May/June 2024

2 A computer game is being designed that users will be able to play using a virtual reality (VR) headset.

(a) Complete the description of the principal operation of a VR headset.

A headset can have one or two ..... that output the image to the user. The headset has speakers that output surround sound to give a realistic experience.

The user's head movements are detected using a sensor.

This sensor is a ..... . The data is transmitted to a microprocessor that analyses the data to identify the ..... of movement. Some headsets use ..... that record the user's eye movements for analysis.

[4]

(b) The computer uses a buffer when transmitting data to the VR headset.

Explain how a buffer is used when data is transmitted between the computer and the VR headset.

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..... [3]

(c) The VR headset has Electrically Erasable Programmable Read Only Memory (EEPROM).

Explain the benefits of using EEPROM instead of other types of Read Only Memory (ROM) in the VR headset.

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..... [3]

(d) The computer can transmit a video made from bitmap images and vector graphic animations to the VR headset.

(i) Describe how the data for a bitmapped image is encoded.

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..... [3]

(ii) Describe the contents of a vector graphic drawing list.

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..... [2]

(iii) The bitmap video is **not** compressed before transmission to the VR headset.

Give **two** reasons why the video does **not** need to be compressed.

1 .....

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2 .....

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[2]

Question	Answer	Marks
2(a)	**1 mark** for each correctly completed statement: • **(**LCD) displays/screens/lenses • gyroscope/accelerometer • direction/speed • digital cameras A headset can have one or two **(LCD) displays/screens/lenses** that output the image to the user. The headset has speakers that output surround sound to give a realistic experience. The user's head movements are detected using a sensor. This sensor is a **gyroscope/accelerometer**. The data is transmitted to a microprocessor that analyses the data to identify the **direction/speed** of movement. Some headsets use **digital cameras** that record the user's eye movements for analysis.	4
2(b)	**1 mark** each to **max 3**: • The buffer is used as a **temporary** store for data going to the headset • Data is **transferred** into the buffer by the computer • Data is **retrieved** from the buffer by the headset • When the buffer is empty/full an interrupt is sent to the computer requesting more data/stopping further data being sent • When the headset has enough data/needs more data, an interrupt is sent by the headset to the computer to stop sending data from buffer	3
2(c)	**1 mark** each to **max 3**: • EEPROM allows **frequent/multiple** read/write/erase operations • … so the headset can take advantage of new features • … without fully erasing the contents of the firmware in the headset first // can erase a particular byte or the whole EEPROM • … without removing the chip(s)/firmware from the headset • ... the contents of the firmware in the headset can be changed by the user without technical expertise • Cheaper to manufacture so headset will be cheaper to purchase	3
2(d)(i)	**1 mark** each: • Image is made of pixels and each pixel has one colour • Each colour has a **unique** binary code • **Code for the colour** of each pixel is stored in **sequence**	3
2(d)(ii)	**1 mark** each to **max 2**: • List of objects in the drawing • A list that stores the command/description/equation required to draw each object • Properties of each object e.g. the fill colour, line weight/colour	2
2(d)(iii)	**1 mark** each to **max 2**: • Dedicated connection to the headset // not sharing bandwidth • Already fast connection that can transmit the data without slowing • Video may already be a small file size and does not need further reduction • Video is not saved so storage is not an issue in the headset	2

May/June 2023

(b) Describe **two** ways the hardware of a laptop can be upgraded to improve the performance **and** explain how each upgrade improves the performance.

1 .....

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2 .....

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[4]

(c) Peripherals are connected to the laptop using ports.

(i) A printer is connected to a Universal Serial Bus (USB) port.

Describe how data is transmitted through a USB port.

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..... [1]

(ii) A monitor is connected to the laptop using a different type of port.

Identify **one** other type of port that can be used to connect the monitor.

..... [1]

5(b)	**1 mark** for description; **1 mark** for corresponding explanation Examples • Increase number of cores • Each core can **independently** carry out a process at the same time // so that more instructions are performed **in parallel** • Increase RAM capacity • ... allowing more applications to reside in memory at the same time, saving disk access times • Increase cache memory • More data can be stored in fast access so less time is spent accessing from RAM • Increase clock speed • More Fetch-Decode-Execute (FDE) cycles can run each second / **per unit time**	**4**
5(c)(i)	**1 mark** for a correct answer • 1 bit is transferred at a time • Can be synchronous **or** asynchronous • USB-3 is full duplex **and** earlier versions are half-duplex	**1**
5(c)(ii)	**1 mark** for identification of a suitable port Examples • HDMI • DisplayPort	**1**

October/November 2023

1 A factory makes chocolate bars.

The factory uses a conveyor belt that moves the products from one stage of production to the next stage.

(a) An automated system counts the number of chocolate bars made at the end of production.

The system includes a sensor positioned above the conveyor belt.

Identify **one** appropriate type of sensor that can be used.

..... [1]

(b) A second automated system removes chocolate bars with an incorrect weight from the production line.

Describe the role of an **actuator** in this second system.

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..... [2]

(c) The factory has many different machines with embedded systems.

(i) Identify **two** features of embedded systems.

1 .....

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2 .....

.....

[2]

(ii) Identify **one** drawback of embedded systems.

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..... [1]

Question	Answer	Marks
1(a)	**1 mark** for: • infra-red / proximity (sensor)	1
1(b)	**1 mark** for each bullet point (**max 2**) • Actuator generates a signal / causes an action / converts electrical energy into a mechanical force • ... to push an arm // to open a trap door // to pick up the chocolate bar with the incorrect weight	2
1(c)(i)	**1 mark** for each feature (**max 2**) • Dedicated to a single task // limited number of functions • Built into a larger system // integrated into a larger system • An embedded system must contain a processor, memory and an I/O capability // Dedicated hardware	2
1(c)(ii)	**1 mark** for each bullet point (**max 1**) • Difficult to change / update the firmware by the user // Difficult to upgrade devices to take advantage of new technology • Cannot be easily **adapted** for **another** task • Troubleshooting faults/upgrading is a specialist task • Devices are often thrown away rather than repaired as difficult to upgrade or repair	1

May/June 2022

2 A car has several features.

(a) One feature is a lane detection system. This system monitors the lines on either side of the lane. If the car gets too close to one line, the system automatically moves the car away from the line.

Explain why the lane detection system is an example of an embedded system.

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..... [2]

(b) Two other features:

- record the number of miles travelled in the current journey, from when the engine is turned on to when it is turned off
- record the total number of miles the car has travelled since it was built.

Identify the data that will be stored in the primary **and** secondary storage of the car for these **two** features.

Primary .....

.....

Secondary .....

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[2]

(c) The car has a resistive touchscreen for the user to select options.

Tick (✓) **one** box in each row to show whether each statement about a resistive touchscreen is true or false.

Statement	True	False
The screen always has five different layers		
A processor determines the horizontal and vertical coordinates of the point of contact		
The touchscreen will work if any object touches the screen		

[1]

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>1 mark per point to max 2

• The lane detection system is built into / integrated into the car

• The lane detection system only performs one task
• The lane detection system is not easily changed/updated by the car owner</td><td>2</td></tr>
<tr><td>2(b)</td><td>1 mark for primary
• e.g. Miles travelled in the current journey, before the engine is turned off

1 mark for secondary
• e.g. Total miles travelled since the car was built // miles for most recent journey after engine switched off</td><td>2</td></tr>
<tr><td>2(c)</td><td>1 mark for all correct ticks

<table>
<tr><th>Statement</th><th>True</th><th>False</th></tr>
<tr><td>The screen always has five different layers</td><td></td><td>✓</td></tr>
<tr><td>A processor determines the horizontal and vertical coordinates of the point of contact</td><td>✓</td><td></td></tr>
<tr><td>The touchscreen will work if any object touches the screen</td><td>✓</td><td></td></tr>
</table>
</td><td>1</td></tr>
</table>

May/June 2021

5 Seth uses a computer for work.

(a) Complete the following descriptions of internal components of a computer by writing the missing terms.

The ..... transmits the signals to coordinate events based on the electronic pulses of the ..... .

The ..... carries data to the components, while the ..... carries the address where data needs to be written to or read from.

The ..... performs mathematical operations and logical comparisons.

[5]

(b) Describe the ways in which the following factors can affect the performance of his laptop computer.

Number of cores

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Clock speed

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[4]

Question	Answer	Marks
5(a)	**1 mark** for each term correctly inserted The **control unit/bus** transmits the signals to coordinate events based on the pulses of the (**system) clock**. The **data bus** carries data to components, while the **address bus** carries the address where data is being written to or read from. The **arithmetic logic unit/ALU** performs mathematical operations and logical comparisons.	**5**
5(b)	**1 mark** per bullet point to **max 3** per factor. **max 4** overall. Number of cores: • Each core processes one instruction per clock pulse • More/multiple cores mean that **sequences of instructions** can be split between them • … and so more than one instruction is executed per clock pulse // more **sequences of instructions** can be run at the same time • **More** cores decreases the time taken to complete task Clock speed: • Each instruction is executed on a clock pulse // one F-E cycle is run on each clock pulse • ... so the clock speed dictates the number of instructions that can be run per second • The **faster** the clock speed the more instructions can be run per second	**4**

October/November 2021

3 Andy likes to play computer games.

(a) Andy uses several input devices to play the games. These include a keyboard and a microphone.

Describe the principal operation of a microphone.

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..... [3]

Question	Answer	Marks
3(a)	**1 mark** for each bullet point to **max 3** • The microphone has a diaphragm / ribbon • The incoming sound waves cause vibrations of the diaphragm • … causing a coil to move past a magnet // causing a magnet to move past a coil (dynamic microphone) // changing the capacitance (condenser microphone) // deforms the crystal (crystal microphone) • An electrical signal is produced	**3**