

# THE UNIVERSITY OF AUCKLAND

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SUMMER SEMESTER, 2018  
Campus: City

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## COMPUTER SCIENCE

### An Introduction to Practical Computing

(Time Allowed: TWO hours)

**NOTE:**

You must answer **all** questions in this exam.

Calculators are NOT permitted.

Answer Section A (Multiple choice questions) on the Teleform answer sheet provided.

Answer Section B in the space provided in this booklet.

There is space at the back for answers that overflow the allotted space.

<b>Surname</b>	
<b>Forename(s)</b>	
<b>Student ID</b>	
<b>Login (UPI)</b>	

	<b>Question</b>	<b>Mark</b>	<b>Out Of</b>
1 - 30	Multiple Choice		30
31	Programming using Python		10
32	Spreadsheets		15
33	Databases		15
34	HTML5 and CSS		15
35	LaTeX		15
	<b>TOTAL</b>		<b>100</b>

**SECTION A****MULTIPLE CHOICE QUESTIONS**

Each question in this section is worth **1 mark**. There is only **one** correct answer for each question. For each question, choose the **best** answer according to the information presented in lectures. Select your preferred answer on the Teleform answer sheet provided by shading in the appropriate box.

**Question 1**

[1 mark] If a CPU takes 4 minutes to do a task today, how long would a CPU of the same price take 6 years from now? Use Moore's Law as taught in lectures to calculate the answer.

- (a) 2 minutes.
- (b) 60 seconds.
- (c) 15 seconds.
- (d) 3 minutes.
- (e) 15 minutes.

**Question 2**

[1 mark] Have a look at the following computer specifications:

Cooler Master Tower case  
Intel i7 quad-core 3.5 Ghz CPU with 8 MB cache  
16 GB DDR4 RAM  
Samsung 250 GB SSD  
Seagate 2TB HDD  
Intel integrated graphics processor  
Microsoft Windows 10 professional

Which of the following statements are TRUE?

- I.** The computer has a 4 core CPU.
- II.** The computer has an integrated graphics card.
- III.** The computer does not have a mother board.
- IV.** The computer comes with an operating system installed.
- V.** The computer has at least 16 GB of primary memory.

- (a) I, II, III and IV.
- (b) I, II, III, IV and V.
- (c) I, II and IV.
- (d) II, IV and V.
- (e) I, II, IV and V.

**Question 3**

[1 mark] What is the decimal equivalent of 1101101?

- (a) 109
- (b) 218
- (c) 78
- (d) 134
- (e) None of the above.

**Question 4**

[1 mark] What is the binary equivalent of 61?

- (a) 101111
- (b) 111001
- (c) 100111
- (d) 111101
- (e) None of the above.

**Question 5**

[1 mark] Which of the following statements about GUIs are TRUE?

- I. GUIs can be inefficient for experienced users.
- II. GUIs let users combine commands.
- III. GUIs are graphically-based.
- IV. GUIs can be difficult to use for novice users.
- V. Keyboard shortcuts help to make GUIs more efficient.

- (a) I, II, III and V.
- (b) II, III and IV.
- (c) I, III and V.
- (d) II and V.
- (e) I and III.

**Question 6**

[1 mark] Which of the following statements is FALSE?

- (a) The Microsoft Office suite of applications is proprietary software.
- (b) The requirements for open source software are detailed in “The Open Source Definition”.
- (c) Shareware gives users a trial period to evaluate the software.
- (d) Open source software licences are generally less restrictive than commercial software licences.
- (e) Anyone can create a derivative work from freeware.

**Question 7**

[1 mark] Which of the following statements about the Internet's backbone are FALSE?

- (a) It uses multiple cable connections for extra capacity and redundancy.
- (b) It is laid out on land and under the sea.
- (c) It is free to use.
- (d) It consists of high-capacity fibre optic cables.
- (e) It provides connections between countries and continents.

**Question 8**

[1 mark] Which of the following statements are TRUE?

- I. A protocol is a standardized means of communication.
  - II. A protocol determines how two devices open and maintain a connection.
  - III. Protocols are defined in RFC documents.
  - IV. A protocol determines how two devices terminate a connection.
  - V. TCP/IP are the primary Internet protocols.
- (a) I, II, III and IV.
  - (b) I, II, IV and V.
  - (c) I, II, III, IV and V.
  - (d) I, II and V.
  - (e) I, II, III and V.

**Question 9**

[1 mark] Which of the following statements about instant messaging are TRUE?

- I. Instant messaging is an asynchronous means of communication.
  - II. The instant messaging server helps clients to exchange IP addresses.
  - III. Once two instant messaging clients are connected, communication can take place without the server.
  - IV. Two instant messaging clients can only communicate to each other via a server.
  - V. Instant messaging is a synchronous means of communication.
- (a) I, II and III.
  - (b) II, IV and V.
  - (c) IV and V.
  - (d) I, II, and IV.
  - (e) II, III and V.

**Question 10**

[1 mark] What Wiki markup would need to be used to create the following list?

**1. Pizza**

- Pepperoni
- Spicy Chicken

**2. Ice-cream**

- Chocolate
- French vanilla

(a) `'''Pizza'''`  
`##Pepperoni`  
`##Spicy Chicken`  
`'''Ice-cream'''`  
`##Chocolate`  
`##French vanilla`

(b) `*'''Pizza'''`  
`*#Pepperoni`  
`*#Spicy Chicken`  
`*'''Ice-cream'''`  
`*#Chocolate`  
`*#French vanilla`

(c) `#''Pizza''`  
`#*Pepperoni`  
`#*Spicy Chicken`  
`#''Ice-cream''`  
`#*Chocolate`  
`#*French vanilla`

(d) `*''Pizza''`  
`*#Pepperoni`  
`*#Spicy Chicken`  
`*''Ice-cream''`  
`*#Chocolate`  
`*#French vanilla`

(e) None of the above.

**Question 11**

[1 mark] Which of the following statements is FALSE?

- (a) A filter bubble occurs when a search algorithm provides personalized results.
- (b) A filter bubble can limit the diversity of information presented to a user.
- (c) A filter bubble is an example of bias in search results.
- (d) A filter bubble can help an individual preserve their browsing privacy.**
- (e) None of the above.

**Question 12**

[1 mark] Which of the following statements is FALSE?

- (a) Search engines record their users' browsing behaviour.
- (b) A person's anonymized search history cannot be used to identify them.**
- (c) Spiders are used by search engines to index the World Wide Web.
- (d) User data collected by search engines is sold to advertisers.
- (e) Search engine popularity varies globally.

**Question 13**

[1 mark] What is the ASCII code for "RefWorks"?

- (a) 82 69 70 87 79 82 75 83
- (b) 114 101 102 119 111 114 107 115
- (c) 82 101 102 87 111 114 107 115**
- (d) 83 102 103 88 112 115 108 116
- (e) 115 102 103 120 112 115 108 116

**Question 14**

[1 mark] Which of the following statements is FALSE?

- (a) A character encoding scheme is used to represent characters of an alphabet numerically.
- (b) Using a text editor is always WYSIWYG.**
- (c) Word processors store text data and formatting data.
- (d) ASCII is a character encoding scheme for the English alphabet.
- (e) Text editors use a character encoding scheme to store text data.

**Question 15**

[1 mark] Jeffrey is 8 years old. Both of his parents are frequently busy with work, and he spends a lot of time on the iPad his parents have purchased for him. Recently Jeffrey's parents have received a letter from school informing them that Jeffrey is having difficulty relating with his peers. Based on the information provided, which of the following statements are TRUE?

- I. Jeffrey should spend more time on social media.
- II. Jeffrey may have deficits in his social skills.
- III. Jeffrey should spend more time interacting with his parents and peers face-to-face.
- IV. Jeffrey may be suffering from narcissism.
- V. Jeffrey may be suffering from a childhood form of OOS.

- (a) II, III and V.
- (b) I and II.
- (c) II and III.
- (d) I and IV.
- (e) III and V.

**Question 16**

[1 mark] Which of the following statements is FALSE?

- (a) Improvements in technology have led to smaller, more discrete devices, which are less cognitively penetrating.
- (b) The relationship between technology and mood disorders is well documented.
- (c) Technology related distraction is a common issue for students during lectures.
- (d) Instant gratification can lead to unrealistic expectations socially and in the workplace.
- (e) Taking regular breaks is an important way to avoid technology related physical issues.

**Question 17**

[1 mark] Which of the following statements is FALSE?

- (a) The Pirate Bay is one of the most famous P2P networks.
- (b) P2P networks use the BitTorrent protocol to share data.
- (c) P2P networks use a client server model.
- (d) P2P networks are often used for copyright infringement.
- (e) None of the above.

**Question 18**

[1 mark] Which of the following statements is FALSE?

- (a) A virus needs to be associated with another host file.
- (b) The best protection against malware is to use a good anti-virus program and safe browsing practices.
- (c) Tor works by obscuring the route data packets take between source and destination.
- (d) Advertisers must abide by the Do Not Track initiative.
- (e) None of the above.

**Question 19**

[1 mark] How many bytes are required to store a bitmap image that has 64 different colours, and is 400 pixels wide by 300 pixels high?

- (a) 72 KB.
- (b) 90 KB.
- (c) 720 KB.
- (d) 9 KB.
- (e) None of the above.

**Question 20**

[1 mark] Aya is designing a new font to use in her posters. She wants the characters of the font to be stored as image files that can scale up in size without any loss of image quality or corresponding increase in file size. Which of the following file formats should she use?

- (a) PDF.
- (b) GIF.
- (c) SVG.
- (d) PNG.
- (e) JPG.

**Question 21**

[1 mark] Which of the following statements regarding digital games is FALSE?

- (a) Realistic sports games are referred to as sims.
- (b) Many games incorporate elements of more than one genre.
- (c) Platform games focus on navigation through environments.
- (d) All strategy games are turn-based.
- (e) Some shooters use a light gun peripheral.



**Question 22**

[1 mark] Which of the following are examples of digital game media?

- I. Floppy disks
- II. SSD
- III. Cassettes
- IV. Blu-Ray discs
- V. Cartridges

- (a) II and IV.
- (b) I, III, IV and V.
- (c) I, IV and V.
- (d) I, II and III.
- (e) I, II, III, IV and V.

**Question 23**

[1 mark] With regard to digital game design, which of the following is an experience element?

- (a) Embedded narratives.
- (b) Narrative mechanics.
- (c) Emergent narratives.
- (d) Interpreted narratives.
- (e) None of the above.

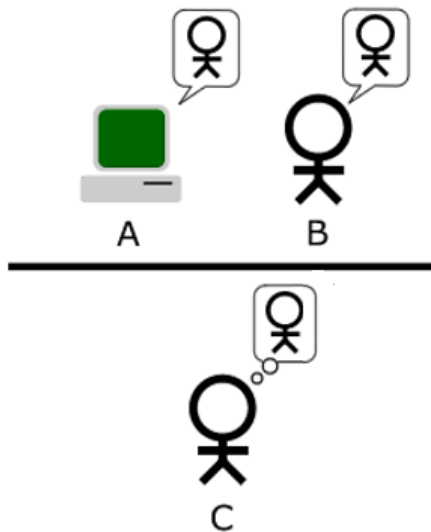
**Question 24**

[1 mark] A mobile game developer releases a game for the Android and IOS platforms. The game is a fast paced shoot 'em up that requires quick and precise user input. Soon after release, the developer receives complaints from gamers who purchased the title, that the game is difficult to control using the touch screen of a phone or tablet. This scenario is an example of bad game design caused by a misalignment between:

- (a) Game mechanics and embedded narrative.
- (b) Game mechanics and technology.
- (c) Game mechanics and aesthetics.
- (d) Dynamics and aesthetics.
- (e) Game mechanics and emergent narrative.

**Question 25**

[1 mark] Take a look at the diagram below:



A, B and C are taking part in a Turing test. Which of the following statements is TRUE?

- (a) If B cannot tell A and C apart, A passes the Turing test.
- (b) If A can tell B and C apart, A passes the Turing test.
- (c) The Turing test falls under the cognitive view of intelligence.
- (d) If C cannot tell A and B apart, A passes the Turing test.**
- (e) None of the above.

**Question 26**

[1 mark] Which of the following statements regarding Artificial Intelligence is FALSE?

- (a) Observations of the environment obtained through sensors are called percepts.
- (b) MYCIN is an example of an agent.**
- (c) Actuators are used to make actions on the environment.
- (d) An agent is an autonomous entity designed to work in a defined environment.
- (e) None of the above.

**Question 27**

[1 mark] Which of the following statements is FALSE?

- (a) The Electric Tabulating System was used to compile the results of the 1890 Census in the USA.
- (b) Alan Turing developed the Bombe in 1939 to decode Enigma messages.
- (c) Tommy Flowers developed the Colossus to decode Lorenz messages.
- (d) Univac and the IBM 701 were two mainframes available in the 1950s.
- (e) The Analytical Engine was the first mechanical computer, being built in 1832.**

**Question 28**

[1 mark] Arrange the following events in chronological order:

- I. Microsoft was founded.
- II. VisiCalc was released.
- III. Apple was founded.
- IV. Intel was founded.
- V. Microsoft purchased QDOS.

- (a) III, II, IV, I, V
- (b) III, IV, I, V, II
- (c) IV, I, III, II, V
- (d) I, V, IV, III, II
- (e) II, I, V, III, IV

**Question 29**

[1 mark] Who sent the first email?

- (a) Leslie Lamport.
- (b) Tim Berners-Lee.
- (c) Ward Cunningham.
- (d) Donald Knuth.
- (e) Ray Tomlinson.

**Question 30**

[1 mark] Which of the following is a disadvantage of Wikipedia?

- (a) Some articles are biased.
- (b) There is no direct quality control.
- (c) You have to take care when referencing Wikipedia articles.
- (d) Vandalism of Wikipedia pages is an issue.
- (e) All of the above.

**THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.**

QUESTION/ANSWER BOOKLET FOLLOWS

## SECTION B

Answer all questions in this section in the space provided. If you run out of space, please use the Overflow Sheet and indicate in the allotted space that you have used the Overflow Sheet.

### 31. Programming Using Python (10 marks)

(a) What is the output of the following program?

```
a = 9
b = 8
c = a % (a - 1)
d = b // 3
sum = c + d
print(c, d, sum)
```

1 2 3

(3 marks)

(b) Using the space provided below, draw the output produced by the execution of the Python 'turtle' program listed below. Assume that the turtle begins in the middle of the window facing right and that the window is approximately 600 steps wide.

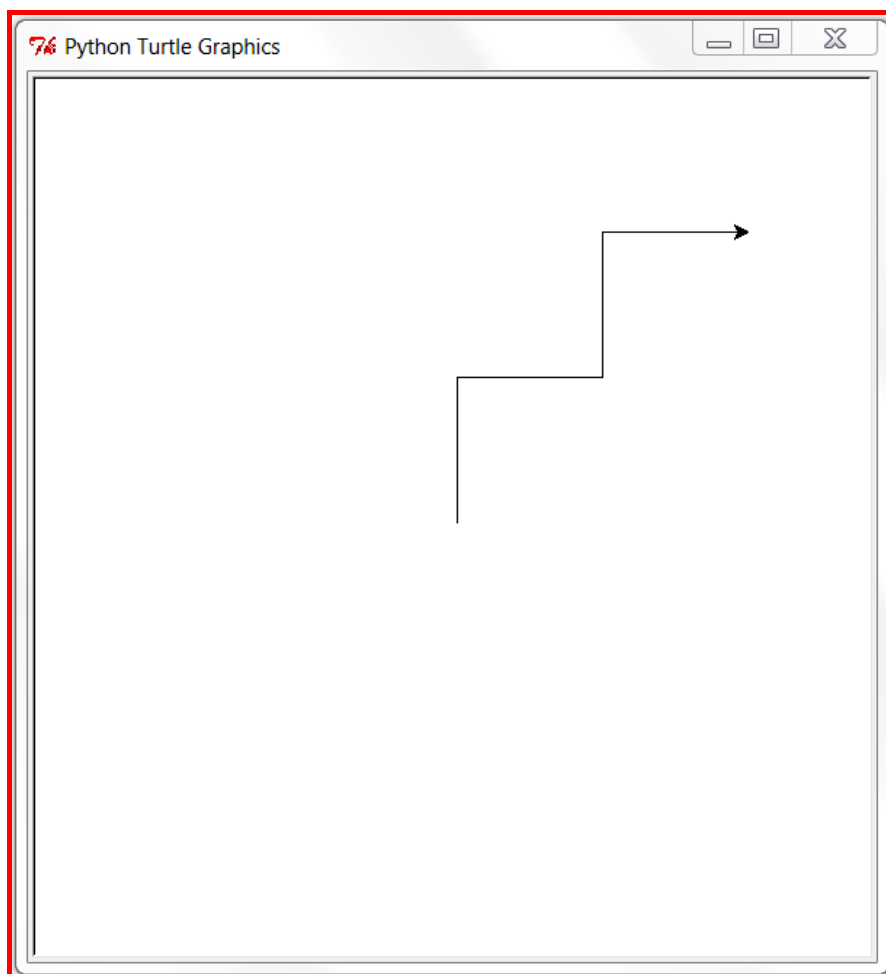
**Make sure to clearly indicate:**

- the path drawn by the turtle.
- the final position and direction of the turtle (using the arrowhead).

```
import turtle

steps = 100
angle = 90
sides = 0
end = 4

while sides < end:
    turtle.left(angle)
    turtle.forward(steps)
    sides = sides + 1
    angle = -angle
```



(3 marks)

- (c) In the space below, write a Python program that displays the highest score out of all the scores that are entered by the user.

Your program first needs to prompt the user to enter the number of scores. You can assume that the number entered by the user will be a valid positive integer. The program then needs to prompt the user to enter each score as in the example screenshot below. You can assume that all the scores entered by the user will be valid positive integers.

The following **example** shows the exact formatting expected for the prompts and output.

*Example:*

```
Number of scores? 3
Score: 43
Score: 25
Score: 10
The highest score is 43
```

```
number_of_scores = int(input("Number of scores? "))
highest_score = 0
count = 0
while count < number_of_scores:
    score = int(input("Score? "))
    if score > highest_score:
        highest_score = score
    count = count + 1
print("The highest score is", highest_score)
```

(4 marks)

**32. Spreadsheets (15 marks)**

The following spreadsheet displays information about students and their scores.

	A	B	C	D	E	F	G	H	I	J
1	<b>ID</b>	<b>First Name</b>	<b>Surname</b>	<b>Labs</b>	<b>Exam</b>	<b>Final</b>	<b>Fail Labs</b>	<b>Fail Exam</b>	<b>Passed?</b>	<b>Grade</b>
2				20	80	100				
3										
4	199444	Jacob	Hodson	18	60	78			Yes	B
5	303114	Michael	Smith	6	37	43	FL	FE	No	FAIL
6	465336	Joshua	Lee	12	55	67			Yes	B
7	769866	Matthew	Weng	19	68	87			Yes	A
8	800526	Ethan	Park	19	39	58		FE	No	FAIL
9	812069	Andrew	Davis	13	52	65			Yes	B
10	887268	Daniel	Denden	15	49	64			Yes	C
11	952348	William	Hung	18	63	81			Yes	A
12	973748	Joseph	Fong	5	79	84	FL		No	FAIL
13										
14										
15	<b>Boundary</b>	<b>Grade</b>								
16	50	C								
17	65	B								
18	80	A								

- (a) Cell **F4** (Final) calculates the final mark which is the sum of the Labs mark (**D4**) and the Exam mark (**E4**). What is the best formula to use in Cell **F4**?

**Note:** Your formula must be able to be filled down from **F4** to **F12** correctly.

**= D4 + E4**

(2 marks)

- (b) Cell **G4** (Fail Labs) indicates whether the student has failed the labs component. If the Labs mark (**D4**) is less than **10**, the **Fail Labs** cell should display “**FL**”, otherwise the **Fail Labs** cell should be empty. What is the best formula to use in Cell **G4**?

Your answer must use an **IF** function.

**Note:** Your formula must be able to be filled down from **G4** to **G12** correctly.

**=IF( D4 < 10 , "FL" , "" )**

(2 marks)



- (c) Cell **H4** (Fail Exam) indicates whether the student has failed the Exam component. If the Exam mark (**E4**) is less than **40**, the **Fail Exam** cell should display “**FE**”, otherwise the **Fail Exam** cell should be empty. What is the best formula to use in Cell **H4**? Your answer must use an **IF** function.

**Note:** Your formula must be able to be filled down from **H4** to **H12** correctly.

```
=IF( E4 < 40 , "FE" , "" )
```

(2 marks)

- (d) Cell **I4** (Passed?) displays whether the student has passed the course. To pass the course the student must have passed both the Labs component and the Exam component. If the student has failed the Labs component or the Exam component, then Cell **I4** should display “**No**”, otherwise it should display “**Yes**”. What is the best formula to use in Cell **I4**? Your answer must use an **IF** function.

**Note:** Your formula must be able to be filled down from **I4** to **I12** correctly.

```
=IF(OR( G4 = "FL" , H4 = "FE" ) , "No" , "Yes")
```

(4 marks)

- (e) Cell **J4** (Grade) displays the grade the student received. If the student failed the course (Cell **I4** = “**No**”) then the grade will be “**FAIL**”. Otherwise, the grade is determined by looking up the table in Cells **A16:B18** to determine which range the Final mark (**F4**) fits into. What is the best formula to use in Cell **J4**? Your answer must use an **IF** function and **VLOOKUP** function. The **VLOOKUP** function has the following syntax:

**VLOOKUP**(lookup\_value, table\_array, col\_index\_num, range\_lookup)

**Note:** Your formula must be able to be filled down from **J4** to **J12** correctly.

```
=IF(I4 = "Yes" ,  
    VLOOKUP( F4 , $A$16:$B$18 , 2 , TRUE ) , "FAIL")
```

(5 marks)

**33. Databases (15 marks)**

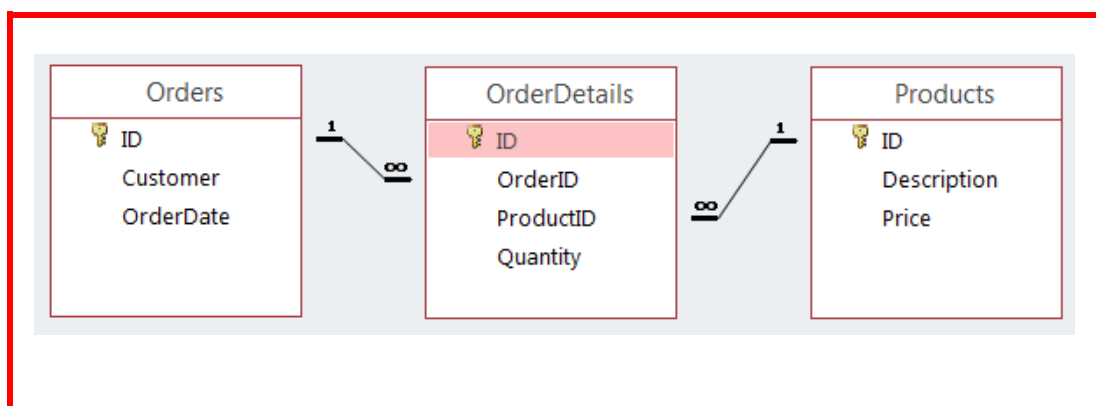
A local candy store has asked you to make a database for their shop. The following tables show the full contents of the database.

ID	Description	Price
1	Fizzing Whizbees	5.00
2	Chocolate Frogs	10.00
3	Sherbert Lemons	4.00
4	Bertie Bott's Bean	11.00
5	Fizzing Whizbees	6.00
6	Chocolate Frogs	9.00
7	Sherbert Lemons	7.00

ID	Customer	OrderDate
30	27	15/01/2017
31	4	20/01/2017
32	12	22/01/2017
33	8	30/01/2017
34	4	10/02/2017
35	27	23/02/2017

ID	OrderID	ProductID	Quantity
1	30	4	2
2	30	2	1
3	31	1	5
4	32	2	10
5	33	3	4
6	34	5	4
7	35	2	10

- (a) The ID field of each table is its primary key. In the space below, draw a relationship diagram for this database, indicating the relationships (if any) between the tables.



(5 marks)

(b) In the space below, write an SQL query that displays the **OrderID**, **ProductID** and **Quantity** of all **OrderDetails** which have a **Quantity** greater than **4**. The query's results should be sorted in **descending** order of **Quantity**. An example of the results obtained by running the query is shown below.

OrderID	ProductID	Quantity
35	2	10
32	2	10
31	1	5

```
SELECT OrderID, ProductID, Quantity
FROM OrderDetails
WHERE Quantity > 4
ORDER BY Quantity DESC;
```

(5 marks)

(c) Complete the Query By Example (QBE) form below so that it generates a query that displays the **Description**, **Quantity** and **OrderID** of all products ordered by **Customer 27**. The results should be sorted in **ascending** order based on the **Description**. An example of the results obtained by running the query is shown below.

Description	Quantity	OrderID
Bertie Bott's Bean	2	30
Chocolate Frogs	1	30
Chocolate Frogs	10	35

Field:	Description	Quantity	OrderID	Customer
Table:	Products	OrderDetails	OrderDetails	Orders
Sort:				
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Criteria:				27
or:				


(5 marks)

### 34. HTML5 and CSS (15 marks)

The following screenshot shows the body of a web page created using HTML5 and CSS:

## THE AUTOMATIC WATCH

An *automatic watch* is a mechanical watch powered by the natural motion of the wearer, making manual winding unnecessary. More information can be found from its [Wikipedia page](#).



### OPERATION

**Mainspring**  
Spiral spring that turns the watch's gears.

**Rotor**  
A weight that can rotate and wind the mainspring.

**Power Reserve**  
The number of hours it takes for the mainspring to unwind.

### POPULAR AUTOMATIC MOVEMENTS

Name	Manufacturer	Complication(s)
Miyota 9015	Citizen	Date
ETA 2893-2	ETA	Date and GMT

Complete the HTML5 code below so that it produces the output shown above.

You **must** use the styles defined in the internal style sheet in the head section below, and **must not** define any new styles.

**Note:**

- (1) The URL for the Wikipedia page is:  
" [https://en.wikipedia.org/wiki/Automatic\\_watch](https://en.wikipedia.org/wiki/Automatic_watch)".
- (2) The image is stored in a file called "AutomaticDiver.png".
- (3) There are two sections: the heading "Operation" and its associated content and the heading "Popular Automatic Movements" and its associated content.

```
<!DOCTYPE html>  
<html lang="en" >  
<head>  
<meta charset="UTF-8" >
```

```
<title>HTML/CSS Exam Question</title>
<style>
body{text-align: justify; font-family: sans-serif}
h1, h2{font-family: "Courier", monospace;
        background-color: rgb(38, 92, 38); color: white;
        font-variant: small-caps; text-align: center}
table, tr, td{border: 2px solid #265C26}
#emphasize{font-style: italic; font-size: large}
#tablehead{background-color: #265C26; color: white;
            text-align: center; font-size: large; font-weight: bold}
.tabledata{text-align: center;}
.terms{font-size: large; font-family: "Courier", monospace; font-
weight: bold; color: rgb(38, 92, 38)}
#image{text-align: center;}
</style>
</head>
```

```
<body>
```

```
<!-- Main Heading -->
```

```
<h1>The Automatic Watch</h1>
```

(1 mark)

```
<!-- Introductory Paragraph -->
```

```
<p>
An <span id="emphasize">automatic watch</span> is a
mechanical watch powered by the natural motion of the
wearer, making manual winding unnecessary. More
information can be found from its <a
href="https://en.wikipedia.org/wiki/Automatic_watch">
Wikipedia page</a>.
</p>
```

(3 marks)

```
<!-- Image -->
```

```
<p id="image">

</p>
```

(3 marks)

<!-- Operation Section -->

```
<section>
<h2>Operation</h2>
<dl>
<dt class="terms">Mainspring</dt>
<dd>Spiral spring that turns the watch's gears.</dd>
<dt class="terms">Rotor</dt>
<dd>A weight that can rotate and wind the
mainspring.</dd>
<dt class="terms">Power Reserve</dt>
<dd>The number of hours it takes for the mainspring
to unwind.</dd>
</dl>
</section>
```

(4 marks)

<!-- Popular Automatic Movements Section -->

```
<section>
<h2>Popular Automatic Movements</h2>
<table>
  <tr id="tablehead">
    <td>Name</td>
    <td>Manufacturer</td>
    <td>Complication(s)</td>
  </tr>
  <tr class="tabledata">
    <td>Miyota 9015</td>
    <td>Citizen</td>
    <td>Date</td>
  </tr>
  <tr class="tabledata">
    <td>ETA 2893-2</td>
    <td>ETA</td>
    <td>Date and GMT</td>
  </tr>
</table>
</section>
```

(4 marks)

```
</body>
</html>#
```

### 35. LaTeX (15 marks)

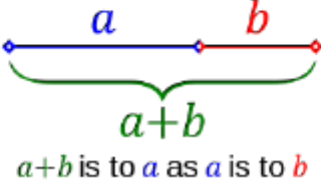
On the following pages, complete the LaTeX code that will produce the output below:

## The Golden Ratio

M. E. Matics  
Summer School, 2018

### 1 Introduction

In mathematics, two quantities are in the *golden ratio* if their ratio is the same as the ratio of their sum to the larger of the two quantities.



$a+b$  is to  $a$  as  $a$  is to  $b$

#### 1.1 Characterization

The golden ratio is represented by the Greek letter phi and can be expressed as:

$$\phi = \frac{1 + \sqrt{5}}{2} \tag{1}$$

It can also be expressed as the following infinite series:

$$\phi = \frac{13}{8} + \sum_{n=0}^{\infty} \frac{(-1)^{(n+1)}(2n+1)!}{(n+2)!n!4^{(2n+3)}} \tag{2}$$

### 2 Usage

The golden ratio has been used in:

- Architecture
- Music
- Painting

The image displayed after the first paragraph is stored in a file called **GoldenRatio.png** and is in the same folder as the LaTeX code. When inserted into the document, the image should be **centred** and **4 cm wide**.

The following LaTeX commands have been included as a reference. You will not need to use all of these commands. Note that the basic document structure has been completed for you.



<i>Normal commands</i>	<i>Environments</i>	<i>Math mode commands</i>
<code>\section{}</code>	itemize	<code>\$</code>
<code>\subsection{}</code>	enumerate	<code>\sqrt{}</code>
<code>\includegraphics{}</code>	verbatim	<code>\frac{ }{ }</code>
<code>\title{}</code>	flushright	<code>\sin</code>
<code>\author{}</code>	center	<code>\phi</code>
<code>\date{}</code>	quote	<code>\sum_{ }^{ }</code>
<code>\maketitle</code>	displaymath	<code>\infty</code>
<code>\item</code>	equation	<code>^</code>
<code>\usepackage{graphicx}</code>	quotation	<code>-</code>
<code>\emph{}</code>		

```

\documentclass[a4paper]{article}
\usepackage{graphicx}
\begin{document}
\title{The Golden Ratio}
\author{M. E. Matics}
\date{Summer School, 2018}
\maketitle
\section{Introduction}
In mathematics, two quantities are in the
\emph{golden ratio} if their ratio is the same as
the ratio of their sum to the larger of the two
quantities.
\begin{center}
\includegraphics[width=4cm]{GoldenRatio.png}
\end{center}
\subsection{Characterization}
The golden ratio is represented by the Greek letter
phi and can be expressed as:
\begin{equation}
\phi=\frac{1+\sqrt{5}}{2}
\end{equation}

```

**It can also be expressed as the following infinite series:**

**`\begin{equation}`**

**`\phi = \frac{13}{8} + \sum^{\infty}_{n=0} \frac{(-1)^{(n+1)}(2n+1)!}{(n+2)!n!4^{(2n+3)}}`**

**`\end{equation}`**

**`\section{Usage}`**

**The golden ratio has been used in:**

**`\begin{itemize}`**

**`\item Architecture`**

**`\item Music`**

**`\item Painting`**

**`\end{itemize}`**

**`\end{document}`**

(15 marks)

**- Overflow Sheet 1 -**

**Write the question number and letter next to your answer. You must ALSO indicate in the allotted space that you have used the overflow sheet.**

**- Overflow Sheet 2 -**

**Write the question number and letter next to your answer. You must ALSO indicate in the allotted space that you have used the overflow sheet.**

**Rough Working – This page will not be marked**

**Rough Working – This page will not be marked**