is by task and Assessment Objective, below is a summary of these along with the mark achieved by the evidence presented and the maximum mark available for each aspect.

Task	Assessment Objectives	Mark achieved	Max mark available
Task 1 Research	- AO1 Plan their approach to meeting the project brief - AO2a Apply core knowledge - AO3 Select relevant techniques and resources to meet the brief	7	9
	- AO2b Application of core skills	4	6
Task 2 Design	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	5	6
	- AO2a Apply core knowledge	4	6
	- AO2b Application of core skills	4	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	4	6
Task 3 Plan	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	3	6
	- AO2a Apply core knowledge	4	6
	- AO2b Application of core skills	2	6
Task 4 Present	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	5	6

	- AO2a Apply core knowledge	5	6
	- AO2b Application of core skills	4	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	5	6
Maths	- AO4a Use of Math skills	2	3
English	- AO4b Use of English skills	2	3
Digital skills	- AO4c Use of digital skills	2	3

What evidence was being assessed for the maths, English and digital skills:

Maths:

- Annotations on sketches (Task 2)
- Dimensioning and scaling CAD drawing (Task 2)
- Supporting calculations (Task 2)
- Calculation of design and manufacturing cost, timescales and critical path within the Programme of work (Task 3)

English:

- Technical brief (Task 1)
- Reflective Notes detailing how the designs meet the brief requirement (Task 2)
- Supporting statement for the programme of work (Task 3)
- Presentation delivery (orally) and materials to support presentation (e.g. slides etc) (Task 4)

Digital:

- Types of sources used for Research (Task 1)
- CAD Drawing (Task 2)
- Presentation of the programme of work (Task 3)
- Presentation materials (slides, handouts, notes etc) (Task 4)

Task 1 Research

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

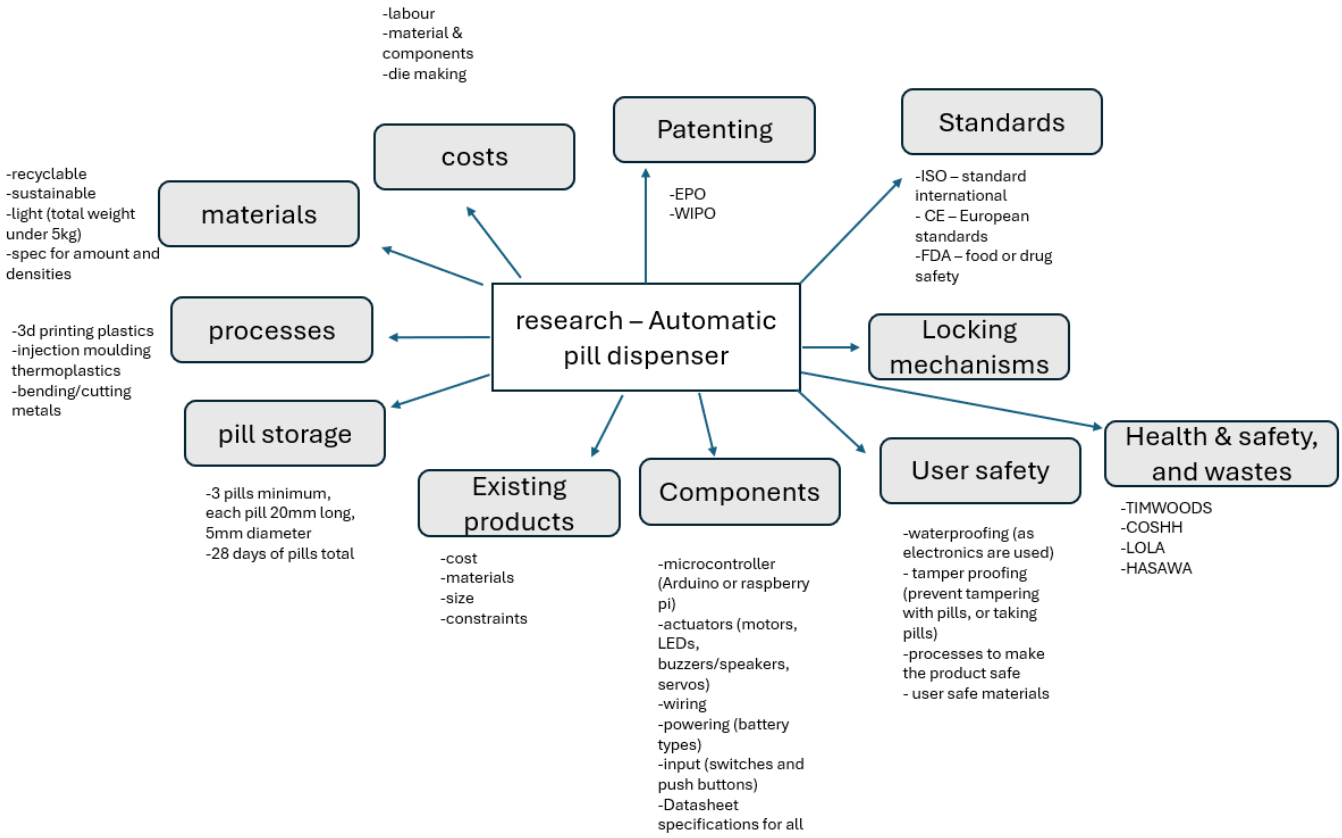
Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1
Evidence title / description	**Evidence expected for marking:** **Part A** Research notes including a list of references/sources **Part B** Technical brief (typically 1500 words) **Evidence submitted for marking:** **Part A** Research notes including a list of references/sources **Part B** Technical brief
Date submitted by candidate	DD/MM/YY

1. Task 1 – Research

Part A – conducting research



Existing products:

£69.99

4x AA batteries

plastic

lockable by key

0.6kg

190x190x50mm

https://www.amazon.co.uk/TabTime-SII-dispenser-medication-Alzheimers/dp/B00PY2P9FU/ref=sr_1_1_sspa?crid=WMBPKEDHHGAK&dib=eyJ2IjoiMSJ9.KGsQogxUXgvHLIrGwp0yZm5RqKnCzbP1EndWjlbpzpGWLvEQBF1WYdON0pLvRjXxlw_3d4CfTls2EXjnvT-WNnk7ya7GsnZY6L88lVQvvmhaL9dvwHURmwD0ylygCojEnnN-OR-dujuxMCs249QGIXmGWQE4FMkqBNSvNjw-6CLMIDY8eDBK4EcmpWc5FOCHujDK8_srjoeiuOO2tWCzUfjrrLlgcmZz-loIU6NENfzaFckrhIUYIEy-ftnkY0lKou5TsZhf6QIMNSg-n4xnWtOQVou24X4iHpiGj-XnYEY.jM9Tq0_z6JmKjylQbssVsuwJXhs4iZtfmxHr-Lpos1c&dib_tag=se&keywords=automatic%2Bpill%2Bdispenser&qid=1745405438&sprefix=automatic%2Bpill%2Bdispenser%2Caps%2C76&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1

£108.95

plastic

lockable

4 AA batteries

254x254x254mm

0.871kg

https://www.amazon.co.uk/Automatic-Dispenser-Electronic-Medication-Organizer/dp/B0963BG8RX/ref=sr_1_8?crid=2QBR5CLQZ794M&dib=eyJ2IjoiMSJ9.KGsQogxUXgvHLIrGwp0yZrL0h-E5owbd8tcgJaVxQy4hY4DM36-02UasESSkoiZEh9MGgHiO5tg2JMayCWQ0BNtmDzJS2vm5KKY7ooxaFosSsV8RQtVd-8WN-NXT-tqT4QNVnEl1WguSRqUBPqX1HLngf_DGKnSc55vWSRXTtPtFP_UpHemsKaihMMjISIMNJRIpRos7z_8JIdl903dkPEM_hM0EmE_qPZXtSjIJBopWX-EFHiBhMtRMDj91zCSJfEtPdHjRgOVS651dRJNLXdVwiqV7Na0J-UuxRTi8qH8.l3nzTm6Rxx1w03YQEg7AeiujYyd_AZ1KqPtEyBwpRxA&dib_tag=se&keywords=au

tomatic+pill+dispenser+with+alarm&qid=1745405462&sprefix=automatic+pill+dispenser+with+alarm%23%2Caps%2C59&sr=8-8

Materials

10kg polypropylene pellets

https://www.celloexpress.co.uk/product/pack-of-10000g-plastic-polypropylene-pellets-10kg-round/

£79

0.92 g/cm^3

(https://plasticseurope.org/plastics-explained/a-large-family/polyolefins/#:~:text=PP%20(polypropylene)%3A%20The%20density,resistance%2C%20but%20less%20chemical%20resistance.)

HDPE pellets

https://www.tradewheel.com/p/granules-plastic-hdpe-resin-high-density-2294426/

£500 per ton

0.941~0.965g/cm^3

pellets chosen as company already has injection moulding machines ==> cheaper to make than using plastic sheets or metals

Nitrile rubber

£17.99 for 5m

10mm diameter

https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwjZi8_umu6MAxWnklAGHe64HF4YABAMGgJkZw&co=1&gclid=EAIaIQobChMI2YvP7prujAMVp5JQBh3uuBxeEAQYASABEgKZRvD_BwE&ohost=www.google.com&cid=CAASJeRohs94OlOfJZaj6z9MhIBgZ1ktAUguGknLkUljcBqu7ToKuVs&sig=AOD64_1hjo8fvH9wvxsSR0dryZzQhwGtpQ&ctype=5&q=&ved=2ahUKEwikxsrumu6MAxUhT0EAHZxxBMoQ9aACKAB6BAgDEBI&adurl=

this rubber will be food safe and recyclable as long as its not contaminated

https://www.google.com/search?q=is+nitrile+rubber+food+safe&sca_esv=a2fccd0347a25b28&rlz=1C1GCEA_enGB1159GB1159&ei=UOQIaKTeM6GehbIPnOOR0Aw&ved=0ahUKEwikxsrumu6MAxUhT0EAHZxxBMoQ4dUDCBI&uact=5&oq=is+nitrile+rubber+food+safe&gs_lp=Egxnd3Mtd2l6LXNlcnAiG2lzIG5pdHJpbGUgcnViYmVyIGZvb2Qgc2FmZTILEAAYgAQYkQIYigUyBhAAGBYYHjIGEAAYFhgeMgYQABgWGB4yBhAAGBYYHjIGEAAYFhgeMgYQABgWGB4yCxAAGIAEGIYDGIoFMgsQABiABBiGAxiKBTIIEAAYgAQYogRIuDRQ-QxY9zJwAngAkAEAmAGrAaABwQmqAQQxMi4zuAEDyAEA-AEBmAIRoALyCagCCsICDhAAGIAEGLADGIYDGIoFwgILEAAYsAMYogQYiQXCAgsQABiABBiwAxiiBMICFBAAGIAEGJECGLQCGIoFGOoC2AEBwgIQEAAYAxi0AhjqAhiPAdgBAcICEBAuGAMYtAIY6gIYjwHYAQHCAgsQABiABBixAxiDAcICDhAuGIAEGLEDGNEDGMcBwgILEC4YgAQYsQMYgwHCAggQLhiABBixA8ICChAAGIAEGEMYigXCAg4QABiABBixAxiDARiKBcICBRAAGIAEwgIFEC4YgATCAggQABiABBixA8ICCBAAGKIEGIkFmAMF8QV6KF5ZgyLYg4gGAZAGCLoGBAgBGAeSBwQxNC4zoAfeebIHBDEyLjO4B-sJ&sclient=gws-wiz-serp

https://www.google.com/search?q=is+nitrile+rubber+recyclable&sca_esv=a2fccd0347a25b28&rlz=1C1GCEA_enGB1159GB1159&ei=v-QIaJfoH46ahbIP-b73mA4&oq=is+nitrile+rubber+recy&gs_lp=Egxnd3Mtd2l6LXNlcnAiFmlzIG5pdHJpbGUgcnViYmVyIHJlY3kqAggAMgUQABiABDIGEAAYFhgeMgsQABiABBiGAxiKBTILEAAYgAQYhgMYigUyCxAAGIAEGIYDGIoFMgsQABiABBiGAxiKBTIIEAAYgAQYogQyCBAAGIAEGKIESN8dUNAHWL4XcAF4AZABAJgBfKAB1AWqAQQxMi4xuAEDyAEA-AEBmAIOoAL4BcICChAAGLADGNYEGEfCAgoQABiABBhDGIoFwgILEAAYgAQYkQIYigXCAggQABiiBBiJBZgDAIgGAZAGBJIHBDEzLjGgB4ldsgcEMTIuMbgH9QU&sclient=gws-wiz-serp

Components

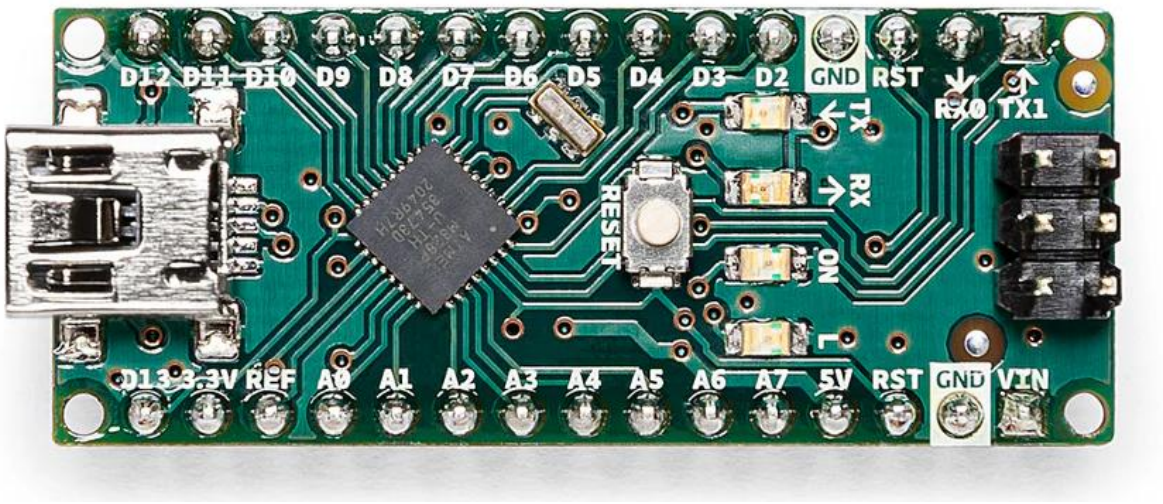
Arduino nano

£5.90 each

18x45mm

7 g

19 mA consumption



https://store.arduino.cc/products/arduino-nano

smallest arduino therefore smallest area + smallest standalone weight

Push buttons

https://www.amazon.co.uk/sourcing-map-Momentary-Soldering-Electronic/dp/B0D8KY96S1/ref=sr_1_8_sspa?crid=26ZNKCPA1ZINY&dib=eyJ2IjoiMSJ9.4mIl87Cge-R5Kf3ku5yAJkMJxg_9Xujaz5lJeiU_AZuidkUlprOqq44DocZ_lKI8oGunG3jFIh78b8m8wbGZkBkgioLA-zjgiunDKWOF3C7YSIyCQexqEqp3edc1BU7HABm-OINHXA5szf-n3ShPUC_Gm3ixynrtd09QwFlrUrJW0IoeReCjP8C2Zt1-BsEX4gJBL_q3GEy6JdyPXEBinhPLqL_4gZUtOVWdnoOuiEQ.3HBclNsHwOAXenM0wws1cA2ujWxe3QjMgMI_4l-4A7Y&dib_tag=se&keywords=bulk+push+buttons&qid=1745418013&s=diy&sprefix=bulk+push+buttons%2Cdiy%2C57&sr=1-8-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9tdGY&psc=1

£7.89 for 20

6x9.5x27mm

80g each

AA battery

https://en.wikipedia.org/wiki/AA_battery

51mm length x 15mm diameter

15 g

up to 1000 mAh

https://www.batterystation.co.uk/energizer-ultimate-lithium-aa-lr6-l91-batteries-120-pack/

£196.96 for 120

Motor

£8.58 for 10 (inc vat)

1.5 to 6v

760mA

30.5mm x 24mm diameter

10mm shaft 2mm wide

https://static.weg.net/medias/downloadcenter/ha0/h5f/WEG-motors-specification-of-electric-motors-50039409-brochure-english-web.pdf

Red LED

£72 for 1500 (inc vat)

5mm LED

max 25 mA

https://kitronik.co.uk/products/3504-red-5mm-diffused-led-275mcd?srsltid=AfmBOopvSgBPzPXosZB-6-9WR6GniK-RdNAO6wBN-uzxyt9row-Cg6wt

https://resources.kitronik.co.uk/pdf/3504_Red_5mm_LED.pdf

Alarm buzzer

https://kunkune.co.uk/shop/uncategorized/sfm-27-buzzer-alarm-90db-electronic-dc-3-24v/?attribute_colour=Black

48x30x15mm

9g

£1147.50 for 1500

15mm tall

3v to 24v range

Wire

https://www.amazon.co.uk/meters-black-cable-extension-suitable/dp/B0D5LF8Q2F/ref=sr_1_5?crid=3MFPV5Y3UJJPR&dib=eyJ2IjoiMSJ9.egR0oath_6qvAJ9bbUyfCx0ftVGGxYTlNmTXZKigt2DLHcMtW1deylrc42IAB_7o28zJgkFpfuZ-67Mk4IknUWOPVQDy-6uvYtEQXIPYLLGZvm2SylNJ8tPQgNfVUxg_7BWZqT0YVpv2aMmrXw0mLiBQR58brGtoScwB6dt-JbnZXf535Snlm2fsdC3ibzz_UDDFOxNzqIRx99H3Pp3XCGthGSNMDCxpsXB0Fzd0jOyACcWhiQI2wtcCAvgUpUfSUbiwarjIdZ2U-IIcyQHdH1kjyEYkwYz3dh0GsC5esuk.kEp385_OUYskubAobqHGr2s4sGn2ozJKERieaCYX6bY&dib_tag=se&keywords=wire+10m&qid=1745412402&sprefix=wire+10m%2Caps%2C76&sr=8-5

£5.25 per 10m (red and black each get 10m)

small locks

https://www.amazon.co.uk/APACALI-Cabinet-Security-Stainless-Mailboxes/dp/B0D9885BLV?source=ps-sl-shoppingads-lpcontext&ref_=fplfs&psc=1&smid=A24N5NUY13WMX8

£15.99 for 16

lock ==> 10x10x10mm

870g

(counter not needed as arduino can do that with the microcontroller)

https://forum.arduino.cc/t/does-arduino-have-hardware-counters/630522

Standards

CE marketting – products in european ecenomic area (EEA) must do these things, as gov.uk states:

- check and meet EU safety, health, and environmental requirements

- free movement of products in the european market

https://www.gov.uk/guidance/ce-marking

ISO 9001 – to get this we must be:

1. Monitoring and measuring equipment calibration records
2. Records of training, skills, experience and qualifications
3. Product/service requirements review records
4. Record about design and development outputs review
5. Record about design and development inputs
6. Records of design and development controls
7. Records of design and development outputs

8. Design and development changes records
9. Characteristics of product to be produced and service to be provided
10. Records about customer property
11. Production/service provision change control records
12. Record of conformity of product/service with acceptance criteria
13. Record of nonconforming outputs
14. Monitoring measurement results
15. Internal audit program
16. Results of internal audits
17. Results of the management review
18. Results of corrective actions

(source https://www.iso-9001-checklist.co.uk/iso-9001-requirements.htm)

ISO 9001 good because it shows international standards are met

- customer trust

-more sales

-more environmentally friendly product

-less competition

https://www.iso.org/standard/62085.html

ISO 13485 – health device standard for international medical products

- more trust with farmacies

-more consumer trust

https://www.qualio.com/blog/iso-13485-standard

ISO 22000

- food system safety

-increased customer safety as pills will be ingested by a person

- shows the product is food safe so pets or children wont be harmed by the product if tampered with

- high standard can beat competitors

https://www.highspeedtraining.co.uk/hub/what-is-iso-22000/#:~:text=ISO%2022000%20explains%20what%20businesses,bits%20of%20packaging%20or%20machinery.

FDA – US main food and drug safety association, but is often involved in international sales

- good credibility

- high standards

- shows the product is safe

https://www.perforce.com/blog/alm/how-get-fda-approval-medical-devices#:~:text=FDA%20approval%20means%20that%20the,device%20is%20safe%20and%20effective.

https://www.fda.gov/about-fda/what-we-do

Health and safety

HASAWA 1974

https://www.hse.gov.uk/legislation/hswa.htm

employers must keep employees and members of the public safe

employees must keep each other safe

self employed have to keep themselves and others safe

COSHH

https://www.hse.gov.uk/coshh/

law that requires you to control exposure to materials in the workspace that could cause harm to people while working

(doesnt cover lead, asbestos, or radioactive materials)

you have to do these things as the HSE states in this website (https://www.hse.gov.uk/coshh/basics/index.htm)

- find out what the health hazards are

- decide how to prevent harm to health (risk assessment)
- provide control measures to reduce harm to health
- make sure they are used
- keep all control measures in good working order
- provide information, instruction and training for workers and others
- provide monitoring and health surveillance in appropriate cases
- plan for emergencies

LOLER 1998

https://www.hse.gov.uk/work-equipment-machinery/loler.htm

the hse website states that if a business were to have anyone do any kind of lifting, they must:

- plan them properly
- using people who are sufficiently competent
- supervise them appropriately
- to ensure that they are carried out in a safe manner

Waste managment

https://phw.nhs.wales/services-and-teams/improvement-cymru/improvement-cymru-academy1/resource-library/academy-toolkit-guides/timwoods-toolkit/#:~:text=Page%20%7C%202,%2C%20defects%2C%20and%20skills%20utilisation.

TIMWOODS is an acronym used to identify the 8 wastes in manufacturing

- transportation

- inventory

- motion

- waiting

- over production

- over processing

- defects

- skills utilization

As a manufacturer we must minimise those wastes

Recyclability – both materials used for the body of the pill dispenser can be recycled as they are a softer thermoplastic that can be remelted and reused for other applications

electronic components if working can be reused on other products or sent back to their manufacturers to fix them and hopefully have them reused or resold by the company

Waste electrical and electronic equipment(WEEE)

Patenting

EPO – cheaper, faster, only in 39 european countries

https://www.epo.org/en/applying

WIPO --> PCT – more expensive, slower, but works for almost all countries, specifically 193 countries have to follow

https://www.wipo.int/pct/en/

Processes

the chosen process is injection moulding as complex parts can be made quickly in bulk, and we already have the machines for it, therefore its much cheaper

Injection moulding process

- clamping

- injection

- dwelling

- cooling

- mould opening

- ejection of part

Die costs can harm budget

3d printing could be a backup as though it is much slower, it can be of a good enough quality to use, however material would have to use filament and not pellets

Estimated costing

10kg polypropylene pellets OR 50kg HDPE pellets	£79 OR £25
Arduino nano	£5.80
Wire 10m	£5.25
Motors x 10	£8.58
AA batteries	£196.96 for 120

Red LED x 1500	£72
Small buzzer alarm x 1500	£1147.50
Push buttons	£7.89 for 20
Small lock and key x16	£15.99
Rubber sealing strips	£17.99 for 5m
Total market cost for all materials/components and their quantities	£1549.07

Assumptions

- labouring costs are £17 an hour

- it would take under 50 man hours to complete all the human-related work

- expense costs like lighting and working conditions are £1000 a month

- we have patent the design after designing it out of our own money to keep rights to it via EPO or WIPO, taking up to £5000 with how large of an office it is and how worthwhile it is to patent the technology

- that we own machinery for injection moulding, programming electronics, souldering, packaging, and conveyor belting to minimise human work

- die costs roughly £5000

(https://www.google.com/search?q=average+cost+of+manufacturing+an+injection+mould+die&sca_esv=a2fccd0347a25b28&rlz=1C1GCEA_enGB1159GB1159&ei=KvsIaJXuD7-GhbIPy4HmiQw&ved=0ahUKEwiVq-bTsO6MAxU_Q0EAHcuAOcEQ4dUDCBI&uact=5&oq=average+cost+of+manufacturing+an+injection+mould+die&gs_lp=Egxnd3Mtd2l6LXNlcnAiNGF2ZXJhZ2UgY29zdCBvZiBtYW51ZmFjdHVyaW5nIGFuIGluamVjdGlvbiBtb3VsZCBkaWUyBxAhGKABGAoyBxAhGKABGAoyBRAhGJ8FMgUQIRifBTIFECEYnwUyBRAhGJ8FMgUQIRifBTIFECEYnwUyBRAhGJ8FMgUQIRifBUiJbFDIBFiQanAHeACQAQCYAaIBoAGRIaoBBTM5LjEwuAEDyAEA-AEBmAI4oAKsIqgCCsICFBAAGIAEGJECGLQCGIoFGOoC2AEBwgIdEAAYgAQYtAIY1AMY5QIYtwMYigUY6gIYigPYAQHCAgsQABiABBiRAhiKBcICChAAGIAEGEMYigXCAhYQLhiABBixAxjRAxhDGI

MBGMcBGIoFwgILEAAYgAQYsQMYgwHCAggQABiABBixA8ICERAuGIAEGLEDGNEDGIMBGMcBwgIQEC4YgAQYsQMYQxjUAhiKBcICEBAuGIAEGEMYxwEYigUYrwHCAg0QABiABBixAxhDGIoFwgIHEAAYgAQYCsICBxAuGIAEGArCAgUQABiABMICBhAAGBYYHsICCxAAGIAEGIYDGIoFwgIHEAAYgAQYDcICBhAAGA0YHsICBRAhGKABmAME8QWdOLNNy74kKboGBAgBGAeSBwU0NC4xMqAHmfkCsgcFMzcuMTK4B5ki&sclient=gws-wiz-serp)

Part B – Brief

Recyclable material options

The automatic pill dispenser will can be recyclable as the chosen materials are all recyclable. This is because both polypropylene and HDPE are thermoplastics, which though they are softer, they can be re-melted or ground up into recycled pellets that could be used in other products. The Nitrile rubber, though not meltable like a thermoplastic because it is a thermoset elostemer (thermosetting rubber), it can still be ground up into pellets as long as it is not contaminated in any way. with the electronics we plan to recycle them if damaged at an electrical recycling plant as to abide by WEEE laws, keeping the atmosphere clearer and making less wastes.

Waterproofing technology

The plastics chosen and nitrile rubber will both ensure to make the pill dispenser waterproof as the nitrile rubber tubing will be used for making waterproof seals in the design, and the polypropylene or HDPE are both waterproof, since they are both plastics that are waterproof and resistant to certain chemicals and harmful substances, keeping the pills safe.

Opening/closing and locking mechanism

Our design for the product could use a small lock and key to ensure that only the pharmacy can open the product to refil or change the prescribed pills inside, and also to keep the user or people who shouldnt have the medication from taking the pills at not regulated times. We think either a revolving mechanism with a small openable plastic door or an inner chamber system would work as the existing products either use a small opening where the user can take the pills with a small door in the way or an enclosed system with a small opening which lets the user take the pills.

Ease of programming and end user ease of use

The product should have some sort of indication of how long it would take until the user can take their medication, and a way of setting the time. For this, we could either make a small labelled interface with LEDs and audible phrases to help in the setup and use of the product. This would also benefit us as having both a speaker and LEDs helps deaf or blind users who

need medication to easily know when to take it, and easier setup for the pharmacy as the audio should be clear enough and they would know how to operate it via the manual.

Key requirements for the dispenser unit

- must be smaller than 190x190x60mm size

- must weigh under 0.5kg fully laden

- must have 28 compartments where each compartment can hold at least 3 pills dimensioned as 20mm x 5mm diameter

- must have means to be battery powered

- must have means to be programmable to work once a day or twice a day

- must have means to alert the user

- must have means to activate the dispensing mechanism by a user

- must be tamper proof and be used repeatedly

- must have a locking mechanism

- casing must be made of recyclable materials

- must be waterproof

- batteries must last at least 28 days with the mechanisms power consumption

Material costs

assuming 10kg of plastic pellets can make 25 cases, all 5m of sealing strip, and 10 wire will be used, the cost for all possible components are as follows

Plastic chassis	£3.16 each (polypropylene) £0.20 each (hdpe)
Arduino nano	£5.80 each
Wire 10m	£5.25
Motors x 1	£0.89
AA batteries x4	£6.57

Red LED x 15	£0.72
Small buzzer alarm x 1	£0.77
Small lock and key x1	£1.00
Rubber sealing strips	£9.00 for 2.5m
Push buttons * 5	£1.97
Total cost per estimated unit	£32.17 per unit Therefore £96495 for all the materials for 3000 units

Manufacturing costs

Assuming labouring costs are £17 an hour, that it would take under 50 man hours to complete all the human-related work, that expense costs like lighting and working conditions are £1000 a month (5 work weeks), we have patent the design after designing it out of our own money to keep rights to it via EPO or WIPO, taking up to £5000 with how large of an office it is and how worthwhile it is to patent the technology, and that we own machinery for injection moulding, programming electronics, souldering, packaging, and conveyor belting to minimise human work, the estimated costs are as follows

Material costs	£96495
packaging	£5000
Expense costs	£7000 (maximum)
WIPO patent	£5000
Labour costs	£850
Die manufacture	£5000
total	£119000 (nearest £1000)

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https://www.google.com/search?q=is+nitrile+rubber+food+safe&sca_esv=a2fccd0347a25b28&rlz=1C1GCEA_enGB1159GB1159&ei=UOQIaKTeM6GehbIPnOOR0Aw&ved=0ahUKEwikxsrumu6MAxUhT0EAHZxxBMoQ4dUDCBI&uact=5&oq=is+nitrile+rubber+food+safe&gs_lp=Egxnd3Mtd2l6LXNlcnAiG2lzIG5pdHJpbGUgcnViYmVyIGZvb2Qgc2FmZTILEAAYgAQYkQIYigUyBhAAGBYYHjIGEAAYFhgeMgYQABgWGB4yBhAAGBYYHjIGEAAYFhgeMgYQABgWGB4yCxAAGIAEGIYDGIoFMgsQABiABBiGAxiKBTIIEAAYgAQYogRIuDRQ-QxY9zJwAngAkAEAmAGrAaABwQmqAQQxMi4zuAEDyAEA-AEBmAIRoALyCagCCsICDhAAGIAEGLADGIYDGIoFwgILEAAYsAMYogQYiQXCAgsQABiABBiwAxiiBMICFBAAGIAEGJECGLQCGIoFGOoC2AEBwgIQEAAYAxi0AhjqAhiPAdgBAcICEBAuGAMYtAIY6gIYjwHYAQHCAgsQABiABBixAxiDAcICDhAuGIAEGLEDGNEDGMcBwgILEC4YgAQYsQMYgwHCAggQLhiABBixA8ICChAAGIAEGEMYigXCAg4QABiABBixAxiDARiKBcICBRAAGIAEwgIFEC4YgATCAggQABiABBixA8ICCBAAGKIEGIkFmAMF8QV6KF5ZgyLYg4gGAZAGCLoGBAgBGAeSBwQxNC4zoAfeebIHBDEyLjO4B-sJ&sclient=gws-wiz-serp

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Task 2 Design

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	2
Evidence title / description	**Evidence expected for marking:** **Part A** 3D Sketches for two designs Supporting Calculations **Part B** Annotated CAD drawing for one preferred design (typically two A3size drawings) Reflective Notes (typically 500 words) **Evidence submitted for marking:** **Part A** Sketches for two designs Supporting Calculations **Part B** Annotated CAD drawing for one preferred design Reflective Notes
Date submitted by candidate	DD/MM/YY

2. Task 2 – Sketches and designs

Part A – sketches and designs

Sketch 1 – revolving pill dispenser

Calculations – Idea 1

The following calculations will be used to determine the material cost of the product, and total number of units possible with the maximum budget of £120000.

rubber ring:

$c = 2\pi r$

c = 2*3.142*86.5

c = 543.6mm of sealant (1 d.p.)

because 2.5m = £9 and 2.5m ==> 2500mm

$\therefore$ one seal for the unit is 546.6/2500 * 9 = £1.95

(assuming pi is 3.142)

max volume of plastic parts:

chassis:

(2 faces + cylindrical wall) – all holes/cutouts

V = $2\pi {r_1}^2 * 0.5 + (2\pi r_1 l - 2\pi r_2 l) - \left(13(\pi {r_3}^2)\right)/2 - (\pi 10^2)/2 - (6 * \pi 2.5^2)/2 - (4 * \pi 3^2)/2$

V = 17677.7 – (31.9 + 78.5 + 58.9 + 56.5)

V = 17839.7 mm^3

Lid:

V = = $\pi {r_1}^2 * 0.5 + (15^3 - \pi * 5^2 * 15) + (9 * 1 * 32)$ + ((2 $\pi 87.5^2$*15)-(2 $\pi 86.5^2 * 15$))-(78.5+58.9+31.9)

Volume = (circle top + cylinder 0.5mm thick + lock chamber + hinge – holes)

V = 12026.4 + 8199.6 + 2196.9 + 288 – 169.3

V = 22541.6mm^3

electronics casing:

V = 2((0.5*62*34)+(0.5*15*30))+3(0.5*15*25)+(0.5*17*25)+(0.5*30*25)+2(0.5*34*25)+(0.5*62*25) – (78.5+58.9+31.9)

Volume = (all faces – holes)

V = 5163.7mm^3

disk:

V= $2(\frac{\pi r^2}{2}) - (= \frac{\pi {r_1}^2}{2})$

(assuming the walls and bottom circle are equal area as the triangles have the same dimensions as the bottom part of the disk)

V = 22698-4417.9 = 18280.1mm^3

Base:

Volume = bottom circle + key chamber + tray – chassis bottom plate – dispenser door + tray

V = = $\frac{\pi(87.5)^2}{2} + \left((2\pi(87.5) * 35) - (2\pi(86.5) * 35) - (0.5 * 15 * 15)\right) + (35 * 15 * 15 - \ \pi(5)^2 * 30)$ + (0.5*15*30) + (0.5*15*10*2)

v = 18252.6mm^3

total plastic volume = 17839.7 + 22541.6 + 5163.7 + 18280.1+18252.6 = 82084mm^3 ==> 82.084cm^3

d=m/v

m = dv

total plastic mass = 82.084*0.965 = 79.2 grams

∴ cost of plastic parts = 79.2/25000 * 500 = £1.58 per unit

this means that each unit consisting of the lid, disk, chassis, main body, and electronics housing would cost

Plastic parts	£1.58
Arduino nano	£5.80 each
Wire 1m	£0.53
Motors x 1	£0.89

AA batteries x4	£6.57
Red LED x 6	£0.29
Small buzzer alarm x 1	£0.77
Small lock and key x1	£1.00
Rubber sealing strips	£1.95
Push buttons * 5	£1.97
Total cost per estimated unit	£21.35 Therefore £64050 for all the materials for 3000 units

manufacturing costs

Material costs	£64050
packaging	£5000
Expense costs	£7000 (maximum)
WIPO patent	£5000
Labour costs	£850
Die manufacture	£5000
total	£86900 for 3000 units

	4500 units can be made in budget (costing 96075)

battery life (all running):

4 AA batteries ==> 4000mAh

arduino = => 0.32mAh

motor ==> 0.21 mAh

max 6 LEDs ==> 2.5mAh

buzzer (assumed) ==>0.5mAh

battery consumption = 0.5+2.5+0.21+0.32 = 3.53 mA an hour

∴ 4000/3.53 = 1133.4 hours ==> 47 day battery life

weight:

7 (arduino) + 79.2 (plastic) + 9 (buzzer) + 15 (motor) + 60 (batteries) + 12 (assumed for 6 LEDs)

total weight = 182.2g

Assumptions

- labouring costs are £17 an hour

- it would take under 50 man hours to complete all the human-related work

- expense costs like lighting and working conditions are £1000 a month

- we have patent the design after designing it out of our own money to keep rights to it via EPO or WIPO, taking up to £5000 with how large of an office it is and how worthwhile it is to patent the technology

- that we own machinery for injection moulding, programming electronics, souldering, packaging, and conveyor belting to minimise human work

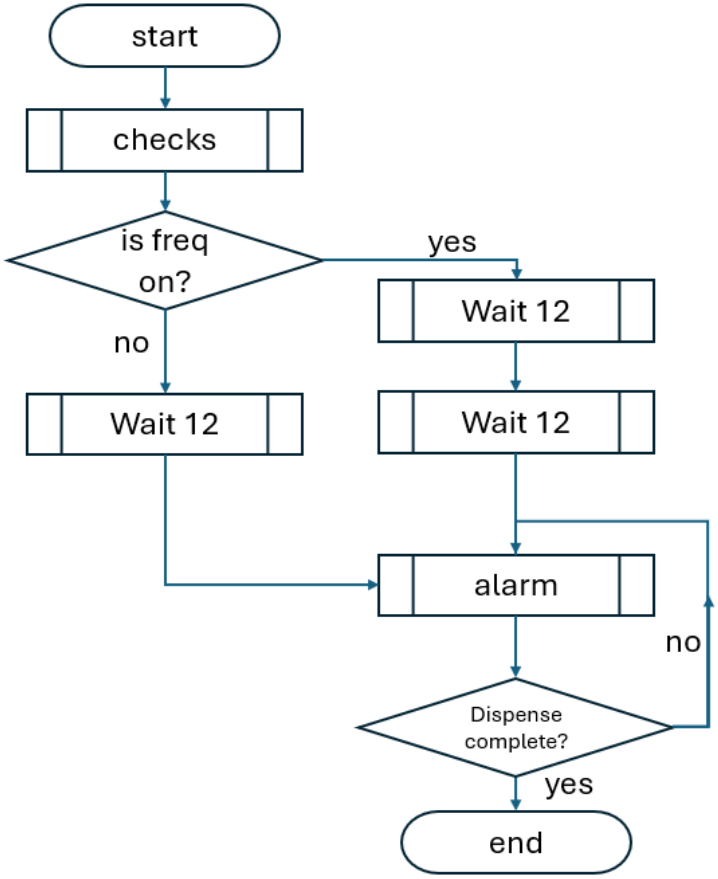
- die costs roughly £5000

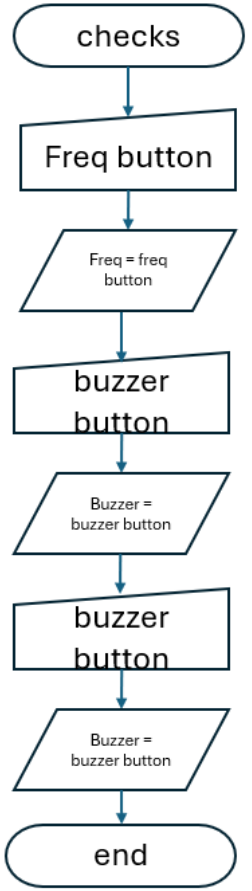
- 1m wire used per unit

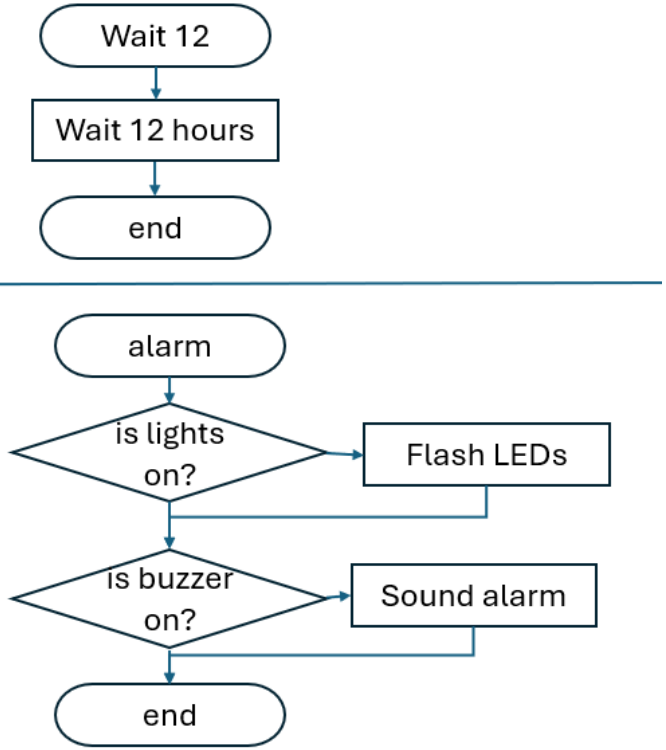
- making more than 3000 units will also increase labour costs and machine uptime costs

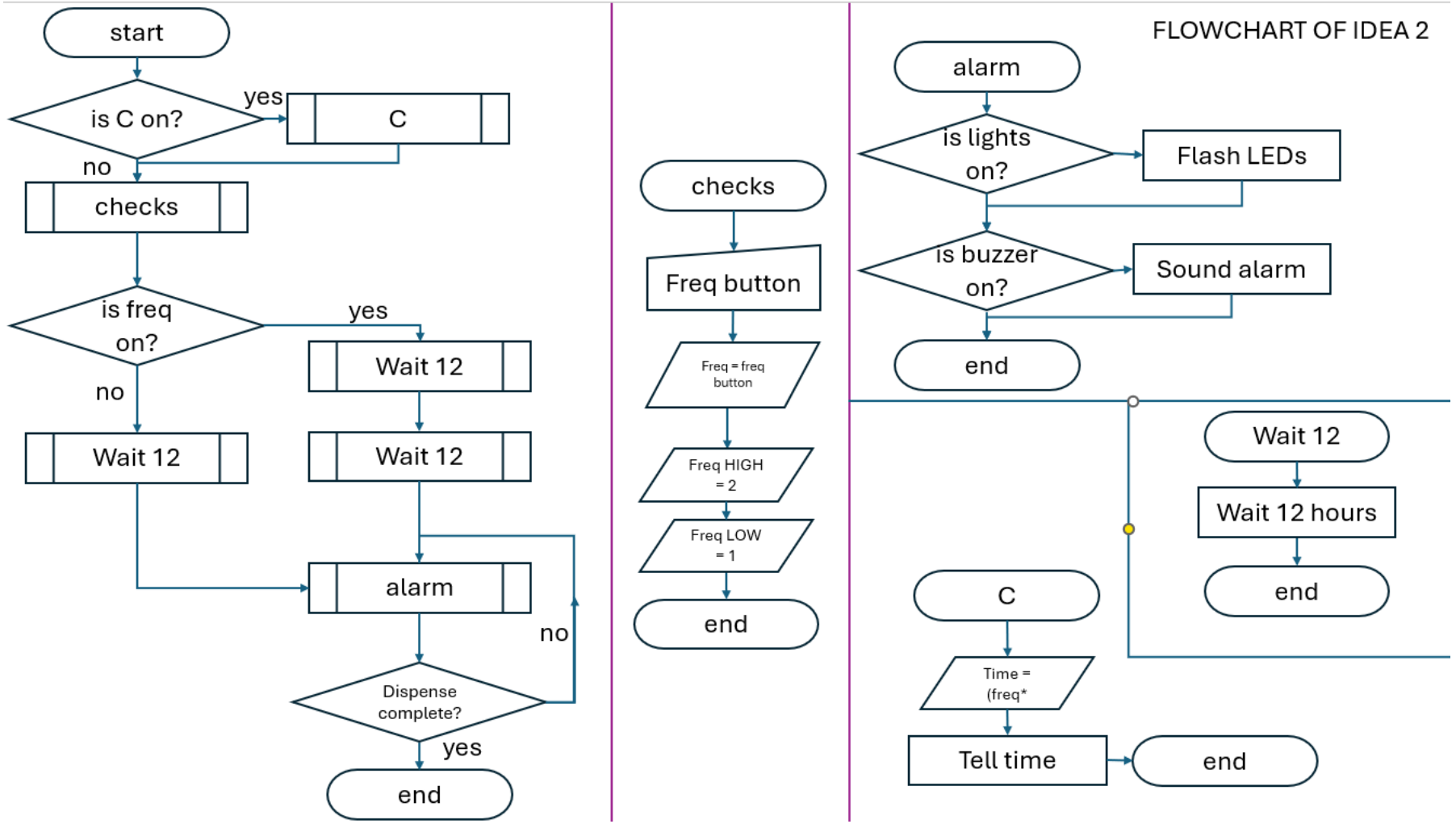
Flowcharts

FLOWCHART OF IDEA 1

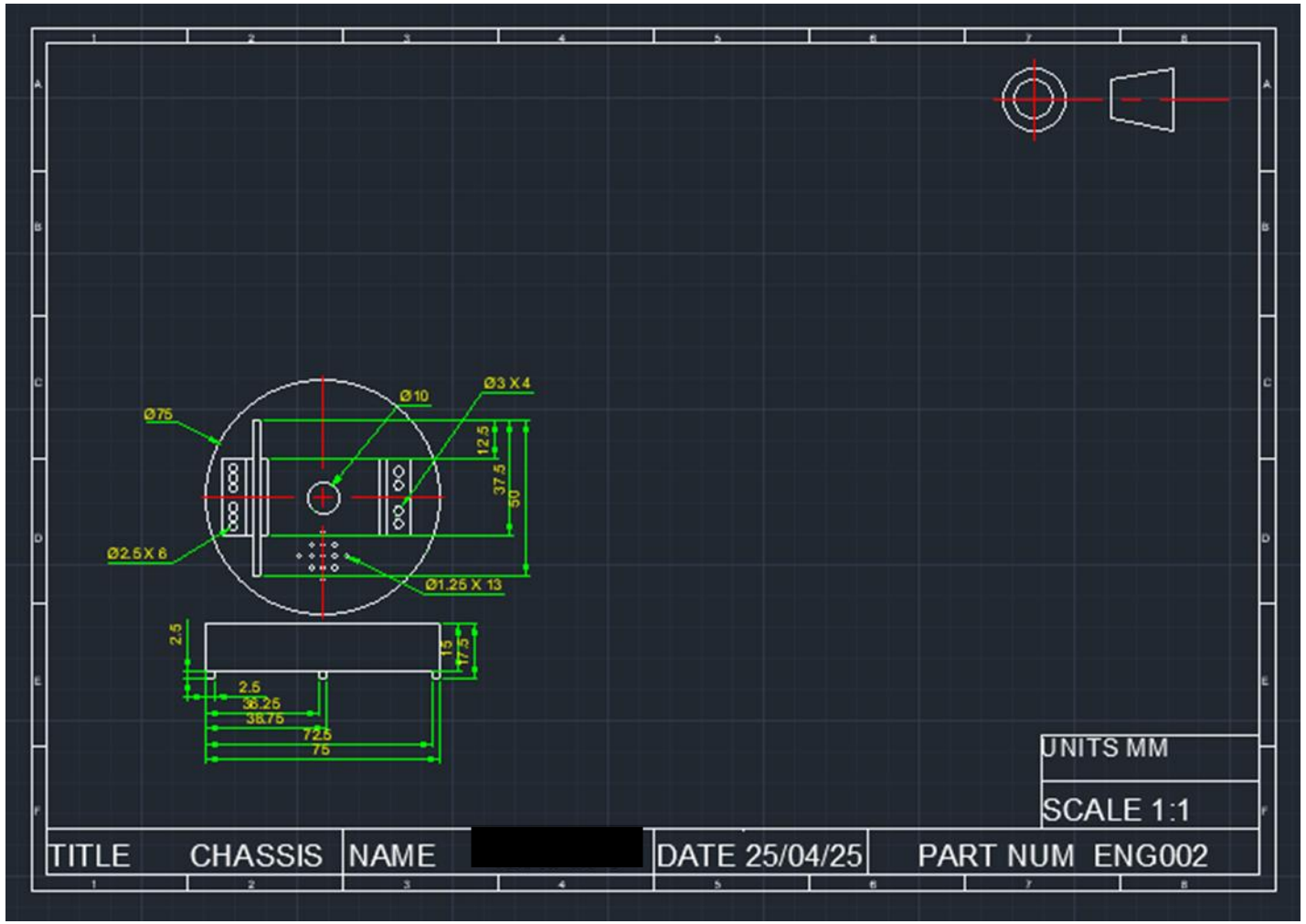


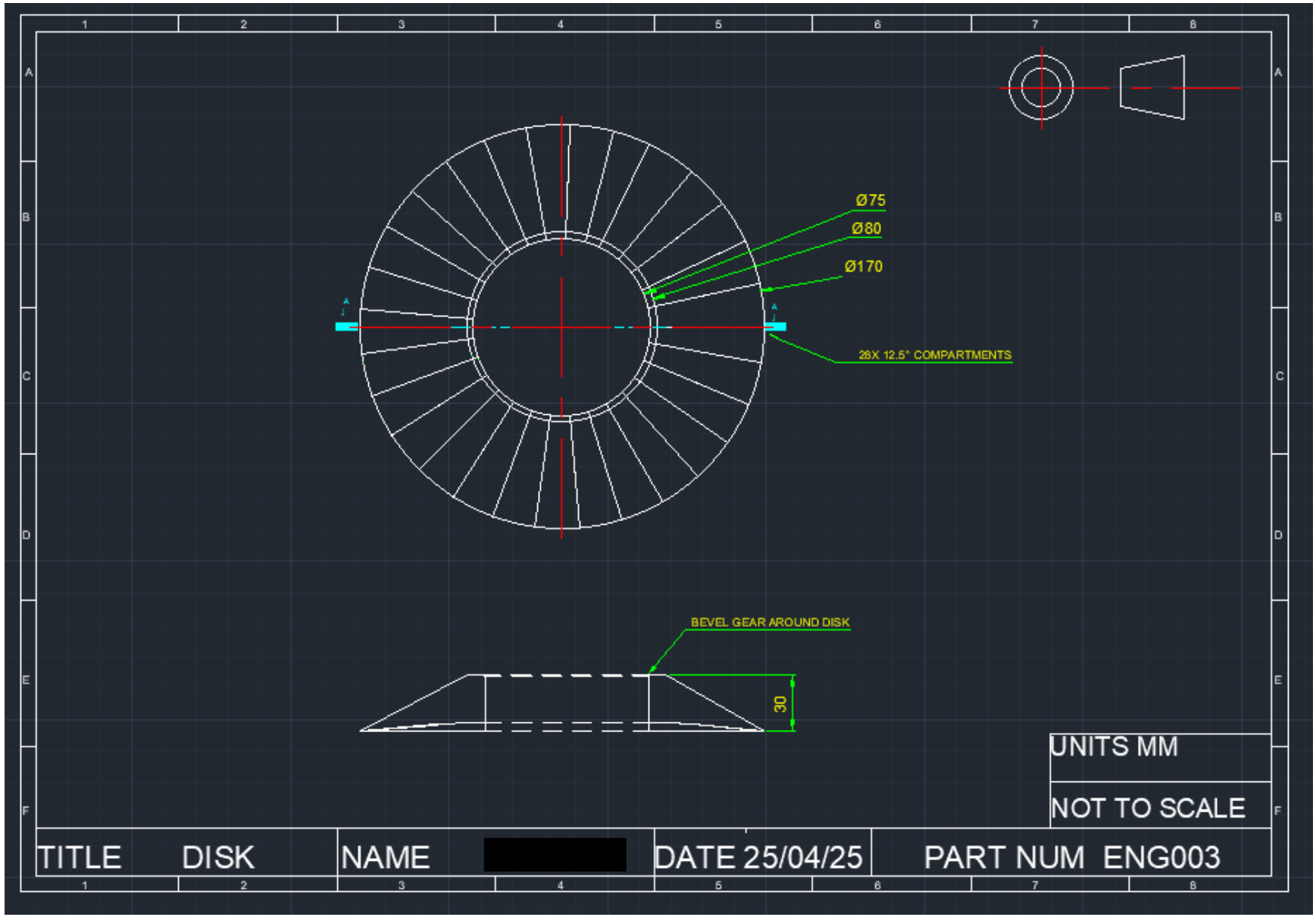


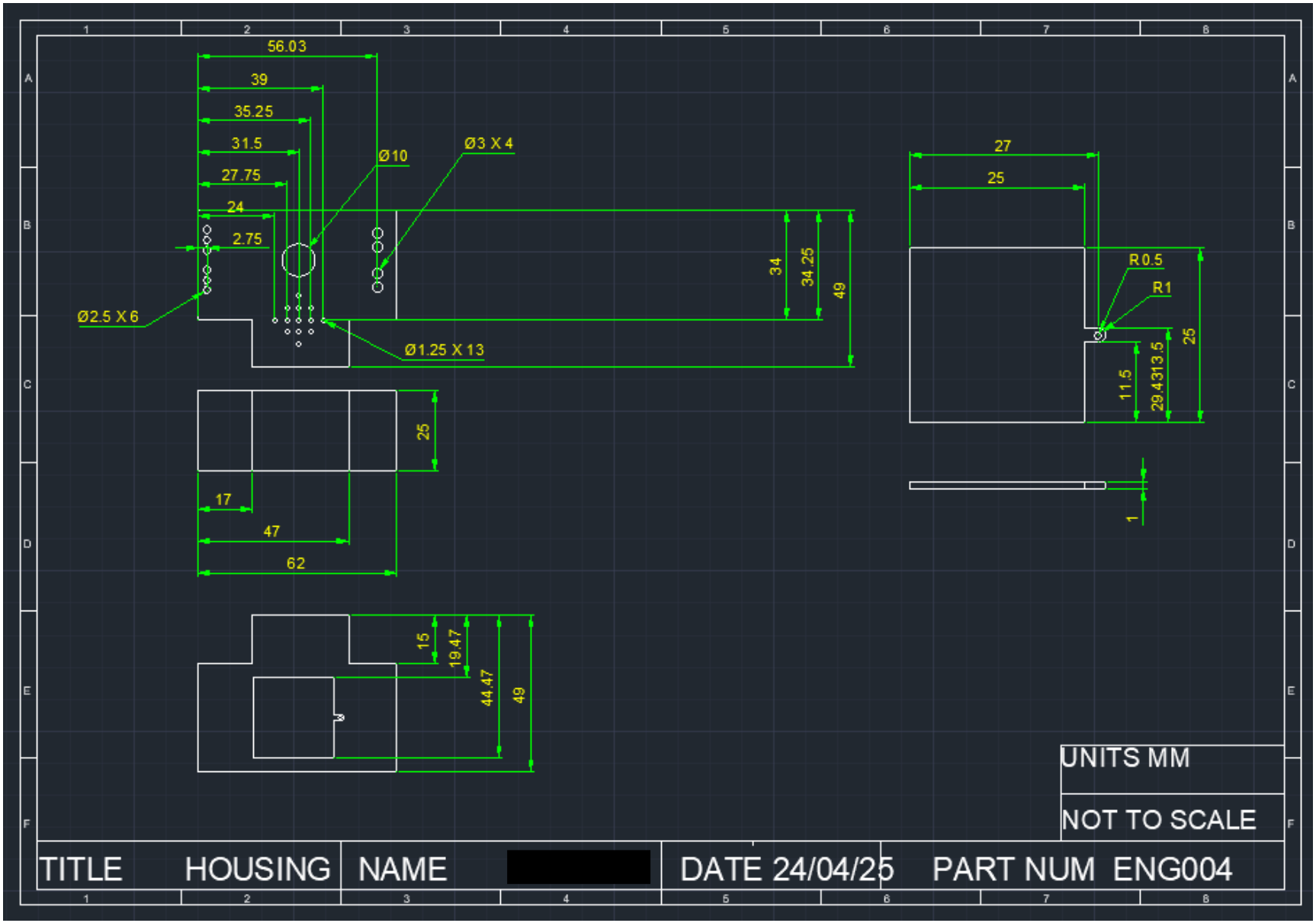


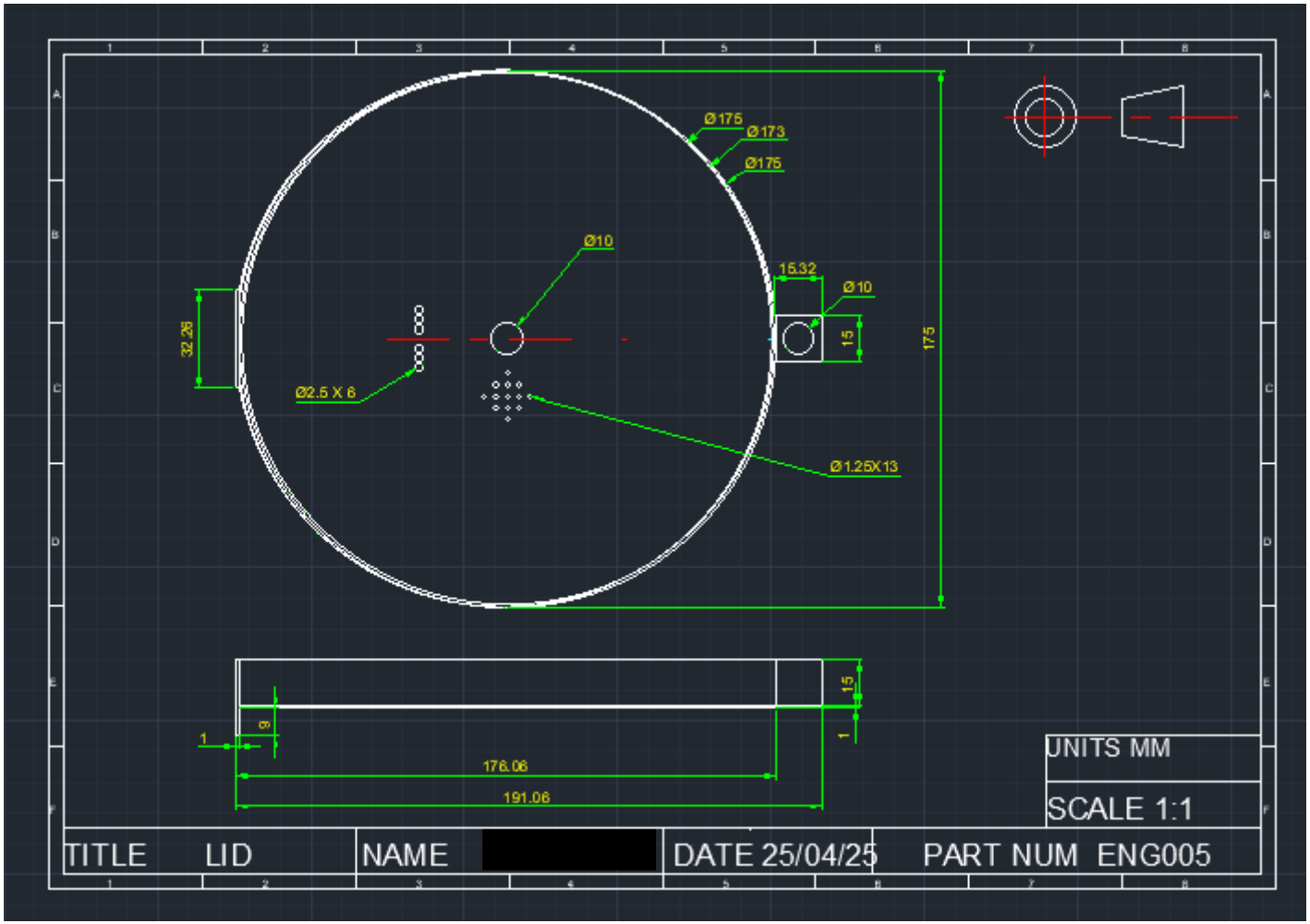

start
is C on?
yes
C
no
checks
is freq on?
yes
Wait 12
no
Wait 12
Wait 12
alarm
no
Dispense complete?
yes
end
checks
Freq button
Freq = freq button
Freq HIGH = 2
Freq LOW = 1
end
FLOWCHART OF IDEA 2
alarm
is lights on?
Flash LEDs
is buzzer on?
Sound alarm
end
Wait 12
Wait 12 hours
end
C
Time = (freq*
Tell time
end

Chosen idea’s CAD drawings

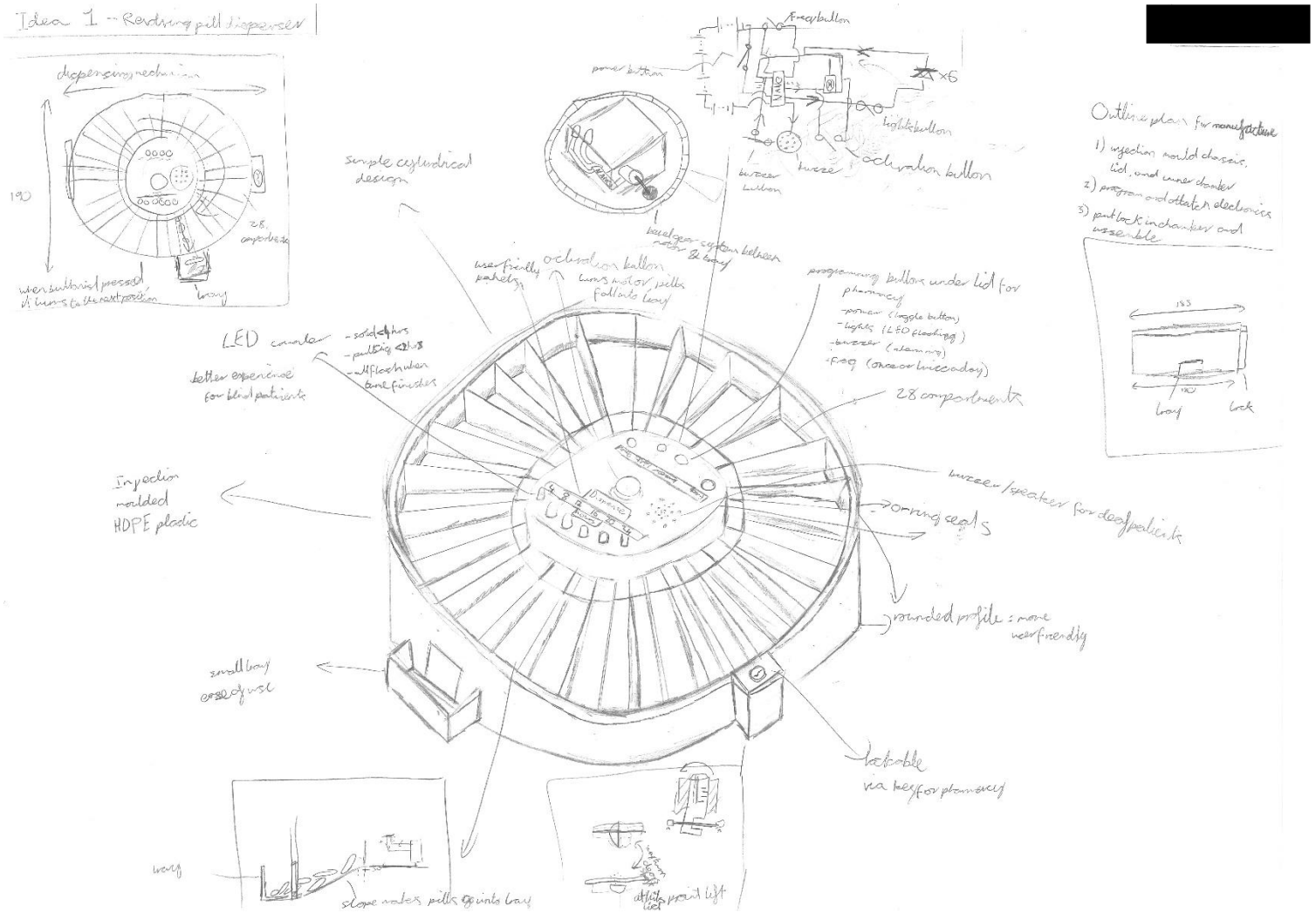



Ø75
Ø80
Ø170
28X 12.5° COMPARTMENTS
BEVEL GEAR AROUND DISK
30
UNITS MM
NOT TO SCALE
TITLE DISK
NAME
DATE 25/04/25
PART NUM ENG003

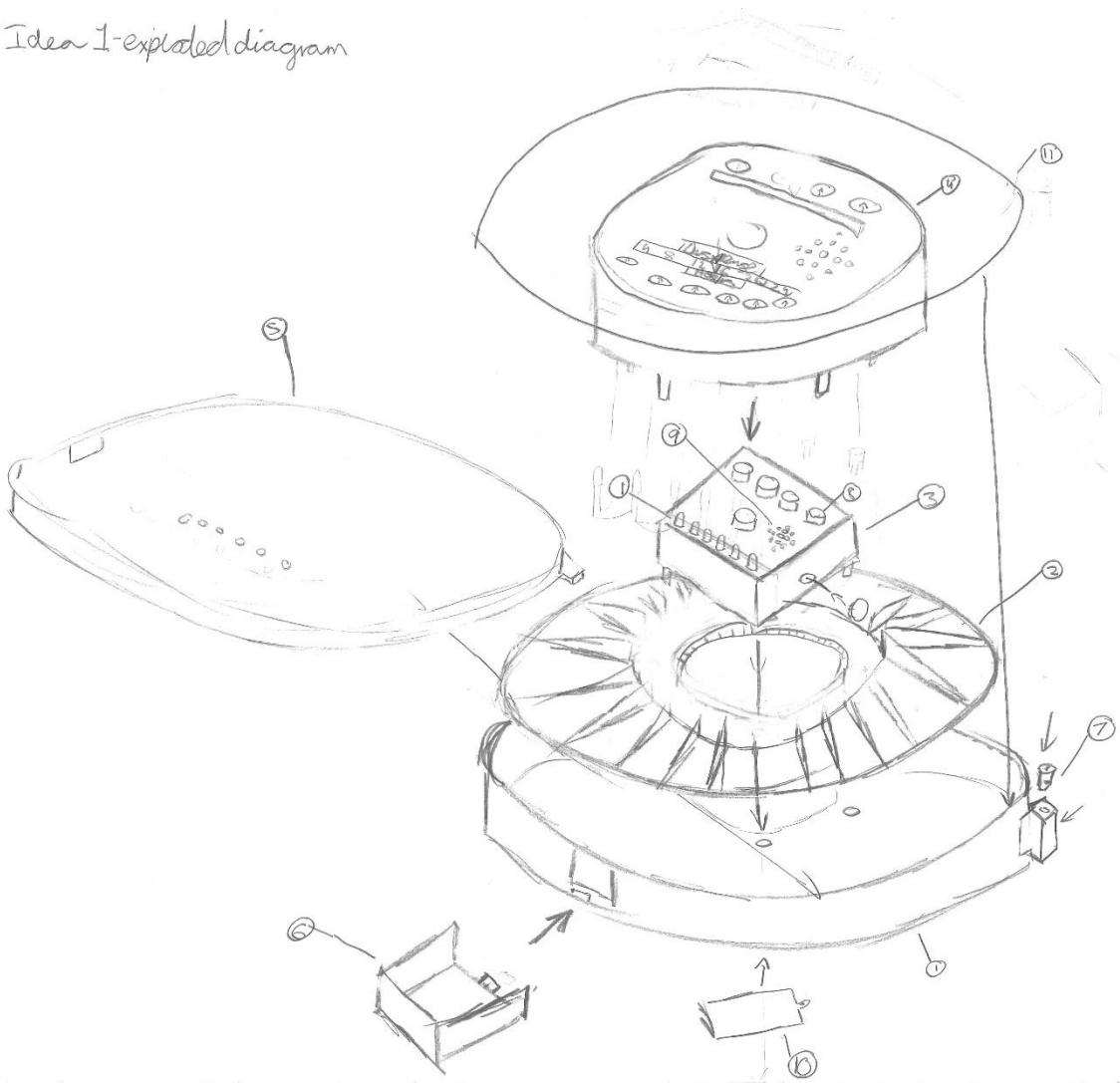

56.03
39
35.25
31.5
27.75
24
2.75
Ø10
Ø3 X 4
Ø2.5 X 6
Ø1.25 X 13
34
34.25
49
27
25
R0.5
R1
11.5
29.43
13.5
25
1
25
17
47
62
15
19.47
44.47
49
UNITS MM
NOT TO SCALE
TITLE HOUSING
NAME
DATE 24/04/25
PART NUM ENG004


Ø175
Ø173
Ø175
Ø10
15.32
Ø10
15
175
32.26
Ø2.5 X 6
Ø1.25X13
15
9
1
1
176.06
191.06
UNITS MM
SCALE 1:1
TITLE LID
NAME
DATE 25/04/25
PART NUM ENG005

Sketch 1 – revolving pill dispenser



Idea 1-exploded diagram



1: TRAY ENG00 6

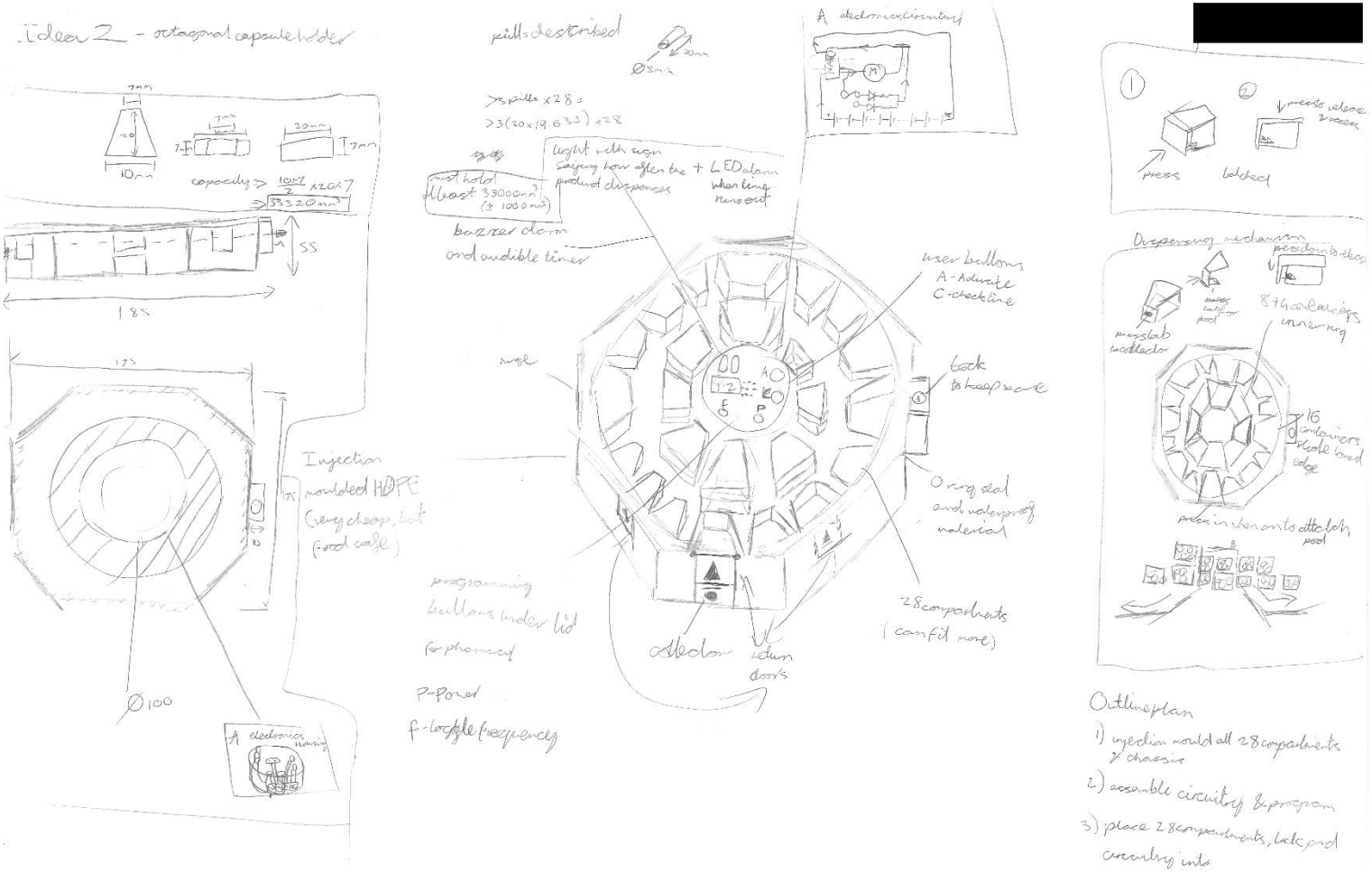
2: DISK/ENG 003

3: HOUSING/ENG004

4: CHASSIS / ENG002

5: LID /ENG-005

Sketch 2 – octagonal pill capsule dispenser



Part B – reflective notes

must be smaller than 190x190x60mm size	Measures out at 190*190*50mm
- must weigh under 0.5kg fully laden	Weighs 182.2g
- must have 28 compartments where each compartment can hold at least 3 pills dimensioned as 20mm x 5mm diameter	Has 28 compartments and each compartment has a big enough area
- must have means to be battery powered	Powered by 4 AA batteries
- must have means to be programmable to work once a day or twice a day	Frequency button allows reprogramming of how often it dispenses
- must have means to alert the user	LEDs and alarm buzzer to alert the user
- must have means to activate the dispensing mechanism by a user	Dispensing motor moves tray to full compartment which pushes pills into a small tray
- must be tamper proof and be used repeatedly	Motor can run for about 50000 cycles before showing any wear
- must have a locking mechanism	Lockable via lock and key
- casing must be made of recyclable materials	Recyclable metal lock, HDPE body
- must be waterproof	O ring seal makes lid waterproof and rest fully enclosed apart from dispensing tray which is covered by the lid
- batteries must last at least 28 days with the mechanisms power consumption	Battery lasts 47 days

Task 3 Plan

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	3
Evidence title / description	**Evidence expected for marking:** **Part A** Programme of work (two sides of A4) **Part B** Supporting Statement (typically 1000 words) **Evidence submitted for marking:** **Part A** Programme of work **Part B** Supporting Statement
Date submitted by candidate	DD/MM/YY

3. Task 3 – Plan

Part A – Programme of work

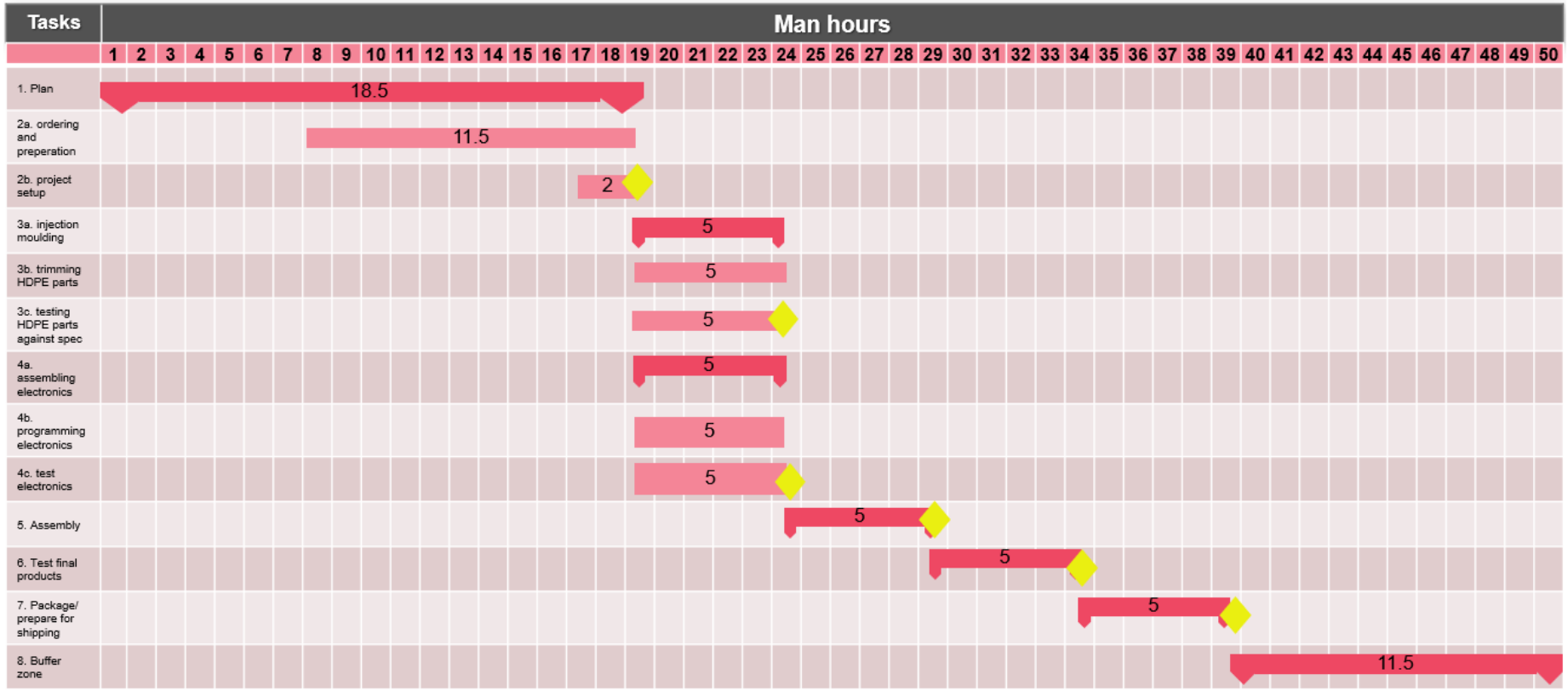
Expected costs:

Material costs	£64050
packaging	£5000
Expense costs	£1000
WIPO patent	£8000
Labour costs	£3136.50
Die manufacture	£25000
total	£106,186.50 for 3000 units

Key stages in form of a Gantt chart

Expected timeline – automatic pill dispenser

Estimated man hours
23/04/2025 to /2025

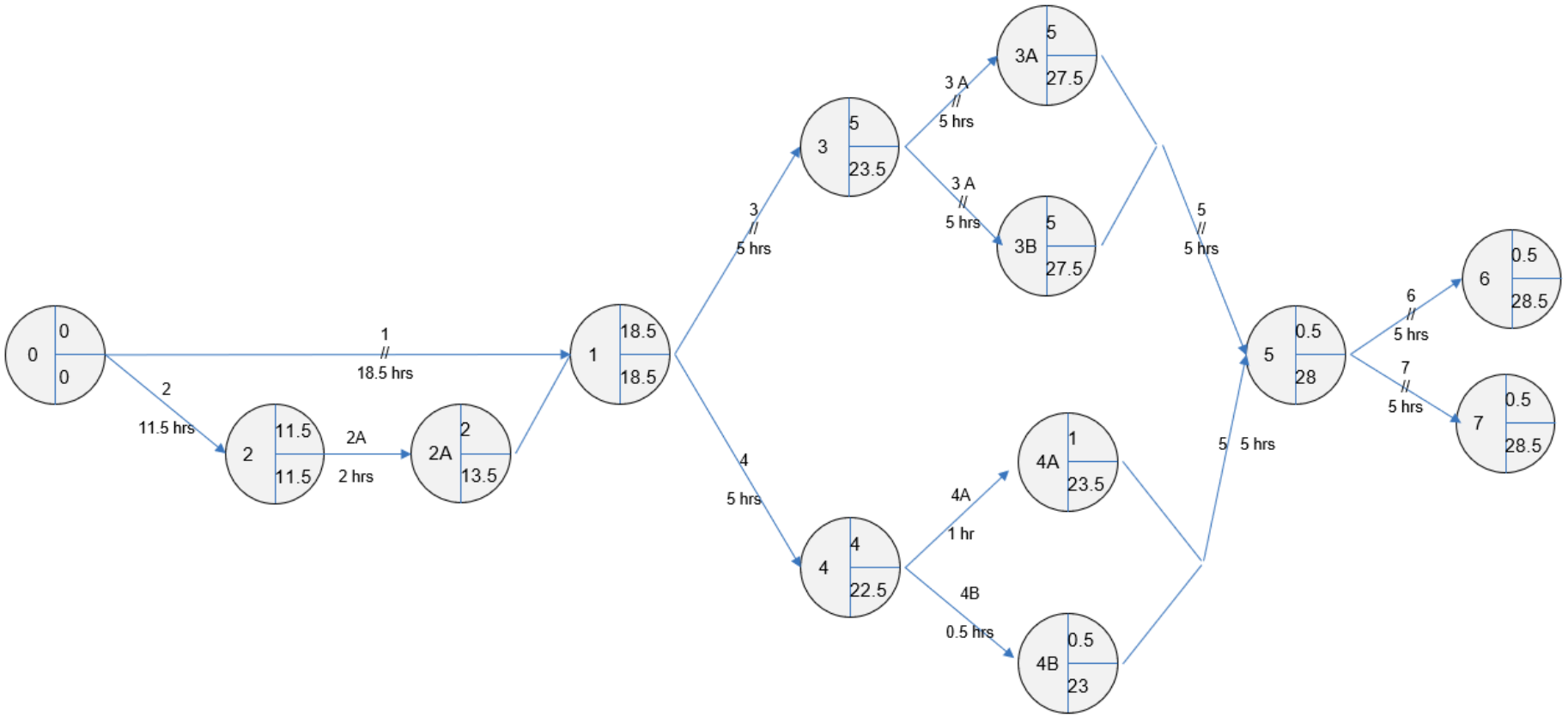


Critical path of project

Critical path information

Task	Duration (man hours)	Start date – end date
1) Planning & patenting	18.5 hours (1 person)	23/04/25 – 01/05/25
2) Ordering parts, materials, and dies, hiring workers	11.5 hours (1 person)	28/04/25 – 01/05/25
2A) Setup of machines	2 hours (4 people)	05/05/25 – 06/05/25
3A) Injection moulding	5 hours (not paid, done by 75 automatic injection moulding machines)	06/05/25 – 07/05/25
3B) Trimming plastic parts	5 hours (not paid, 15 specialist automatic machines)	06/05/25 – 07/05/25
3C) Testing part tolerances	5 hours (1 person)	06/05/25 – 07/05/25
4A) Assemble electronics	5 hours (not paid, 10 machines)	06/05/25 – 06/05/25
4B) Program electronics	1 hour (not paid, 10 machines)	06/05/25 – 06/05/25
4C) Test electronics	0.5 hours (10 people)	06/05/25 – 07/05/25
5) Assembly	5 hours (10 people)	07/05/25 – 08/05/25
6) Test products	5 hours (10 people)	07/05/25 – 08/05/25
7) Packaging	5 hours (10 people)	07/05/25 – 08/05/25
8) [Buffer time]	11.5 hours	08/05/25 – 08/05/25

Critical path diagram



Resources and machines used

Machine/tool used	Purpouse	Specialist equipment requirements
Injection moulding machine	Melts thermoplastic pellets into a liquid plastic that gets pressed into a die	Process knowledge, health and safety knowledge, how to operate safely and how to secure to be safe
Die	A part for an injection moulder that has an internal shape for the part used that gets ejected when cooled	Assembly knowledge
Sand blasting machine	An automatic machine that blasts sand onto a surface to make it more textured and to smoothen corners and edges	None
Soldering machine	An automatic machine that solders together circuits	Risk of electronics and how to shut machine off
Programming machine	An automatic machine that taps into the microcontrollers data lines and programs the required code into the board	Risk of electronics and how to shut machine off
Vernier calipers	Measuring tool used for testing tolerances	
Conveyor belts	An automatic belt that helps transport parts into where they need to go	Logistics knowledge and expertise

Part B – Supporting Statement

Quality control

Quality control is the practise which helps us reduce faults. We will sample check our products every 20 products to check for any defects at which any defective products will be re-made. Quality assurance is also a large part of ensuring quality is up to standard, therefore we will ensure we comply to ISO 9001 standards to ensure our products are within specification and regulation which will result in less defections and wasted time.

Key stages of the project:

1) Patenting

The first stage in out project right after planning would have to be patenting to the EPO or the WIPO for either a european or international patent respectively. This is vital for our company as it means our design would become intellectual property that the client could also own to keep rights for the special design features of our product. The whole process could take up to 2 years however we get some of the rights for the idea as soon as we apply for the patent, and when it is finallised up to a year later, then we would have rights for the design for roughly about 10 years. It is estimated to cost about £7000 to patent to the WIPO so our maximum charge for patenting will be £8000.

2) Supplying:

One of the key stages of this project is the supplying of our materials, components, machinery, and its preperation towards the next part in the project. As we are with good relations with suppliers, we hope to get all the materials, dies, and electronics within 22.5 man hours into the project (not including weekends). We expect the dies to come in first as then we can prepare for the production by replacing the dies on the injection moulding machines, and then can test them with an engineering qualification model (EQM) before starting the full scale production.

3) manufacture:

This stage is the bulk in the project as it is where all the planning goes to be turned into the physical product. Our manufacturing line is split into 3 sections, the injection moulding and treating, the electronics assembly and programming, and then the overall assembly of the product. Injection moulding is the process where a machine takes in plastic pellets (in our case HDPE), pushes it through a heated screw that melts the pellets into a liquid plastic, and then presses said plastic into a die, which makes the plastic take the shape of the desired product. We have 5 parts we'll be making with this

process, the base, the revolving disk, the chassis, housing for the electronics, and the lid, making a total of 15000 parts needed to be made. Having 10 large injection moulding machines that can make 5 sets of all 5 parts in one die each minute, means we can make all 15000 parts in 5 hours. the next process when making the plastic parts is trimming and making the product safe. For this we have 15 sand blaster machines

that would smooth down edges and cut through the plastic supports which we make easily removable to make the product not have sharp edges or damage. At the end one inspector looks through and quickly checks all units for visual defects or sharp edges before putting them onto a conveyor belt which double checks with a high definition camera.

The second section in this project's manufacturing is the electronics of each unit, which consists of an arduino nano, a DC motor, a small buzzer alarm, 6 LEDs, and a battery compartment put on when its assembled via automatic soldering machines. We'll use the previously mentioned soldering machines to connect the components together cleanly and quickly to make all 3000 sets of electronics with our 10 soldering machines we can do it in 5 hours assuming each machine can do one unit's electronics in one minute. After this our 10 programming machines would press against the data lines of the arduino and program 5 arduinos at a time each minute totalling all 3000 units in an hour. Finally we get 10 people to check the electronics totalling 0.5 hours each using our multimeters then sending it onto the conveyor to the next station where sensors check all the electronics weights and high definition camera inspection, they are then ready to assemble

4) assembly

After making both the hardware and software of the body and electronics, we get 10 people working 10 hours each to assemble, thoroughly test and check the units against the specification, and package the units into boxes and environmentally friendly cardboard casings to be ready to ship out

5) shipping:

Although we didnt include this in our process of work, it is vital to know we will send all 3000 units at once to the client via an agreed apon service or their own shipping method if they have one. This is because anything that happens after we send the order to the client we are not legally responsible for anything that happens in the delivery phase.

Standards

FDA – The Food and Drug administration is one of the main Standards people look for in the USA and generally internationally as it is one of the most well known standards for food products and health products. We'll work towards this standard as it is good for

credibility and ensuring our product is food safe as pills will be injested from the product and we do not want to cause harm via the main use of this product. This standard expects us to maintain products healthy towards anything it stores, meaning nothing like BPA plastics that could cause harm if injested in any way.

ISO 9001 is the international standard for products to ensure that they are made as effectively and efficiently as possible. We will conform to this standard as it would also give good credibility to our product, but also to show to customers that we do things in such a way that keeps the environment healthy with our recycling and reusing of damaged or defective parts or materials, setting us apart from competitors

ISO 13485 is the international standard for health and medical products. Awareness of this and conforming to it would drastically benefit us as this product is a health product made to help patients who might not take their medication regularly or at allotted times, and a product with such a lisence would be yet another thing that would set us apart from competitors internationally, making sales for the client easier.

ISO 22000 is the internationally recognized standard for food safety of products and services. Though we are not necessarily a food product, it is still a vital standard to work towards as we are focused on the fact that our products should be food safe if it would hold something which a person would injest, this is because we believe if we do a sub-par job with our material choices or manufacturing processes we could harm users by having for example a toxic to health material or process that could poison users and make our products look untrustworthy. To comply with this our research prioritised food safe materials and chose HDPE for the chassis as we knew food containers are made of HDPE, but also nitrile rubber which is food safe and well known for being one of the main materials used in sterile gloves.

Waste managment/environmental considerations

Below I will explain how we conform towards minimising wastes, organised by the recognised acronym, TIMWOODS.

Transportation – this waste mainly considers the transport of raw materials, components, and later the final product. this is a waste as time is not used on the process which would increase the value of the product, which in turn makes it a loss of value. We try to mitigate the problem by using local suppliers as much as possible so transport isnt overly hindered by waiting for them to deliver to us, but we cannot do anything about any problems that arise in the delivery phase.

Inventory – this waste involves the space wasted by keeping products, components, and raw materials in storage. For this waste we try to reduce the product count as low as possible by only ordering enough for the project, and holding the materials,

components, and products for as little time as possible, which is why our project is 50 man hours, finishing in about a week so that we can use the space after the project

Movement – The waste of users moving the product from one space to another for the next step of the manufacturing process. We reduce this risk by using a lot of high end conveyor belt systems developed over many years of the PDCA cycle and making work more efficient. These belts help us as users wont have to move the product or component to the next process as when they are done they just place the product on the belt for a machine or another user to continue the process

Waiting – This waste is mainly about waiting between processes resulting in time lost. To reduce this risk as much as possible I made a critical path showing the longest process. This is useful as we can do the non-critical processes in time to finish all concurrent stages at once.

Overproduction – This waste is about making too many products than required by the client, resulting in more time and money spent on machine time, but also in inventory as it is still a fully funtional product or raw materials/components. To try mitigate this waste, we make only about 5 extra units in case the client wants backups if shipping damages any units, but we would also reuse the raw materials on other projects if the client is ok with it, with us even being able to offer reimbursals for any excess materials that we could use which they paid for

Overprocessing – The waste of time by making a product with tolerances way too tight for the application. This is a waste as usually such tolerances would need more specialist knowledge in workers, or more time to make the tolerances so tight. To try to minimise this risk, we incorporate six sigma with our existing products to find out that our tolerances should be about ±0.25mm as our plastic parts are 0.5mm wide.

Defects – This waste is about any defective parts that occur in our process, for example with this project, the sand blaster could break the plastic parts when smoothing the edges if not tuned. For this we encourage our employees to work but also keep an eye out on any gauges, fill levels, and anything else that could be a problem as the people working on the machines know them best, especially if something goes wrong. This maintenance and preventative mindset is valued so if we see employees going out of the way to ensure no defects occur from malfunctions would be definitely rewarded with bonuses and raises.

Skills not used – This waste is mainly about our workers' skills and not using them to the fullest extent possible. this is a waste as if someone lower down in the factory, like a cleaner or machine operator could also work with managment, then we would lose their potential value in the company. For this reason, we try to keep a good eye on our employees in work hours to see if they have more potential than what they are just doing at the moment, for example a machine operator having good non-utilised leadership

skills or organizational skills, and offer them bonuses and maybe even raises for better positions with training to keep the workers skills optimised and also keeping the workers happy knowing they are a valuable part of the process.

Assumptions

below are all the assumptions we made for this document

- labouring costs are £17 an hour

- it would take under 50 man hours to complete all the work

- expense costs like lighting and working conditions are £1000 a month

- we have patent the design after designing it out of our own money to keep rights to it via EPO or WIPO, taking up to £5000 with how large of an office it is and how worthwhile it is to patent the technology

- that we own machinery for injection moulding, programming electronics, souldering, packaging, and conveyor belting to minimise human work

- die costs roughly £5000

- 1m wire used per unit

- making more than 3000 units will also increase labour costs and machine uptime costs

- we have enough space to hold all the materials, components and products

Health and safety

Hazard	Risk	Likelyhood (/5)	Severity (/5)	Overall risk score (/25) Low (1-4) Medium (5-17) High (18 – 15)
Working with chemicals	Worker passing out from fumes	2	3	6
Working with chemicals	Corrosive material can cause damage to workers	1	2	2
Working in a workplace	Slips, trips, and falls could occur, causing damage to workers, their peers, or the machinery	2	1	2
Working with hot plastics	Workers could burn themselves if not careful	2	3	6
Working with electronics	Workers could electrocute themselves or zap the electronics via Electromagnetic discharge	2	1	2
Working with heavy machinery	Workers could get crushed if a mechanical failure were to occur	1	5	5

For our work to be safe, we will be working within regulation of the health and safety at work act (HASAWA) of 1974, and the Control of substances hazardous to health law (COSHH)

The health and safety at work act of 1974 (HASAWA 1974) is an act which states that all employees are to keep themselves and others safe, for employers to keep themselves, employees, and members of the public safe, and for private contractors to keep themselves and others safe when at work. This means for us that we would take precautions to keep all workers safe when working, including our buildings having signs on the floor to indicate hazards when near machines, or where users can walk and cant, and also where to be careful if conveyor belts are used to move our products up around the building. Additionally, Something we do to comply with HASAWA is ensure all staff are trained to do what they're supposed to, with knowing all the security features of all the machines and tools we have, what PPE (protective personal equipment) to use, and what to look out for if there is a problem.

COSHH, the Control of substances hazardous to health law, is there to ensure anybody working with any chemicals is to know how to be safe using them, how to store them, and what to do with them. Our site teaches this alongside safety training for machines, including where to our COSHH locker is on site, what to be careful of when handling and working with hazardous chemicals and substances, and ensure that anyone working with hazardous chemicals to have the correct PPE and the 3 layers of ventilation of all times, personal, station-based, and site-based, those being the ventilator masks, station air conditioning, and the site wide air conditioning respectively.

Specialist equipment requirements

Machine/tool used	Purpouse	Specialist equipment requirements
Injection moulding machine	Melts thermoplastic pellets into a liquid plastic that gets pressed into a die	Process knowledge, health and safety knowledge, how to shut off safely and turn back on to continue as it is automatic
Die for injection moulders	A part for an injection moulder that has an internal shape for the part used that gets ejected when cooled	Assembly and disassembly knowledge
Sand blasting machine	An automatic machine that blasts sand onto a surface to make it more textured and to smoothen corners and edges	How to shut on and off the machine and calibrate it
Soldering machine	An automatic machine that solders together circuits	Risk of electronics and how to shut machine off
Programming machine	An automatic machine that taps into the microcontrollers data lines and programs the required code into the board	Risk of electronics and how to shut machine off
Vernier calipers	Measuring tool used for testing tolerances	none
Conveyor belts	An automatic belt that helps transport parts into where they need to go	Logistics knowledge and expertise

Task 4 Present

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

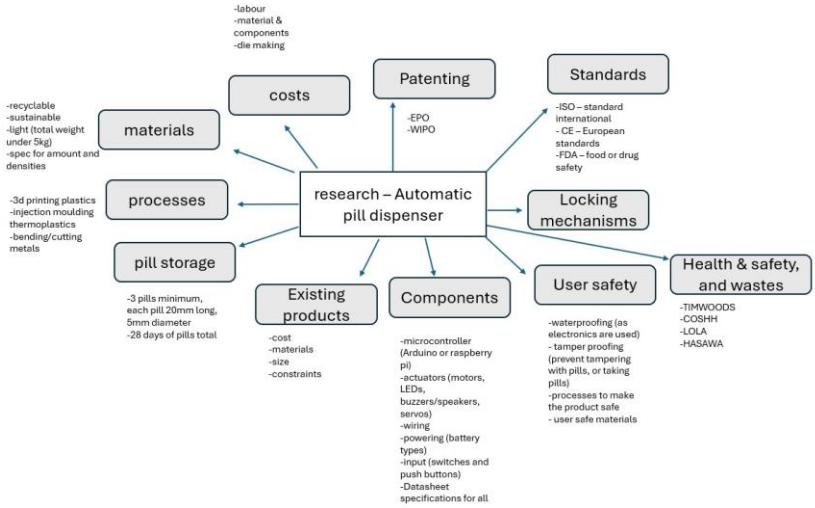
Task(s)	4
Evidence title / description	**Evidence expected for marking:** Presentation materials Presentation Q & A Record **Evidence submitted for marking:** Presentation materials Presentation Q & A Record
Date submitted by candidate	DD/MM/YY

WBEP Lt.™ Automatic Pill Dispenser

My engineering project

- To research automatic pill dispensers
- To design an idea for manufacture
- To plan out the program of work used in the manufacture of the product

Plan of research



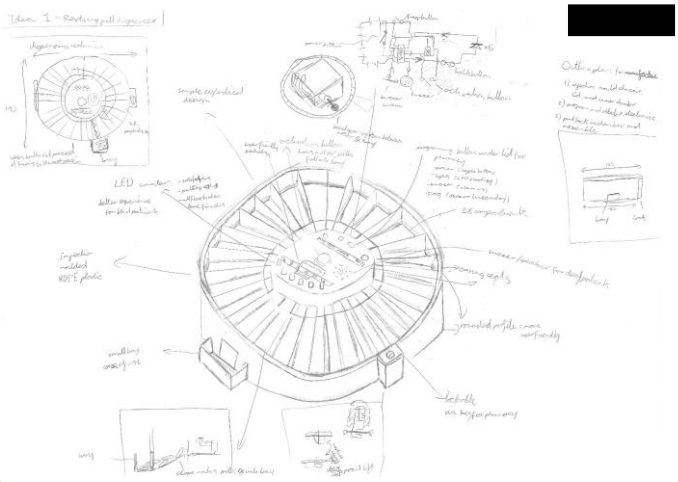
Summary of research

- HDPE chosen for body as its dirt cheap and food safe, ISO 22000 & 13485 approved
- Nitrile rubber chosen for seals as its food safe and ISO 13485 approved
- Arduino nano chosen for small size and weight
- LEDs, small DC motors, and buzzers chosen for price and effectiveness
- AA batteries chosen as they give a good power output and have a great battery life

Constraints in the project

- Time – target under 50 man-hours
- Knowledge – employees get trained with what they need to do
- Money – budget is £120,000 for 3000 units or £90,000 for 1500 units
- Equipment – not an issue, we have all needed equipment

Idea 1 – Revolving pill dispenser

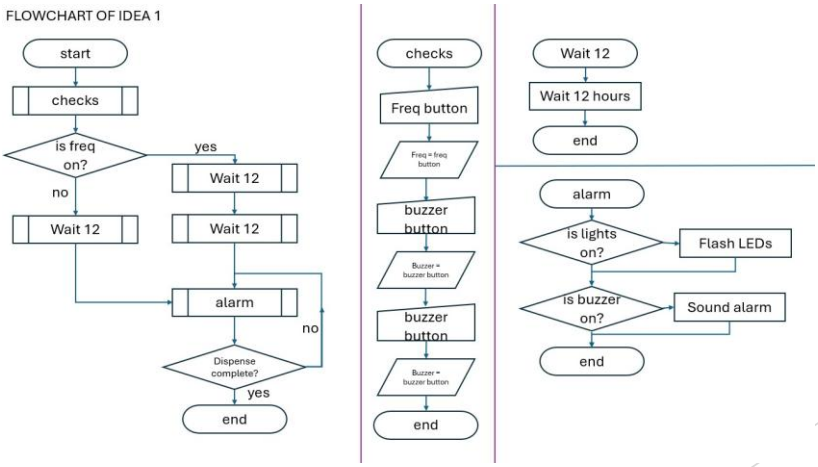


[redacted]

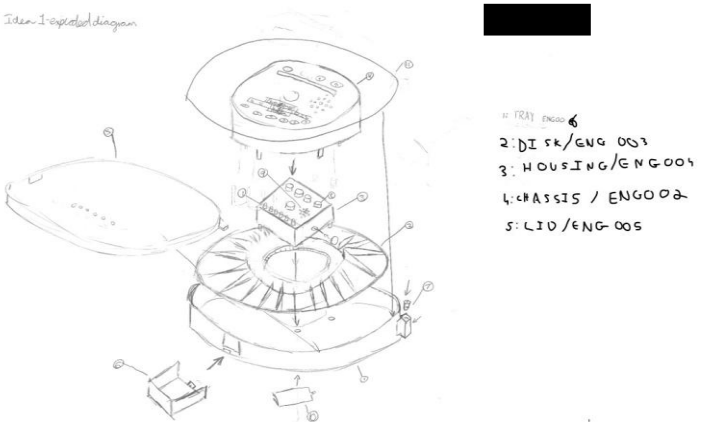
Advantages

- simple
- cheap
- low maintenance
- calculated 47-day battery life
- few parts & few components = more user friendly
- can be made automatically
- LEDs and buzzer to alert patients when to take medicine
- motor driven disk drive to dispense in a simple fashion
- HDPE chassis at a food grade level with nitrile rubber seals to make waterproof

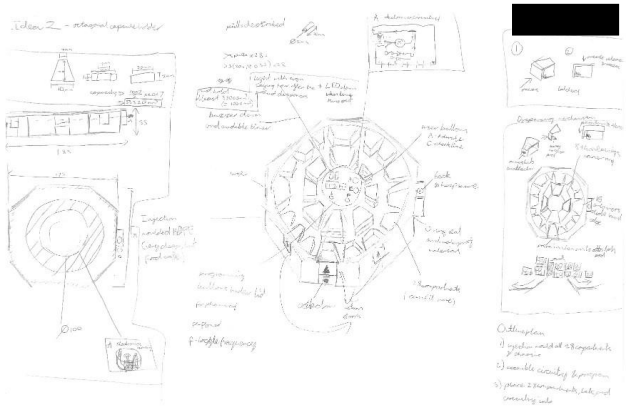
Idea 1 - logic



Idea 1 – assembly drawing

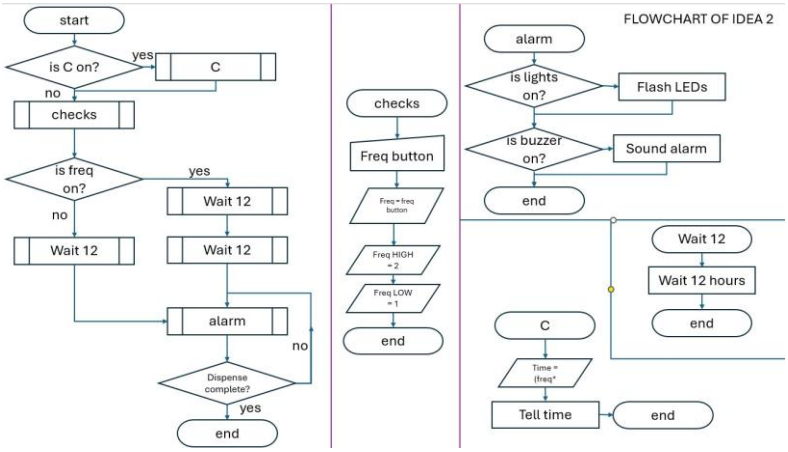


Idea 2 – capsule dispenser



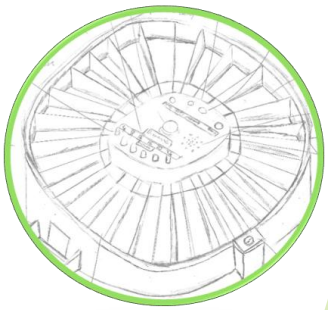
Advantages
- really secure via capsules
- LED alarms and buzzer to alert patient
- HDPE food safe plastic body
- easy simple programming buttons in secure place under lid

Idea 2 - Logic

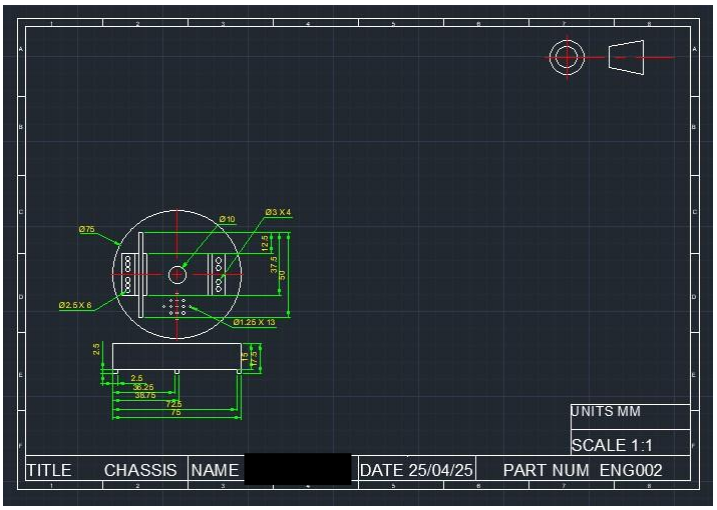


Which idea chosen to manufacture?

- Idea 1 chosen
  - simple design
  - less parts = easier to make
  - more programmability options & more user friendly
  - quicker to make = better for client

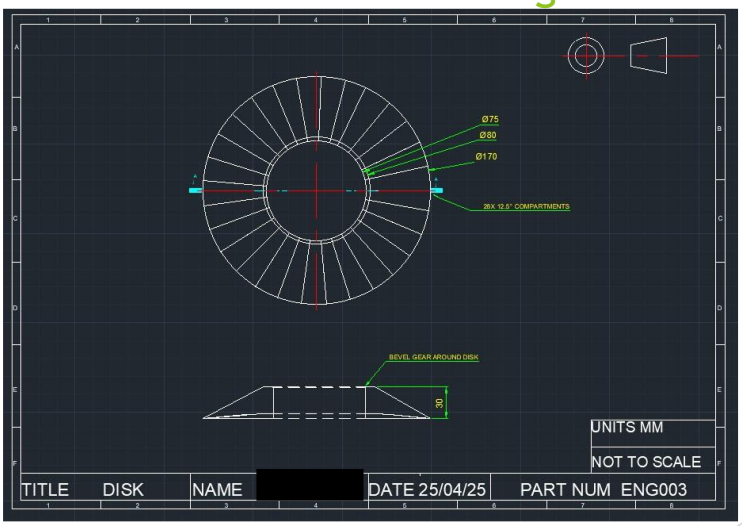


Chosen idea – CAD drawings - Chassis



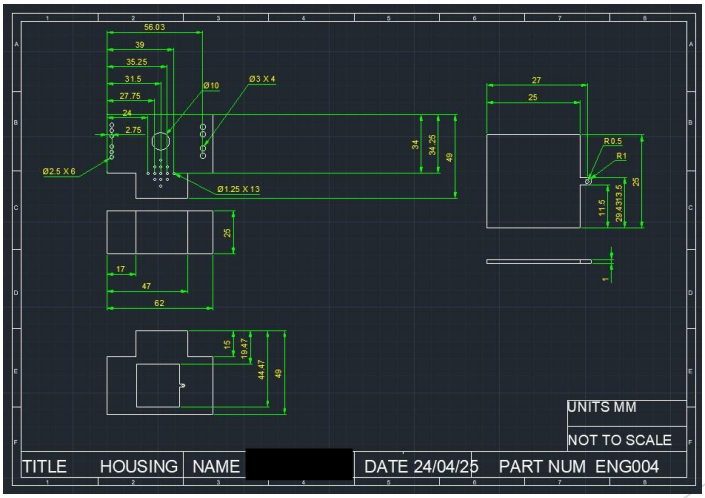
- Covers electronics housing
- HDPE plastic food safe injection moulded
- 0.5mm thick walls
- easy to manufacture
- labelled LEDs and buttons for ease of use for patients

Chosen idea – CAD drawings - Disk



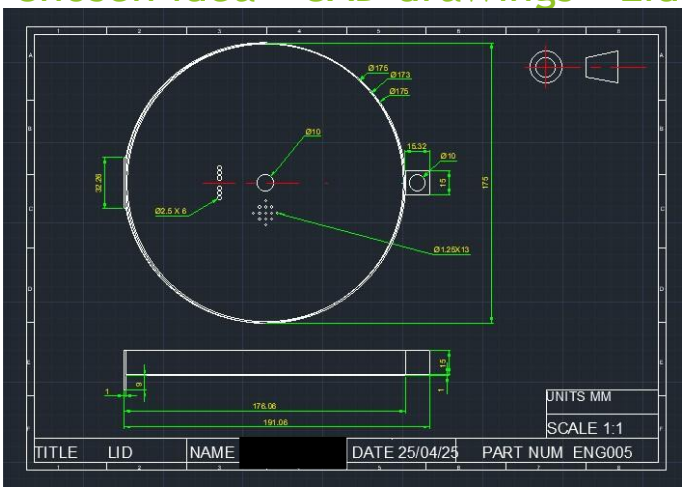
- 28 compartments in a circular design
- HDPE plastic - food grade injection moulded
- bevel gear turret drive for easy dispensing
- Angled bottom plate so pills can slide toward dispenser tray
- 45x[(9+19)/2]x30mm containers with volume of 75600mm^3

Chosen idea – CAD drawings – electronics housing



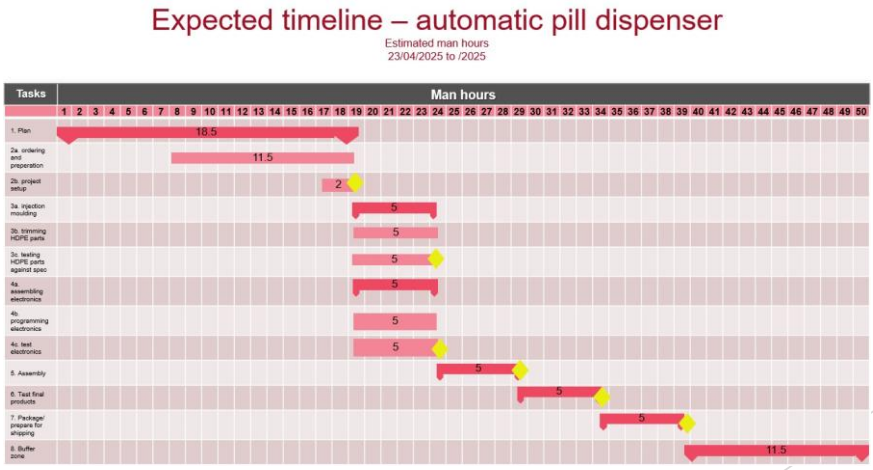
- easy clean organised box for all electronics
- holds 4 AA batteries totalling 4000 mAh
- HDPE food grade injection moulded
- 1mm thick walls

Chosen idea – CAD drawings - Lid



- cutout in lid for rubber sealant
- lockable latch for security of contained pills
- central hole for dispenser button, user friendly
- holes for alarm and LEDs which alert the user
- Food safe HDPE injection moulded

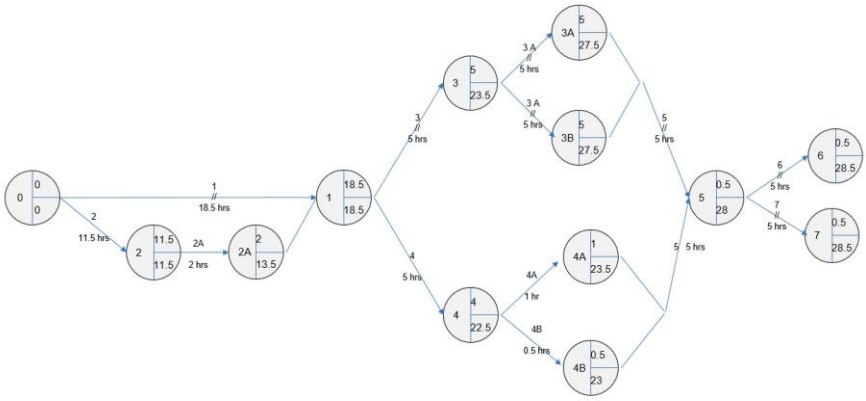
Program of work – Gantt Chart



Program of work – CPA details

Task	Duration (man hours)	Start date – end date
1) Planning & patenting	18.5 hours (1 person)	23/04/25 – 01/05/25
2) Ordering parts, materials, and dies, hiring workers	11.5 hours (1 person)	28/04/25 – 01/05/25
2A) Setup of machines	2 hours (4 people)	05/05/25 – 06/05/25
3A) Injection moulding	5 hours (not paid, done by 75 automatic injection moulding machines)	06/05/25 – 07/05/25
3B) Trimming plastic parts	5 hours (not paid, 15 specialist automatic machines)	06/05/25 – 07/05/25
3C) Testing part tolerances	5 hours (1 person)	06/05/25 – 07/05/25
4A) Assemble electronics	5 hours (not paid, 10 machines)	06/05/25 – 06/05/25
4B) Program electronics	1 hour (not paid, 10 machines)	06/05/25 – 06/05/25
4C) Test electronics	0.5 hours (10 people)	06/05/25 – 07/05/25
5) Assembly	5 hours (10 people)	07/05/25 – 08/05/25
6) Test products	5 hours (10 people)	07/05/25 – 08/05/25
7) Packaging	5 hours (10 people)	07/05/25 – 08/05/25
8) [Buffer time]	11.5 hours	08/05/25 – 08/05/25

Program of work – Critical path



Budget of project – expected unit cost

- Can go more if negotiated with client, estimated between 3500 and 4000 units possible considering labour costs and machine uptime cost

Plastic parts	£1.58
Arduino nano	£5.80 each
Wire 1m	£0.53
Motors x 1	£0.89
AA batteries x4	£6.57
Red LED x 6	£0.29
Small buzzer alarm x 1	£0.77
Small lock and key x1	£1.00
Rubber sealing strips	£1.95
Push buttons * 5	£1.97
Total cost per estimated unit	£21.35 Therefore £64050 for all the materials for 3000 units

Budget of project – expected project cost

Material costs	£64050
packaging	£5000
Expense costs	£1000
WIPO patent	£8000
Labour costs	£3136.50
Die manufacture	£25000
total	£106,186.50 for 3000 units

Accomplishments and future improvements

What went well:

- very cheap and easy product designed
- process is very straight forward and quick, under 50 man-hours
- battery life is way better then what was expected

What would we do better next time?

- make the locking mechanism stronger
- app reminder & programming, AKA Bluetooth app incorporation
- make a more efficient wiring solution, using custom PCBs

Challenges faced and how I overcame them

Problem faced	How I overcame them
The injection moulders wouldn't make the HDPE parts in time	We considered and made a concept for the injection moulding dies to hold 5 of each part
Couldnt make the chassis or electronics compartment go through the disk	The disk's design was changed to a turret drive system and a hollow centre like on tanks which allows for 360° rotation
28 compartments in a circle is not easy to design	Calculated for the disk to have compartments every 12.5° spacings and 0.5mm walls making the disk have 28 compartments

Design against specification

must be smaller than 190x190x60mm size	Measures out at 190*190*50mm
- must weigh under 0.5kg fully laden	Weighs 182.2g
- must have 28 compartments where each compartment can hold at least 3 pills dimensioned as 20mm x 5mm diameter	Has 28 compartments and each compartment has a big enough area
- must have means to be battery powered	Powered by 4 AA batteries
- must have means to be programmable to work once a day or twice a day	Frequency button allows reprogramming of how often it dispenses
- must have means to alert the user	LEDs and alarm buzzer to alert the user
- must have means to activate the dispensing mechanism by a user	Dispensing motor moves tray to full compartment which pushes pills into a small tray
- must be tamper proof and be used repeatedly	Motor can run for about 50000 cycles before showing any wear
- must have a locking mechanism	Lockable via lock and key
- casing must be made of recyclable materials	Recyclable metal lock, HDPE body
- must be waterproof	O ring seal makes lid waterproof and rest fully enclosed apart from dispensing tray which is covered by the lid
- batteries must last at least 28 days with the mechanisms power consumption	Battery lasts 47 days

Thank you for your time!

Any questions?

Employer-Set Project – Presentation Q & A Record (Task 4)

8730-14 T Level Technical Qualification in Design & Development for Engineering and Manufacturing

8730-035 Employer-Set Project (Summer 2024)

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234
Date	DD/MM/YY

Provider name	<provider name>
City & Guilds Provider No.	999999a

Record observation notes below to inform external marking. **Notes must be detailed, accurate and differentiating.**

Tutor questions to candidate	Candidate responses
What did you find the most challenging aspect of our brief?	Tracking System
How sustainable is the proposed design?	HDPE – Body recyclable, good company contacts, recycling is not in house, send back to suppliers
How to ensure fully waterproof?	All parts and holes have seals

Any other comments

Tutor signature	Date
X_____	DD/MM/YY

If completing electronically, double click next to the 'X' to add an electronic signature once the record is **finalised**.

Get in touch

The City & Guilds Quality team are here to answer any queries you may have regarding your T Level Technical Qualification delivery.

Should you require assistance, please contact us using the details below:

Monday - Friday | 08:30 - 17:00 GMT

T: 0300 303 53 52

E: **technicals.quality@cityandguilds.com**

W: **http://www.cityandguilds.com/tlevels**

Web chat available **here**.