

# Product investigations

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The four exercises provided here can be used to provide students with experience of carrying out a preliminary product investigation before they go on to tackle the more rigorous product investigation (such as that prescribed by the awarding body in any examination pre-release information that may be issued to centres). Alternatively, these exercises can be incorporated into a revision programme in the final term of the course.

All four investigations are based on products that students should recognise and be familiar with. The investigations are divided into smaller tasks which are of the same type as the questions that students are likely to face in the final examination.

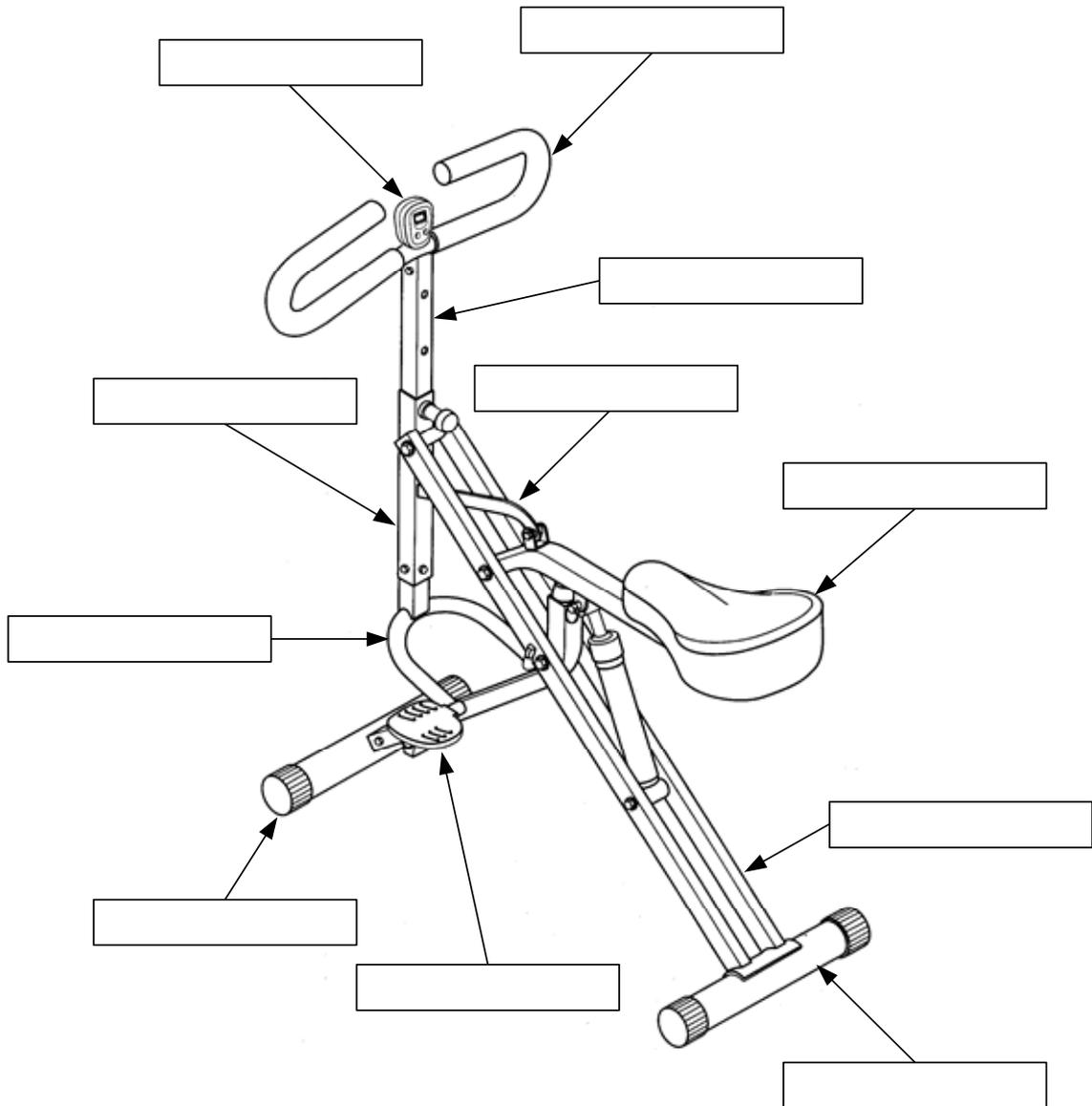
As they undertake each investigation, students should be encouraged to carry out library or Internet research, making relevant notes and sketches that will later help them to answer the questions posed in each task.

In most cases these investigations can be completed in about one to three hours. Students should be advised that they must spend a considerably longer period than this when carrying out product-based research prior to the final examination. In particular, they must ensure that they have a comprehensive set of notes, sketches and diagrams to refer to.



**Product Investigation: An exercise machine**

The diagram below shows a common type of exercise machine. The machine consists of a frame with fixed pedals and a seat that moves against a resistance cylinder. Use your library or the internet to carry out some research into different type of exercise machine.



**Task 1**

Identify the parts listed in the table on the next page by writing their names in the boxes on the diagram.

**Task 2**

Suggest a suitable material for each part and write the name of this material in the table on the next page.

<i>Part</i>	<i>Material</i>
Exercise monitor	
Seat	
Handlebar	
End cap	
Crank arm	
Handlebar post (height adjustable)	
Frame	
Pedal bar	
Front post	
Pedal	
Rear stabilizer	

**Task 3**

Explain the function of each of the following parts:

- (a) Front and rear stabilizers: \_\_\_\_\_
- (b) Crank arm: \_\_\_\_\_
- (c) End cap: \_\_\_\_\_
- (d) Exercise monitor: \_\_\_\_\_

**Task 4**

A **microprocessor** is used in the exercise monitor. Explain what a microprocessor is and why it is needed in this product.

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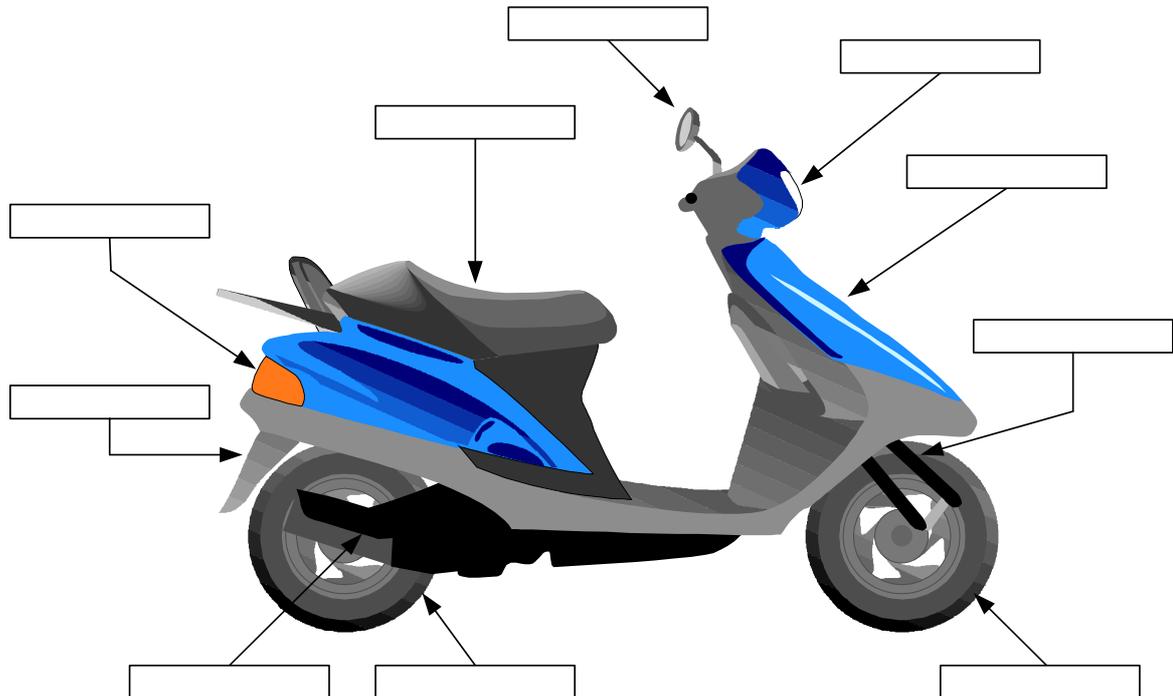
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**Product Investigation: A motor scooter**

The diagram below shows a typical motor scooter. Carry out research into motor scooters using your library or the Internet and locate information from several manufacturers and/or suppliers of motor scooters.



**Task 1**

Identify the parts listed in the table on the next page by writing their names in the boxes on the diagram.

**Task 2**

Suggest a suitable material for each part and write the name of this material in the table on the next page.

**Task 3**

Suggest a suitable manufacturing process (e.g. moulding, casting, extrusion, machining, etc) that would be used in order to manufacture the indicated parts and show this in the table.

<i>Part</i>	<i>Material</i>	<i>Processes</i>
Front tyre		
Rear light cover		
Exhaust pipe		
End cap		
Mirror		
Seat		
Mud flap		
Front suspension		
Front fairing		
Front light cover		
Rear tyre		

**Task 4**

**Programmable logic controllers (PLC)** are used in the manufacture of motor scooters. Explain what a PLC is and why it is used.

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**Task 5**

**Computer aided design (CAD)** is used in the manufacture of motor scooters. Explain three advantages of using CAD.

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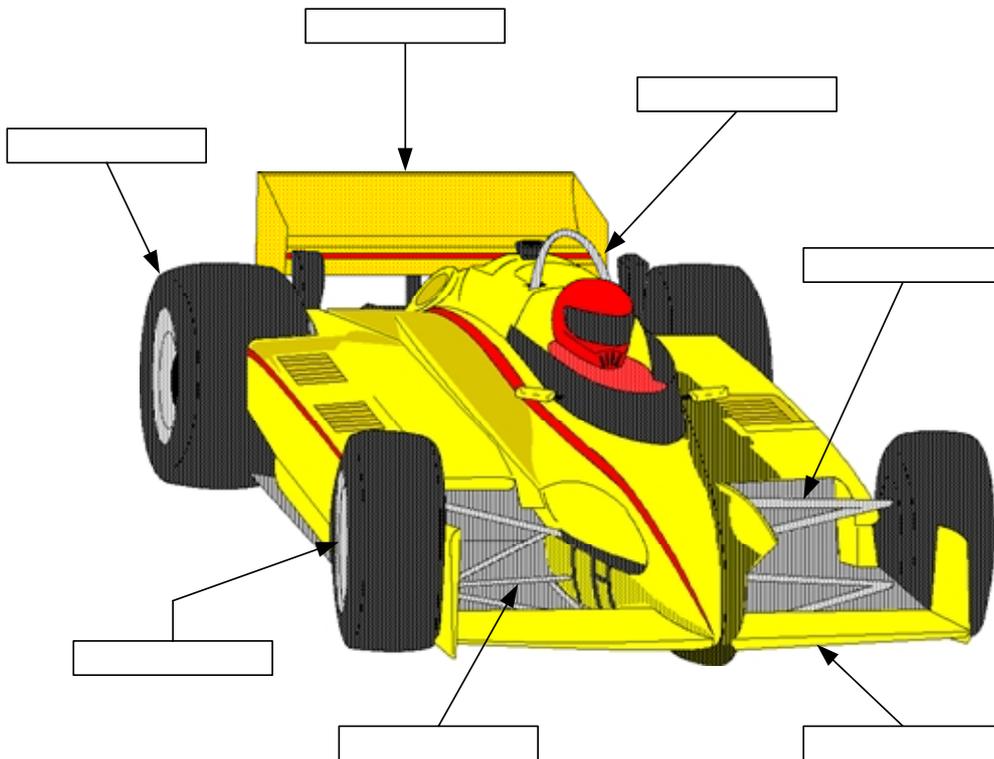
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**Product Investigation 4: A race car**

The diagram below shows a some features of a typical formula race car. Carry out research into race cars using your library or the Internet and locate information from several manufacturers and race teams within the motorsport industry.



**Task 1**

Use your research to identify and label each of the features indicated shown in the diagram.

**Task 2**

The race car is assembled from components that are manufactured using several types of new material, including **composite materials**. Explain what a composite material is and place a tick against the box in the diagram above if the indicated part is suitable for manufacturing using a composite material.

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**Task 3**

**Computer Aided Engineering (CAE)** is used in the design and manufacture of parts for a race car. Give **two** examples of where CAE is used. In each case give reasons for its use.

Example 1:

*CAE application:* \_\_\_\_\_

*Reasons for use:* \_\_\_\_\_

Example 2:

*CAE application:* \_\_\_\_\_

*Reasons for use:* \_\_\_\_\_

**Task 4**

Apart from Computer Aided Engineering (CAE) suggest **two** other applications of ICT in conjunction with a race car.

*Application 1:* \_\_\_\_\_

*Application 2:* \_\_\_\_\_

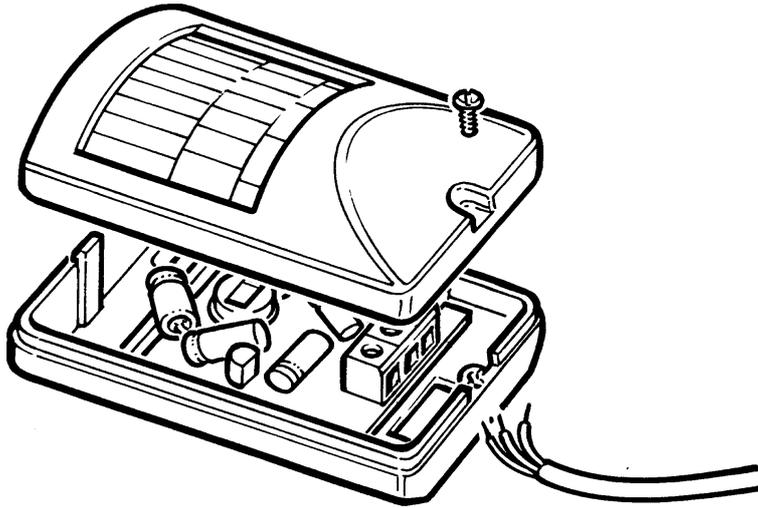
**Task 5**

Explain, using a labelled sketch, how the **rear spoiler** works:



### Product Investigation: A PIR sensor

The diagram below shows a typical domestic passive infrared (PIR) motion sensor. The sensor uses a number of small electronic components mounted on a printed circuit board (PCB). The front cover incorporates a translucent lens which effectively segments the infrared illumination of the target area. Carry out library or Internet research in order to find out how a PIR sensor works.



#### Task 1

Suggest **three** ways in which modern technology is used to manufacture the PIR sensor:

- (a) \_\_\_\_\_
- (b) \_\_\_\_\_
- (c) \_\_\_\_\_

#### Task 2

Suggest **one** application of ICT in the design and manufacture of the PIR sensor:

\_\_\_\_\_

#### Task 3

Name a **modern material** that could be used to manufacture the sensor's enclosure. Explain the advantages of using this material compared with materials such as wood or metal.

*Material:* \_\_\_\_\_

*Advantages:* \_\_\_\_\_

**Task 4**

The PIR detector uses a **printed circuit board**. Explain what a printed circuit is and state typical materials that are used in its manufacture.

*Explanation:*

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*Materials:*

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**Task 5**

The PIR detector uses a **semiconductor diode** that emits infrared radiation. Explain what a semiconductor is and state typical materials used in its manufacture.

*Explanation:*

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*Materials:*

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**SAMPLE EXAMINATION****PAPER 1****SECTION A (Answer ALL questions in this section)****Question 1**

- (a) Identify **two** products from those listed in the table below that belong to the **mechanical engineering** sector:

<i>Product</i>	<i>Tick the box if the product belongs to the mechanical engineering sector</i>
A microwave oven	
A car jack	
A mobile phone	
A CD-player	
A milk bottle	
A portable scaffold tower	

**(2 marks)**

- (b) Identify **two** products from those listed in the table below that belong to the **engineering fabrication** sector:

<i>Product</i>	<i>Tick the box if the product belongs to the engineering fabrication sector</i>
A PTFE bearing	
A jar of grease	
A machined screw	
A box of matches	
A cook-chill ready meal	
A roll of food wrap	

**(2 marks)****Total 4 marks****Question 2**

The **three** components listed are used in the manufacture of a wide range of engineered products. Explain why each component is needed:

- (a) A reduction drive

*Explanation:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(b) A voltage regulator

*Explanation:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(c) A microprocessor

*Explanation:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

**Total 6 marks**

### Question 3

A small family car is one of many examples of engineered products that use modern materials, control technology, and ICT in its manufacture. Identify another product taken from the engineering fabrication sector (**not** a car) that uses modern materials, control technology, and ICT in its manufacture.

(a) State the name of the product:

\_\_\_\_\_

**(1 mark)**

(b) Explain the purpose of the product:

\_\_\_\_\_

**(2 marks)**

(c) Name one modern material used in the manufacture of the product:

\_\_\_\_\_

**(1 mark)**

(d) Explain how the material in (c) benefits the design of the product:

\_\_\_\_\_

**(2 marks)**

(e) Identify one stage in the manufacture of the product that involves the use of control technology:

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**(1 mark)**

(f) Use notes and sketches to explain how the control technology in (e) is used. Your answer should include reference to:

- inputs
- processes
- outputs
- feedback.

**(4 marks)**

(g) Identify one stage in the manufacture of the product that involves the use of ICT:

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**(1 mark)**

(h) Describe how ICT is used in (g):

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**(2 marks)**

**Total 14 marks**

### Question 4

Computer aided design (CAD) is widely used in the manufacture of engineered products.

(a) Explain **three** advantages of using computer aided design (CAD) in the manufacture of products:

(i) \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(ii) \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(iii) \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(b) Explain **one** benefit to the consumer of using CAD in the manufacture of products.

\_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

**Total 8 marks**

### Question 5

Control technology has replaced traditional methods of manufacturing engineered products.

(a) Give **two** examples of how modern control technology has replaced traditional methods of manufacturing engineered products. For each example name the traditional method as well as the modern method that has replaced it.

#### Example 1

*Traditional method:* \_\_\_\_\_

*Modern method based on the use of control technology:*

\_\_\_\_\_

**(2 marks)**

**Example 2**

*Traditional method:* \_\_\_\_\_

*Modern method based on the use of control technology:*

\_\_\_\_\_  
**(2 marks)**

(b) Describe advantages for each modern method based on control technology identified in (a) when compared with traditional methods:

**Example 1**

*Advantage:* \_\_\_\_\_

\_\_\_\_\_  
**(2 marks)**

**Example 2**

*Advantage:* \_\_\_\_\_

\_\_\_\_\_  
**(2 marks)**

**Total 8 marks**

**Question 6**

Robotics is used in modern methods of engineering production. Explain the impact of robotics on:

(a) Safety \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**(3 marks)**

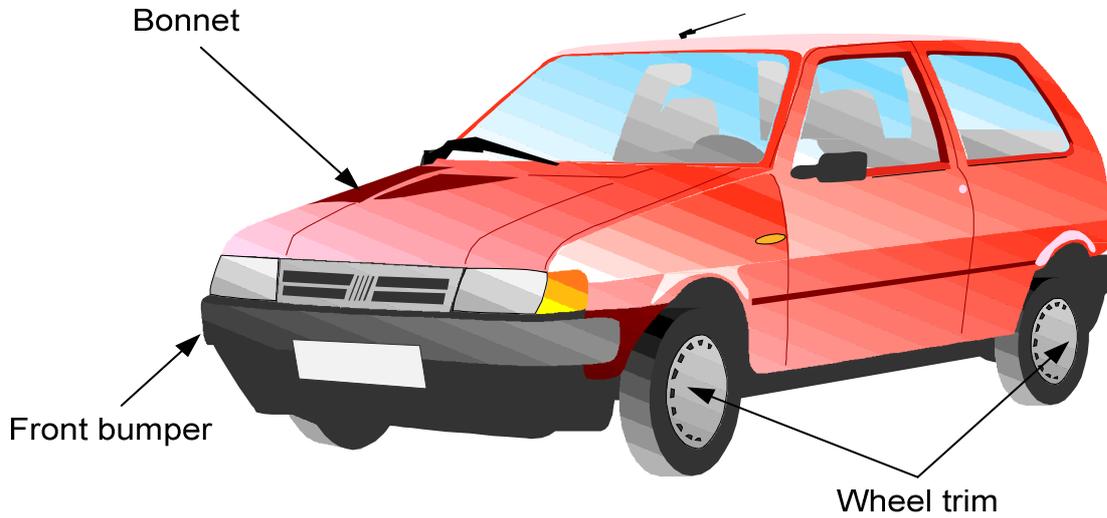
(b) Efficiency of methods of production: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**(3 marks)**  
**Total 6 marks**

**SECTION B (Answer ALL questions in this section)**

The diagram below shows a small family car:



**Question 7**

Explain with the aid of labelled diagrams:

(a) How the bonnet works:

**(3 marks)**

(b) How the wheel trim is fitted:

**(3 marks)**

**Total 6 marks**

**Question 8**

Small family cars are produced using a variety of different materials and different methods of production.

(a) Describe each of the **four** main stages in the production of a small family car.

(i) *Materials supply:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(ii) *Processing:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(iii) *Assembly:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(iv) *Despatch:* \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(b) Name the specific material most commonly used in the following parts of a car:

(i) *Front bumper:* \_\_\_\_\_

**(1 mark)**

(ii) *Bonnet:* \_\_\_\_\_

**(1 mark)**

(iii) *Trim:* \_\_\_\_\_

**(1 mark)**

(iv) *Tyres:* \_\_\_\_\_

**(1 mark)**

(c) Glass Reinforced Plastic (GRP) can be used in the manufacture of certain parts of a car.

(i) Explain what GRP is: \_\_\_\_\_

\_\_\_\_\_  
(2 marks)

(ii) Name **one** part of a car that could be manufactured using GRP and explain why GRP is used for this part.

*Part name:* \_\_\_\_\_  
(1 mark)

*Reason for using GRP for this part:* \_\_\_\_\_  
(1 mark)  
**Total 17 marks**

**Question 9**

Computer technology is widely used in the design and manufacture of cars.

(a) State and describe **two** uses of Information and Communication Technology (ICT) in the design of a car.

*Use of ICT:* \_\_\_\_\_  
(1 mark)

*Description:* \_\_\_\_\_  
\_\_\_\_\_  
(2 marks)

*Use of ICT:* \_\_\_\_\_  
(1 mark)

*Description:* \_\_\_\_\_  
\_\_\_\_\_  
(2 marks)

(b) State and describe **two** uses of computer control in the manufacturing process.

*Use of computer control:* \_\_\_\_\_

**(1 mark)**

*Description:* \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

*Use of computer control:* \_\_\_\_\_

**(1 mark)**

*Description:* \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

**Total 12 marks**

### **Question 10**

The application of modern materials, components and technology has enabled the development of cars. Explain how each of the following has helped to make small cars a more marketable product:

(a) Modern materials

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(3 marks)**

(b) Components

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(3 marks)**

(c) Technology

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**(3 marks)**  
**Total 9 marks**

**Question 11**

Control systems and control technology are both widely used in modern engineering manufacturing processes. Evaluate, giving at least **three** reasons, the effect that these technologies have had on the following:

(a) The supply and demand for small family cars

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**(5 marks)**

(b) The workforce and the working environment

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**(5 marks)**  
**Total 10 marks**

**End of examination**