

1. Meaty Chunks Pet Food is a company that has an automated system for the production and manufacture of pet food.

(a) One of the products they produce is a packet of dried rabbit food. Robot arms with suitable end-effectors are used to pick up food and place it in the bags. The filled bags are then placed on a conveyor belt.

(i) What is an end-effector?

(ii) Suggest two suitable end-effectors for this task.

(b) (i) The control software for the robot arm is held in ROM. Give **one** advantage of holding the software in ROM rather than on disc.

(ii) The control software is written in *control language*. Why is *control language* used?

(c) The same robots are used for the production of tins of dog food. The company can use the same robots because of their *adaptability*.

What is meant by *adaptability*?

(d) The company is doing well and has decided to expand. It intends to invest in two new robot arms each costing £250,000.

Explain how the company can justify this expense.

(e) The company currently uses a mixture of open and closed loop systems.

(i) Explain what is meant by a *closed loop system*.

(ii) Suggest **two** sensors that could be used in a closed loop system.

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2. Carter's Cakes has several large bakeries around the country. They are currently investigating the possibility of automating the production of the items they produce.

(a) (i) Before the bakeries can be automated a *system analysis* must be carried out. Describe what happens in this process.

(ii) Why would the systems analyst continue to be employed once the new system is set up?

(b) The ovens in the bakery have temperature sensors to ensure that the temperature is kept constant.

(i) What device is required to change the temperature to an analogue signal?

(ii) Explain why computers cannot understand the analogue signals that are produced.

(iii) What kind of interface is required between the computer and the temperature sensor?

(c) Robot arms are used in the factory to ice the cakes and place them into boxes. The same robot arm is capable of doing both jobs.

(i) Describe **two** end effectors that would be used.

(ii) The robot arms have four *degrees of freedom*. Explain the term degrees of freedom.

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3. A bicycle firm has an automated system in place to produce their bicycles. They want to upgrade their system to a new system.

(a) They decide to employ the services of a *systems analyst*. What would a systems analyst do?

(b) The installation of this new computer system is said to be *capital intensive*.

(i) What is meant by capital intensive?

(ii) Give **two** reasons why the firm would consider installing the new system if it is capital intensive.

(c) The new systems control programs are stored on *ROM* chips. This is an expensive method of storage. Give **two** reasons why the firm would choose to use this method.

(d) Robot arms are used in the new system. They have a number of different *end effectors* with various *degrees of freedom* to produce the bicycles and this increases their *adaptability*.

(i) What is an end effector?

(ii) What is meant by degrees of freedom?

(iii) What is meant by adaptability?

(e) The new system also includes mobile robots. The firm is concerned about safety as a number of people also work in the factory. Describe one precaution that the firm could take?

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4. A company produces different types of signs e.g. road signs, houses for sale signs and shop signs. The company uses an assembly line to produce the signs. A number of different types of robots are used.

(a) Robot arms, using suitable *end effectors*, are used to pick up the completed signs and to paint them.

(i) What is meant by an end effector?

(ii) Suggest **two** suitable end effectors that could be used.

(b) A computer system is used to control the temperature of the paint, which has to be kept above a certain temperature. A sensor is used to detect the temperature.

(i) Which type of converter, *analogue to digital* or *digital to analogue*, would be needed. Explain your answer.

(ii) This is an example of a *closed loop system*. Why should a closed loop system be used in this case?

(c) The control software for the automated system can be stored on *disc* or in *ROM*.

(i) Give **one** advantage of being able to load the software from disc.

(ii) Give **one** advantage of holding the software in ROM.

(d) The productivity of the company has increased since the introduction of the automated system. Give **two** explanations of how an automated system can increase productivity

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