6 Automated and emerging technologies

1 Use the following set of words or phrases to complete the paragraph below. Each word or phrase can be used once, more than once or not at all.

» attributes	» explanation system	» objects
» conclusions	» inference	» repository
» database	» inference engine	» rules base
» dialogue boxes	» inference rules	» search engine
» expert system	» knowledge base	» user interface

..... are a form of AI developed to mimic human knowledge and reasoning. They use knowledge and ..... to solve problems where a degree of human expertise would be needed. Expert systems interact with the user by way of a ..... through ..... and command prompts. Once a conclusion is found, the ..... can be used to inform the user of the reasoning behind the conclusion. The main processing element of an expert system is the ....., which behaves like a search engine examining the ..... for data that matches the queries. The ..... is the problem-solving component which makes use of ..... stored in the ..... . The knowledge base is a collection of ..... and their associated .....; it is often referred to as a ..... of facts.

2 Eight descriptions and ten computer terms are shown in the diagram below.

Draw lines to connect each description to the correct computer term.

Devices that can move between point 'A' and point 'B' without the need for manual input	Rules base
A form of AI that has been developed to mimic human knowledge and expertise	Knowledge base
Robots that roam the internet, scanning websites and categorising them for search purposes	Autonomous
Simulated intelligence in machines; building of machines capable of thinking like a human	Chat bot
A repository of facts and expertise in the form of a collection of objects and their attributes	Artificial intelligence
Combination of software and hardware designed and programmed to work automatically without the need of any human interaction	Expert system
A subset of AI in which the algorithms are 'trained' and can learn from their past experience and from examples	Robotics
Branch of computer science that brings together the design, construction and operation of 'intelligent' electromechanical machines	Machine learning
	Automated system
	Web crawler

3 Many examples of automated systems exist.

a Define what is meant by an automated system.

.....

.....

.....

.....

b One part of the automated system involves the use of sensors.

Explain what a sensor is.

.....

.....

.....

.....

c Name **three** areas where automated systems are used.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

d Give **three** general advantages of using automated systems.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

e Give **three** general disadvantages of using automated systems.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

4 An example of an automated system is the control of the entry and exit to a private car park. Cameras take a photograph of a car's number plate on entry which is then checked before the barrier is raised. At the exit, another camera captures the car's number plate, which is again checked before raising the barrier.

a Name the software that is needed to convert the camera image of the car's number plate into an electronic format that can be used in, for example, a database.

.....

b Describe how sensors, cameras, actuators and a computer system can be used to control entry to and exit from the car park. Your answer should include how a car number plate meets the criteria for entry and any other security or safety aspects.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

c i Describe the advantages of using an automated system to control entry and exit to the car park.

.....

.....

.....

.....

ii One disadvantage is the possibility of illegal copying of number plates to 'fool' the system and allow unauthorised access to the car park.

Discuss how you might think this problem could be overcome.

.....

.....

.....

.....

5 a A car is equipped with self-parking technology. Explain the role of the following devices in the self-parking technology:

i cameras:

.....

.....

.....

ii sensors:

.....

.....

.....

iii actuators:

.....

.....

.....

b Describe how embedded systems in a car prevent the driver exceeding a set speed and also prevent the car getting too close to the vehicle in front of it. Include the role of the microprocessor and any named sensors in your answer.

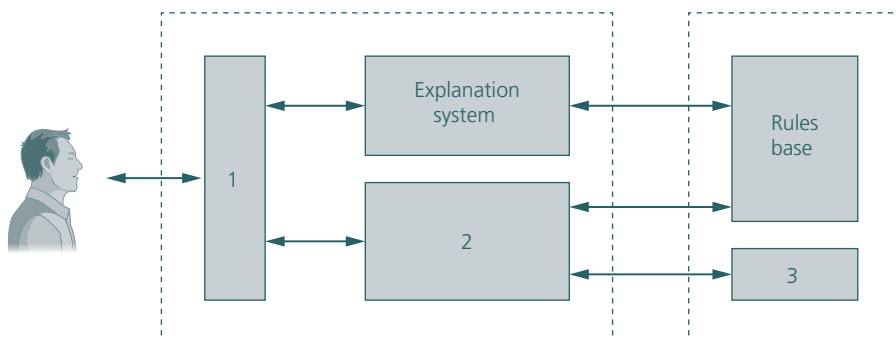
6 a Name suitable sensors for each of the following automated systems. Describe the function of your named sensor in each case.

Description of automated system	Suitable sensor(s)	Function of named sensors
Manufacture of a new vaccine which requires the mixing of four liquids in the ratio 1:2:3:4 as a single batch. The four liquids must be totally mixed and the temperature must be maintained at 35°C, which is critical to the process. When fully mixed, the solution turns an even yellow colour.	.....	.....
A lighting display has been set up in one room of an art gallery (as part of the exhibition). A random sequence of different coloured LED lights is under microprocessor control. The display only switches on when visitors walk into the room; at the same time, the room lights are dimmed to give the lighting display its most dramatic effect.	.....	.....
A train uses automatic twin-doors. Both doors open automatically when the train stops. Both doors close again when no-one is still boarding or leaving the train. The doors have a safety mechanism so that a passenger cannot become trapped between the two closing doors. The train can only move off when every door on the train has been safely closed.	.....	.....

b The eight statements on the left-hand side of the following table are either true or false. Tick (✓) the appropriate box to indicate which statements are true and which are false.

Statements	True (✓)	False (✓)
Automated systems lead to less consistent results or less consistent products		
Automated systems are more expensive to set up than traditional manual systems		
Automated systems could be quickly overwhelmed by the amount of data presented to them		
Automated systems are inherently less safe than manual systems		
Automated systems generally require enhanced maintenance when compared to manual systems		
Automated systems allow processes to run at optimum conditions at all times		
Software failures, due to unforeseen conditions, are unlikely to impact on an automated system		
Automated systems will react more quickly to unusual process conditions than a manual system		

7 a Complete the diagram of an expert system.



1 .....

2 .....

3 .....

b A section of a knowledge base is shown below.

	Attribute 1	Attribute 2	Attribute 3	Attribute 4
Bus	Hybrid electric/petrol engine	Uses a road	Has 4 wheels	Up to 80 passengers
Train	Electric motors	Uses rails	Has 40 wheels	Up to 400 passengers
Taxi cab	Diesel engine	Uses a road	Has 4 wheels	Up to 4 passengers

i What is the correct expert system name for the items in column 1?

.....

ii The following set of questions was asked by the expert system. The user's answers to each question are shown. Using the knowledge base section shown above, what would be the expected output?

Expert system question	User response
Does it have a hybrid engine?	NO
Does it use a road?	YES
Does it have four wheels?	YES
Can it take more than 5 passengers?	NO

.....

c Describe the steps in setting up an expert system.

.....

.....

.....

.....

.....

.....

.....

.....

.....

8 a Explain what is meant by the following terms:

i artificial intelligence (AI):

.....

.....

.....

.....

ii machine learning:

.....

.....

.....

.....

b Describe the differences between AI and machine learning.

.....

.....

.....

.....

.....

.....

9 a Which one of the following is NOT a component of an expert system? Circle the correct answer.

A an inference engine

B rules base

C accelerometer

D knowledge base

E user interface

b The practice of getting a machine to make decisions without being programmed to do so, via data acquisition, is a feature of:

A robotics

B a search engine

C an inference engine

D an automated system

E machine learning

Circle the correct answer.

c The combination of software and hardware designed and programmed to work automatically without the need for human interaction is known as:

A a chatbot

B an automated system

C an expert system

D machine learning

E robotics

Circle the correct answer.

d The branch of computer science that brings together the design, construction and operation of electromechanical devices is known as:

A robotics

B control technology

C computer programming

D automated systems

E electronics

Circle the correct answer.

e Which one of the following is NOT an advantage to the management of using robots in an industrial application? Circle the correct answer.

A they can work 24/7 without the need for breaks or holidays

B their work is more consistent

C they lead to higher productivity

D they can cause deskilling of the workforce

E they are less likely to make errors

10 Autonomous vehicles are becoming increasingly common. Discuss the advantages and disadvantages of:

- autonomous trains
- autonomous cars and buses

.....

.....

.....

.....

.....

.....