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Examiners' report

DESIGN AND TECHNOLOGY: DESIGN ENGINEERING

H404

For first teaching in 2017

H404/02 Summer 2022 series

Version 1

ocr.org.uk/designandtechnology

Contents

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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Paper 2 series overview

Overall, the performance of the candidates in this series has been encouraging. The candidates are starting to understand the structure of the examination and developing some excellent skills which can be used throughout the rest of their education.

Candidates were able to use current examples in their responses, which enhanced the response. Candidates who did well in the paper were able to break the question down and construct a response which was focused on the question and gave concise responses rather than moving away from the question. In the extended responses question, candidates who achieved higher level marks, were able to construct a response that was structured well, with a coherent discussion on the required topic area.

Candidates who did not do as well struggled to construct their responses in line with the question, often going away from the question and discussing matters which are not relevant. Another example of where people struggled was in producing a flowchart and the required circuit diagram. It is suggested that in their teaching candidates learn how to produce a flowchart from a for a problem. Candidates struggled with using the correct shapes in the flowchart and how a flowchart works. Other candidates misread the maths questions leading to simple mistakes which could easily be avoided by taking more time re-reading the questions carefully.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• used the advance information well. Aiming their revision at understanding what may be expected from the paper and researching some examples which they could use • broke the questions down and understood what was being asked of them, answering all the points in the question • were able to use their own examples from their learning and embed them in their responses.	• got distracted by a single point in the question and did not demonstrate across all the points required • were unable to produce a flow diagram of a basic system, using correct symbols • made basic mistakes in the calculation driven by not ready the question correctly • found it difficult to match their knowledge to different situations.

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Question 1*

1* Stand-up paddle boarding (SUP) has become popular in recent years with a rapid growth in the number of people trying out the sport, leading to an increase in sales of stand-up paddle boards.

The market now boasts a large selection of stand-up paddle boards with prices ranging from a few hundred pounds to thousands of pounds.

Critically examine the factors that a company looking to develop a new stand-up paddle board would need to consider, making specific reference to the different stakeholders affected.

Refer to information on **page 2** and **page 3** of the Resource Booklet. **[14]**

Most candidates answered this question well and understood the requirement for the answer to be in an extended response, however some still used short bullet points.

Candidates who achieved the higher level bandings were able to focus on multiple factors the company would need to consider and make them, specifically to the various stakeholders that would be affect by those factors.

Most candidates made good use of the Resource Booklet, with the higher level responses being able to relate the information to the factors being considered.

Some candidates spent too long explaining how they would get the information rather than explaining what the factors were.

Some candidates listed points, which were mostly correct, but did not do a critical examination of them.

Level 4 responses were able to give a comprehensive examination of the different factors, showing clear understanding of the impact on the relevant stakeholders.

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Exemplar 1

Initially, due to the increasing popularity and therefore market, it is likely there will be existing products and market competitors that companies will need to identify. This is vital as it would allow the company to find weaknesses in competing products and develop their own unique selling point, therefore increasing a products commercial viability.

On page 2, it states growth of sales are up 300%, which inevitably leads to supply problems where manufactures cannot keep up with demand. This could urge a company to look at the most sustainably yet fast production method and material, for example injection molding is great for mass production and the material must float, be water resistant with great strength : weight ratio.

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The company must also identify its target user group, which could be beginner paddle boards 'All-around stand up paddle boards' or more advanced 'Touring stand up paddle boards' Identifying the target audience will allow the user to make design changes to suit these as in Figure 2, it shows multiple shapes and sizes of paddle boards which could be considered in the design and development of the board.

Due to the concern for the sagety on paddle boarders on page two, the company should endeavour to apply as many sagety features to the board, similiar to the leg attachments in Fig 1. Furthermore, companies could work in partnership with training gacilities to express the need for ~~training~~ training, and provide access to this in a mutual profitable relationship.

Exemplar 1 shows a Level 4 response where the candidate has identified multiple factors and linked them to the stakeholders.

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Question 2

2 Selecting the correct paddle for riding a stand-up paddle board is vital for an efficient paddling action and to reduce the strain on the user's back.

Use the information on **page 4** and **page 5** of the Resource Booklet to identify the design features and relevant data which a design engineer would need to consider when designing a successful paddle for the SUP market.

Your response **must** refer to ergonomic and anthropometric requirements as well as the use of materials in the paddle construction. You may use annotated sketches to explain your response.

[14]

This question was answered well by many candidates. Good responses were able to use the information in the Resource Booklet making specific reference to the information given and relating it to their own learning.

Candidates who gained higher level marks were able to talk about the three key parts of a paddle outlined in the Resource Booklet: Shaft, Blade and Handle. They were able to use the data provided as well as their own understanding of Ergonomics and Anthropometrics to construct their response. These candidates also made the link between the materials the paddle would be made from and the useability of it.

Most candidates took advantage of the space provided to produce sketches to help support their response.

Level 4 responses were able to identify all the features of a paddle and were able to show sound understanding of how ergonomics and anthropometric data could be used in the design of them. They also would have referred to the different users of the paddle and where the paddle would be used and looked at how this can affect the design.

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Exemplar 2

The handle must be comfortable in the users hand and have good grip, to allow for it to be used for long periods of time even when wet. Therefore, a design engineer would have to look into hand anthropometrics to find the most ergonomic handle shape and also the best material for grip and to avoid blisters. The shaft is key to user comfort and reducing the risk of injury. An efficient paddle should be 20 cm taller than the users height. Therefore, anthropemetric data on height and vertical/forword grip reach must be investigated to find the most suitable length. However, an adjustable shaft could also be looked at, as fixed length shafts will likely be un-inclusive to the extreme percentiles of users. Therefore, the design engineer should look at how easy the paddle is to adjust using different 'configurations' and by what margin can it be adjusted by. For example an 'adjustable length' shaft can be changed by the smallest increments making it easier to adjust to the perfect height for the user.

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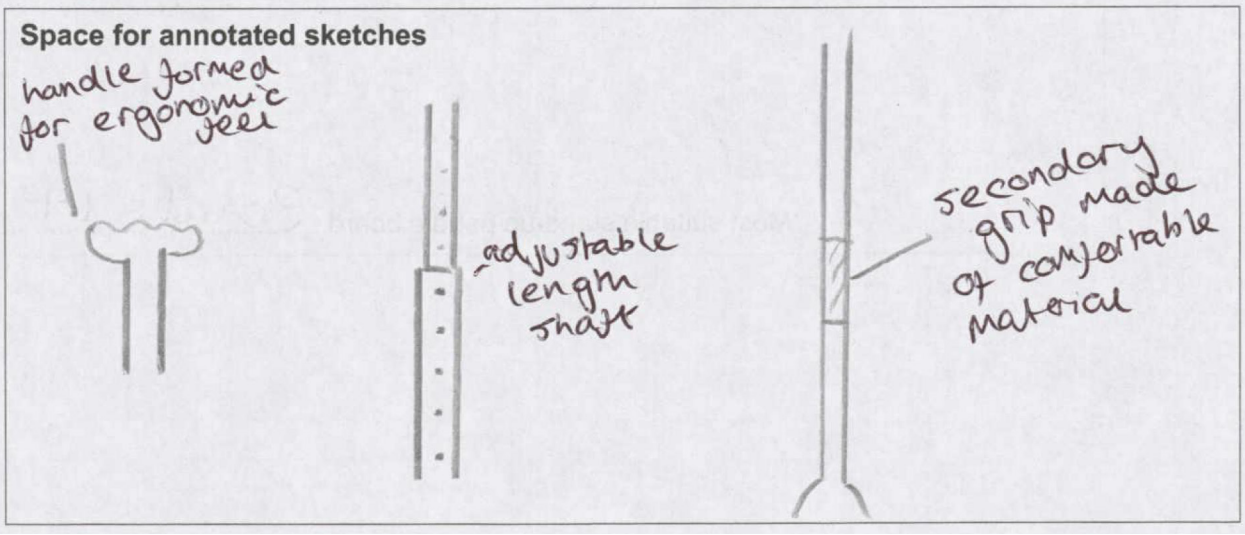
whereas, a breakdown paddle can be dramatically adjusted to fit the extreme anthropemetric height percentiles. It also makes the paddle more easily portable improving the ease of use and how well the user feels part of the product. The design engineer must investigate their target audience in order to find which blade shape would be the most ergonomic for the most amount of people as people will have different strengths. This could be done by doing product testing with a range of people as anthropemetric data is based on 'healthy people. The forward grip reach could be used to ~~determine~~ find the best possible position for a secondary handle on the shaft to improve user comfort. knuckle height and finger tip reach could also be used for determining the diameter of the shaft so it can be comfortably held. The designer must also, investigate the materials used in each part of the product.

Space for annotated sketches



Exemplar 2 shows a high Level 4 response where the candidate has discussed each feature in detail referring to the Resource Booklet where needed.

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Question 3 (a)

3 **(a)** Stand-up paddle boards are made in different sizes to suit the weight of the user and the load they wish to carry. The Resource Booklet contains data for five stand-up paddle boards.

A user has a mass of 80 kg and they will also carry a backpack of mass 12 kg and a paddle of mass 3 kg. They will use the stand-up paddle board in the sea.

Determine by calculation the most suitable stand-up paddle board for this user, ignoring the weight of the paddle board.

Refer to **Fig. 7** and the information on **page 6** of the Resource Booklet. **[6]**

Many candidates answered this question well.

Those that achieved the maximum marks were able to show through calculation how they achieved the answer. Candidates who did not show how they got to the answer .? often missed out on attaining full marks?

Question 3 (b) (i)

(b) The NW20 air pump, described on **page 7** of the Resource Booklet, has been specifically designed to inflate a stand-up paddle board and is run from a 12 V car battery.

The NW20 air pump is being used to inflate Board-16 to the pressure shown in **Fig. 7** on **page 6** of the Resource booklet.

(i) Using **Fig. 9** as the basis for your calculations, estimate the time taken for the NW20 air pump to inflate Board-16 to the required pressure. Give your answer in seconds (s) and show your working.

You will need to use the information on **page 6** and **page 7** of the Resource Booklet. **[3]**

Most candidates answered this question. Most were able to read the graph and establish the time taken to fill 100 litres but did not then calculate the time taken to fill the required 250 litres.

Assessment for learning

Care should be taken when reading data from the resource booklets. This simple question was made difficult for some by not reading the data correctly.

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Question 3 (b) (ii)

(ii) Use your answer from **part (b)(i)** and the information on **page 7** of the Resource Booklet to calculate the electrical energy used by the NW20 air pump to fill Board-16 to the required pressure. Give your answer in joules (J) to **0** decimal places and show your working. **[3]**

Candidates who did not calculate the full inflate time for the 250 litres but used the 100 litre time had their answer carried forward into this question enabling them to still access the full marks if they showed the correct working.

Question 4

4 A start-up company wishes to develop an electronic Paddle Board (PB) Speedometer which gives an indication to the user of the speed that the stand-up paddle board is travelling through the water. Information for the proposed product is given on **page 8** of the Resource Booklet.

The design engineers have been instructed to solve the following two issues to help with the development of the PB Speedometer.

Issue 1:

To measure the speed that the stand-up travel board travels through the water, a suitable sensor needs to be designed. This sensor must be able to be firmly attached to an inflated stand-up paddle board but must be removable when the stand-up paddle board is deflated and packed away. The electronic output signal from the sensor will be processed by a microcontroller.

An electronic sensor is required which can be attached to an inflated stand-up paddle board and removed when the stand-up paddle board is packed away.

Issue 2:

The signal from the sensor will be processed by a GENIE-14 microcontroller and the speed of the stand-up paddle board will be displayed to the user on a 5-LED bar graph display. Details of the GENIE-14 microcontroller and the bar graph display are shown on **page 8** of the Resource Booklet.

A circuit diagram and a program flowchart are required to enable the PB Speedometer system to function as described. The circuit diagram must show how the sensor and the five LEDs are connected to the microcontroller. The program flowchart should indicate how increasing speed causes more LEDs to light.

Use sketches and/or notes to determine suitable technical solutions that overcome the **two** issues identified. Refer to information on **page 8** of the Resource Booklet.

[16]

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The variety of this question appealed to some candidates, enabling them to produce some very detailed responses to each of the issues:

Issue 1:

Out of the two issues candidates' responses to Issue 1 were the strongest.

Where candidates achieved the higher level mark, they were able to show both elements of the issue clearly, drawing on their learning throughout the course to demonstrate how they would approach this issue.

Some candidates struggled to design a sensor for measuring the speed of the paddle board through the water opting for a 'black box' method. Those candidates that excelled in this question showed high quality systems that would measure the speed in one form or another.

Methods of attachment varied but the higher level candidates were able to demonstrate how the sensor would be attached and removed when not in use. They made reference to the processes involved and the materials that the attachment would be made of.

Issue 2:

This issue involved drawing a circuit diagram from the information given and a flowchart showing how the system would work.

Most candidates were able to draw a flow chart to solve the problem. However, there were still some candidates that did not use the correct symbols for a flow chart. The higher level response candidates recognised the need to source a value from the sensor and then have some sort of comparison in their flowchart to produce the correct sequence of LEDs at the output.

There were a number of candidates that were not able to draw the circuit diagram. Those that did managed to draw a potential divider for their sensor, allocate a power supply and connect LEDs and protective resistors using the correct circuit symbols.

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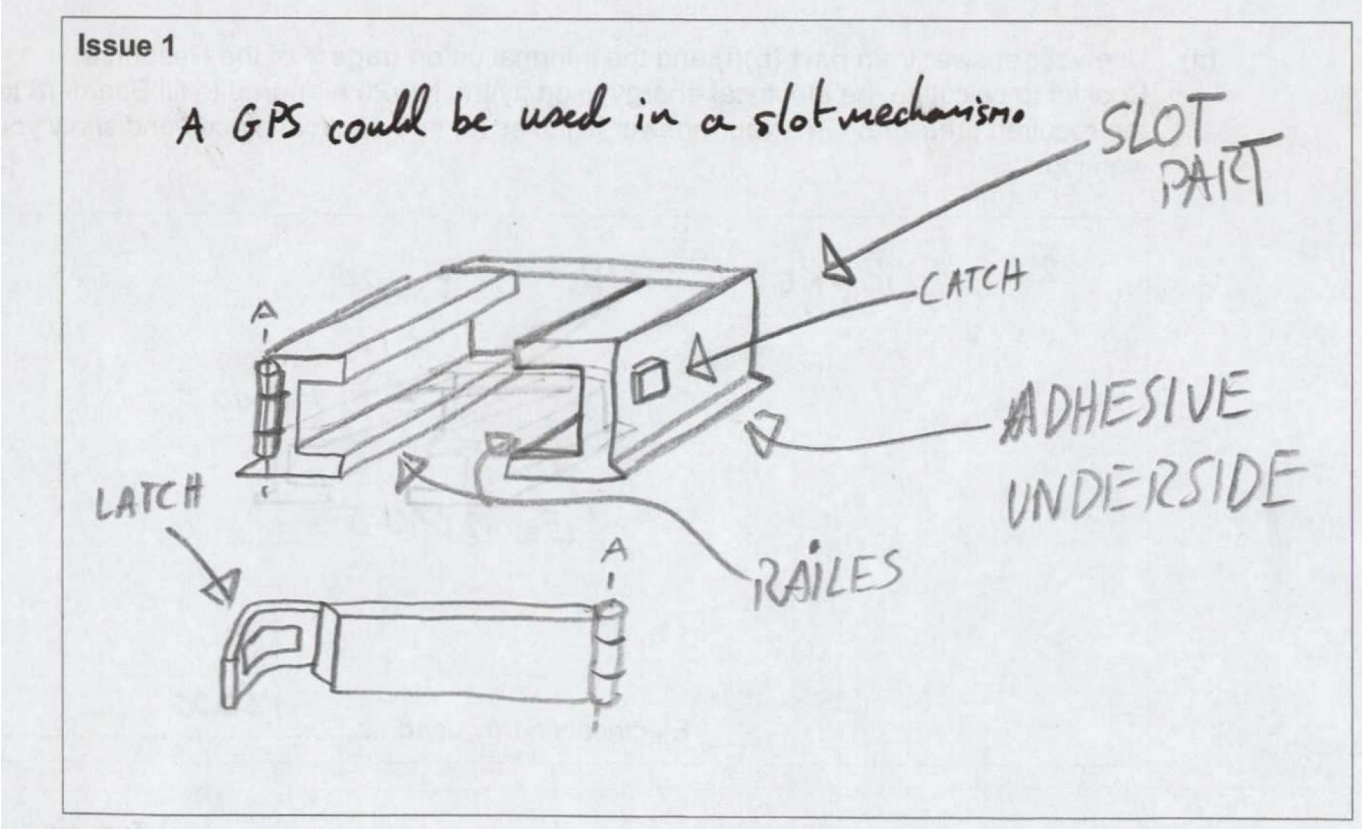
Exemplar 3



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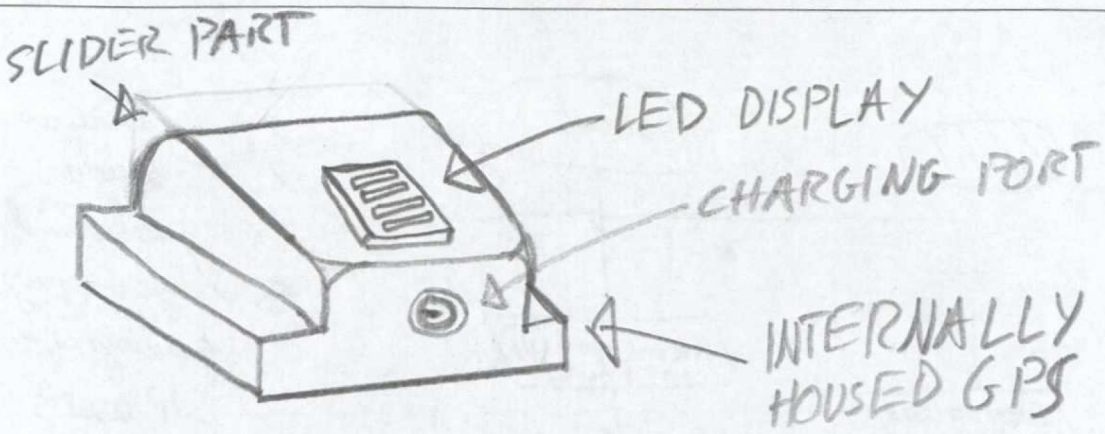

. The slot could be a flat part permanently attatched to the board with an adhesive layer peeled off when applied.
The latch would prevent the slider part from being removed.

• The slider par could have the GPS and LED display and micro controller. It has a charging port that can be used when the ~~sensor par~~ sliding part is removed.

• The GPS would track the location of the board and at regular intervals calculate the speed over a distance $s = \frac{d}{t}$ and communicate this to the LED display.

• You can remove the slider after use.

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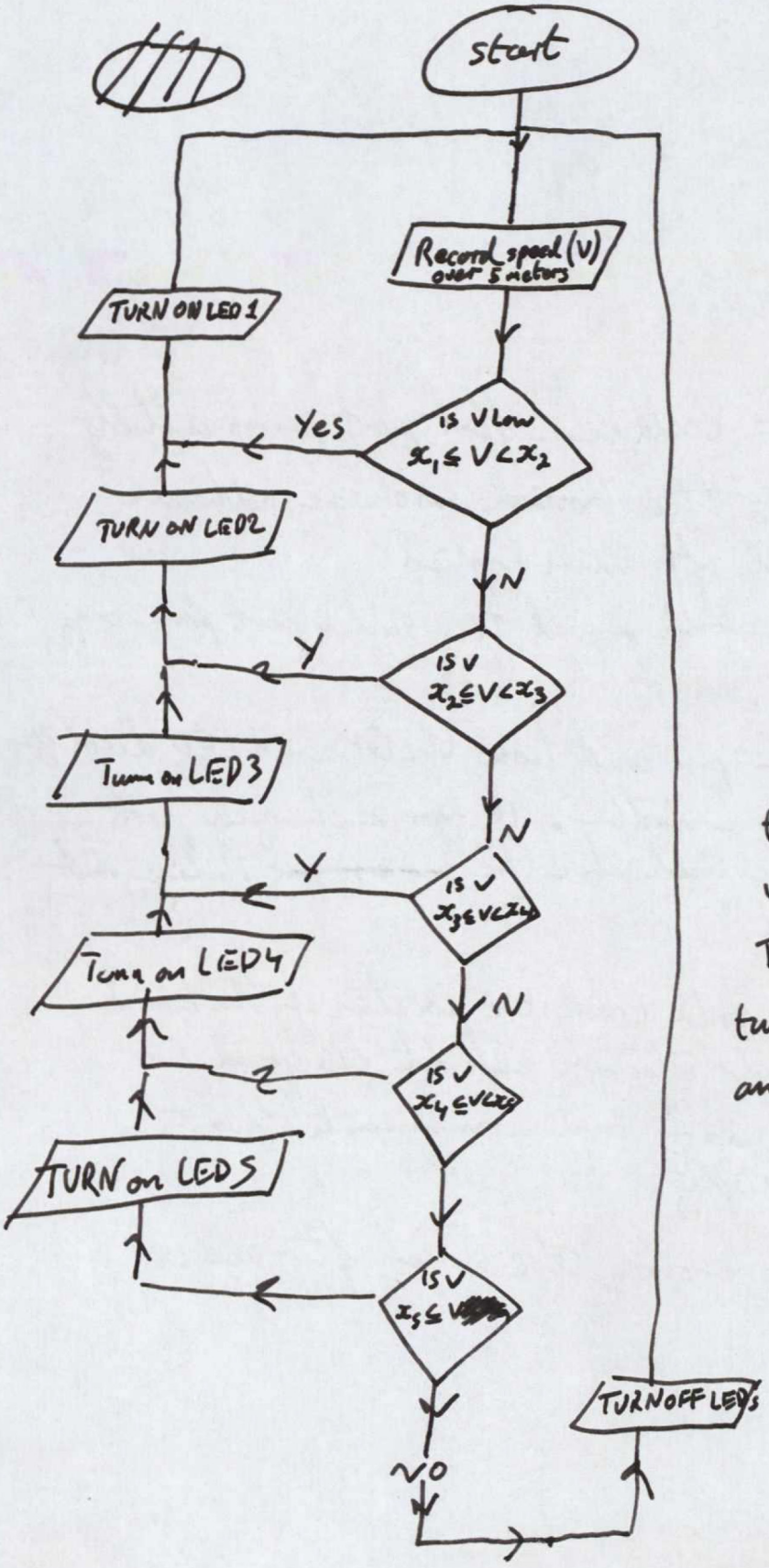
Issue 2



x_1
x_2
x_3
x_4
x_5
[redacted]

These are speeds determined by average findings of SUP users from low to high

x_1 is close to zero

- As speed increases the LEDs light up when stationary

The μcontroller will turn off all LED's and return to start

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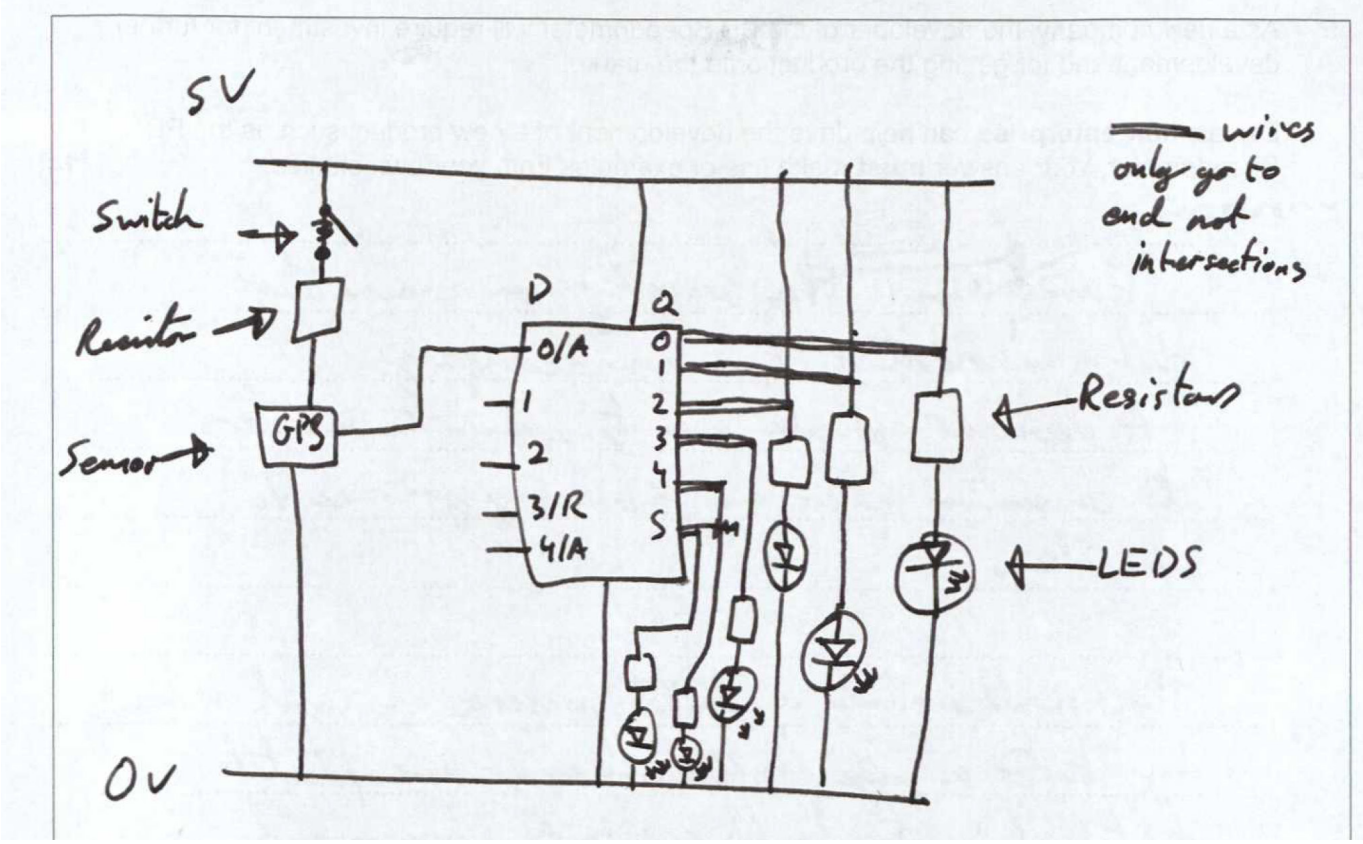

Exemplar 3 gives a Level 4 response to this question. This candidate chose to use a GSP system to monitor the speed which was acceptable. Other noticeable responses included Reed switches and slotted-opto switches connected to a rotating disc powered by the water.

Assessment for learning

Time should be taken throughout the course to develop candidates' skills in communicating ideas with confined time frames. Some candidates' drawings were of a low quality which made it very difficult to understand what they were trying to communicate.

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Question 5*

5* As a new company, the developer of the PB Speedometer will require investment for further development and for getting the product onto the market.

Explain how **enterprise** can help drive the development of a new product such as the PB Speedometer. Your answer **must** make use of examples from your own studies. **[14]**

This question was answered well by most candidates. It was clear that candidates used the advance information well in preparing for their response to this question.

The best responses were able to make direct links with the Resource Booklet and importantly, their own learning and experiences. The use of examples was very good in a lot of cases with candidates using some clear examples that they had learnt about. It was also important for this question that they relate how enterprise can drive the development of the PB Speedometer.

Most candidates recognised some of the ways that enterprise can help development, from Crowdfunding, Venture capitalists and collaboration. They were able to link these to the PB Speedometer and give some excellent examples of how these have been used with products on the market.

While a lot of candidates responded very well to this question there were a few that seemed confused by the term enterprise and therefore did not answer the question, thinking enterprise was a different thing. A few candidates who knew about enterprise, either did not link it to the drive in development or did not use their own examples of this.

This was an extended response question; therefore, candidates are expected to produce a concise and detailed explanation. The use of short, sentenced bullet points is not appropriate for a response of this type.

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Exemplar 4

With the emergance of new companies with innovative technologies, the producers of the products are not the only people interested in seeing it develop and succeed. The producers of the PB Speedometer could turn to crowd funding as a more casual starting approach to grow their company, and also get a vague idea of what kinds of people (and how many of them) would be interested in the product. Crowdfunding is a popular way to develop a software applications, as the ~~monetary~~ financial yield may not be as great, but is enough to fund such projects. A lot of crowdfunding occurs via social media, like Facebook, where again, object of less value are funded. The producers of the PB speedometer may turn to venture capitalists, offering them personal ownership of part of the company if they invest in the product. The Huel protein supplement company relied on this to break through a saturated sports supplement market. This kind of investment can lead to successful long term partnerships with wealthy companies and individuals that can further help the company develop over time. However, getting

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investments from venture capitalists can be difficult, as the idea must be seen as entirely innovative and needed in saturated markets. Selling company stocks to the public is also a way to get investments. Even though the producers & the PB speedometer may lose some control of the company, that is less likely as one individual would have to purchase 51% of it. In this way, the funding isn't dependant on one specific person or company, as it would be with venture capitalism, ~~back~~ so allows for more flexibility within the company. Many companies are public, like Zoom, Apple and Uber, and actually attract people to buy their stocks as their value increases, further allowing them to break through markets.

Exemplar 4 shows a good example of a Level 4 response.

Assessment for learning

The use of examples is key in this paper. A candidate who is able to use examples in their response are able to give a more rounded response and make more links to real world products.

When teaching topics, try and given examples of where this can be found, or encourage the students to read more around the subject.

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