



## **PIABC LEVEL 5 DIPLOMA IN PACKAGING TECHNOLOGY**

(Qualification No. 610/0740/7)

### **SAMPLE EXAMINATION PAPER (WITH SUGGESTED SOLUTIONS)**

**J/650/2133 UNIT 1**

### **UNDERSTAND THE ROLE AND FUNCTIONS OF PACKAGING**

#### **INSTRUCTIONS TO CANDIDATES**

Write your answers in the answer book provided.

Wherever possible, use diagrams to illustrate your answer.

This is a closed book examination.

100 marks are available in total for this examination.

The number of marks is given in brackets ( ) at the end of each question or part question.

Leave time at the end to check your answers.

Examination Time: 2 Hours

Issued under the authority of the  
PACKAGING ASSESSMENT BOARD  
14 February 2023

## SECTION 1

### TWO QUESTIONS - 20 MARKS EACH

#### Question 1

750g of cornflakes are packed in a high-density polyethylene bag inside a paperboard carton. 12 cartons are placed in a corrugated board case and palletised on a wooden pallet. The load is secured with stretch wrap.

Discuss how this packaging system performs the functions of packaging. (20 marks)

#### Question 1 – A Suggested Solution

- Contain – the primary pack (PP) must contain the product in a way which prevents leakage or ingress. Must have an integral seal. The corrugated case (SP) must hold the required number of PP. SP are collated onto pallets and stretch wrapped to prevent loss of SP through distribution system.
- Protect – from mechanical hazards – shock, vibration, compression and puncture. Paperboard carton provides some puncture protection to the HDPE bag from external sources, but the bag must be strong enough to provide puncture protection from product. Vibration must not cause scuffing of printed design on carton therefore must be in tightfitting packs to prevent rubbing. SP must be strong enough to withstand compression and puncture. Sealed HDPE bag may provide some compression protection to product – pillow pack. Carton board PP will also contribute to compression resistance. SP and PP board susceptible moisture damage. Stretch wrap will provide some protection from moisture during distribution.
- Preservation – Product requires the packaging to control moisture ingress. HDPE provides a good barrier to prevent moisture uptake. It must provide some protection from taint.
- Convenience – On the filling line in distribution, in store, in use by the consumer and in disposal. Need explanation about how it is likely to have been filled e.g. VFFS, collated into outers. Tape or hot melt glue sealed with printed SP. Outer to maximize pallet cube; Weight should not be an issue. These packs have not gone to SRP in a significant way, the packs need to be easy opened, and PP removed to place on shelf. Easy for customer to buy. Needs to be easy to open and provide some recloser method. Most material easily recycled.
- Inform – ensure all the relevant information is easily found and legible, food labeling required on pouch with batch and BBE dates clearly marked on the 3 levels of pkg.
- Sell – pack must aim to be recognized, differentiate itself and stand out from the competition. Shelf ready outer likely to be colour matched and design similar to pouch pack.
- Commercial - Pack must be commercially viable.
- Environmental - Environmental issues such as problem of recycling pouch.

## Question 2

- A) Define and briefly describe the primary, secondary and tertiary packaging for a 400g rectangular pack of hard cheese. (3 x 2 mark)
- B) For the packaging described above, discuss the ways the components work together to optimise the complete packaging solution in the supply chain. (3 x 3 marks)
- C) What are the most significant hazards faced by the packed product in the supply chain and discuss how they can be minimised or controlled? (5 marks)

## Question 2 – A Suggested Solution

- A) Primary packaging is packaging which forms a sales unit for the user or final consumer, for example, a printed, polymeric laminate filled and sealed on a HFFS machine.

Secondary packaging is that which contains a number of sales units, for example, a taped B-flute corrugate case containing a number of packs of cheese, with an identification label on the outside.

Tertiary packaging is packaging that is used to group secondary packaging together to aid handling and transportation and prevent damage to the products, for example a wooden pallet to carry a number of cases, possibly stretch wrapped, with a paper pallet ID label.

- B) Primary Packaging - A pack of hard cheese has significant stacking strength which allows corrugate case to have lower compression strength. The rectangular nature of the cheese pack provides stability through secondary and tertiary packaging.

Secondary packaging - Tight fit of packs in the case will prevent them shifting and bursting case and will aid stability. B-flute will aid cushioning preventing packs getting damaged. Optimum number of packs in the case will allow maximum number of packs to fit onto pallet thus reducing storage and transport costs.

Tertiary packaging - Heavy load of cheese packs requires a strong pallet, particularly if reused. Stretch or shrink wrap can assist stability as well as case design. Need to find optimum mix. Pallet layers can also be considered. Stretch wrap also gives dust protection.

*(Other suggestions can be accepted if they show that the total packaging system has been considered)*

- C) Key hazards could include temperature control, compression, puncture, vibration or contamination. Answers must indicate how these are controlled.

## SECTION 2

### SIX QUESTIONS - 10 MARKS EACH

#### Question 3

- A) What are the 4 Ps of marketing? (2 marks)
- B) Briefly discuss how EACH of these terms is relevant to fast moving consumer goods. (4 x 2 marks)

#### Question 3 – A Suggested Solution

- A) Product, Price, Promotion and Place.
- B) Product - First impression gained of product is its packaging (contain, protect/preserve, convenience functions). Packaging maybe an integral part of product (e.g. mascara)  
Price - Determined by the position required for the brand. Consider all costs (materials, development, tooling, artwork etc).  
Promotion - How to recognise and encouragement to buy. Promotional activity (e.g. coupons, money off, added value and packaging is often the major vehicle). Range extensions (increases shelf impact).  
Place - where sold and method of distribution.

#### **Question 4**

Recently many organisations have expressed an interest in moving away from plastic packaging.

Discuss, using examples, the possible environmental impacts of this strategy if implemented. (5 x 2 marks)

#### **Question 4 – A Suggested Solution**

Discussions could include the some of the following:

- Shelf-life reduction and possible increase in product waste with associated environmental impact.
- Reduced protection from distribution damage.
- Reduction in “ocean plastic” accumulation.
- Reduction in litter.
- Increased demand for alternative materials. More mining of metals, extraction (e.g. silica sand etc).
- Increased energy use of switching to glass from plastics & CO<sub>2</sub> production.
- Rapid increased forestry demand, FSC sources may not be available with switch to alternative sources.
- Increased transportation costs (e.g. glass bottle rather than plastic).

### **Question 5**

Discuss how legislation is being developed and used to address concerns regarding the sustainability of packaging. (10 marks)

### **Question 5 – A Suggested Solution**

Wide range of current legislation which can be included:

- Single use plastic ban. Removes some plastic packaging items e.g. straws, to reduce ocean pollution and litter.
- Producer responsibility obligations. Users of packaging must recover and recycle a proportion of the plastic that they use.
- Essential requirements legislation requires that the minimum amount of packaging should be used and limits levels of heavy metals.
- Tethered closures will be required on many common littered pack types. As pack and closure stay together, they can be collected and recycled together.
- DRS will require some packaging types to have DRS to encourage return of material to generate high quality recyclate.
- Plastic Tax will encourage the use of recycled plastic by imposing a tax on the use of virgin materials.

**Question 6**

- A) Discuss how packaging has adapted to suit the needs of modern lifestyles. (8 marks)
- B) As well as being environmentally responsible, identify the TWO other major drivers that encourage manufacturers today to reduce the amount of packaging they use. (2 x 1 mark)

**Question 6 – A Suggested Solution**

- A) Examples include:
- Change in households' occupancy (e.g. increase in single occupancy households in some countries and smaller families) e.g. smaller packs and ready meals.
  - Globalisation e.g. development of common and standardisation packaging sizes/multi ling.
  - Growth of modern retailer (e.g. shelf ready packaging).
  - "Eating on the go" convenience.
  - Increase in ready meals.
  - Internet shopping/home shopping.
  - Growth of urbanisation.
  - Ageing population require easy open packs.
  - Grazing, less formal meals, require variety of convenience snacks.
  - Working parents use convenience foods.
- B) Drivers for packaging reduction include cost and legislation. Cost makes commercial sense to use the minimum adequate amount of packaging required to fulfil its functions and consider product waste (particularly food) to ensure enough packaging is used. Legislation - now widespread legislation in the UK, EU and around the globe concerning packaging use and its disposal.

### Question 7

Define active and intelligent packaging. (2 marks)

Briefly describe FOUR examples of active and/or intelligent packaging that have been developed to improve the consumer's experience. (4 x 2 marks)

### Question 7 – A Suggested Solution

- Intelligent packaging is a type of smart packaging that uses information and communication technologies to monitor the condition of a product. This can include internet of things technologies. However, it does not actively interact with the product or environment. This data can be used for several purposes, such as to verify the authenticity of a product, to track the location of a product, to monitor the condition of a product and to provide information to consumers.
- Active packaging, alternatively, is a type of smart packaging that uses interactive technology to actively affect the product or environment. It may or may not be used for data collection purposes. This can take many forms, such as controlling moisture levels, regulating oxygen and carbon dioxide levels with oxygen absorbers, controlling the temperature, killing bacteria with antimicrobial packaging and extending a product's shelf life. Some active packaging examples include modified atmosphere packaging (MAP), controlled atmosphere packaging (CAP), active film packaging, intelligent skin packaging, time-temperature indicator labels (TTIs) and reversible indicator labels (RILs).

Common packaging applications include:

- Freshness packaging - The freshness packaging system extends the shelf life of food and beverages. It does this by using materials that absorb ethylene gas, a ripening agent. This helps to keep fruits and vegetables fresh for longer periods. *(Active)*
- Reusable packaging - This type of smart packaging is for customers who want to be more sustainable. It can be used multiple times as it's made from recycled materials. It may track the environmental impact of that packaging by monitoring where it ends up and encouraging that it goes back to be reused. *(Intelligent)*
- Connected packaging - Connected packaging uses technology to connect the product to the internet. This allows for things like NFC tags, QR codes, or barcodes to connect the product to digital content. This might include a link to a website, social media profile, review site, or augmented reality campaign. It can also be used for things like inventory tracking and product authentication. *(Intelligent)*
- Security packaging - Security packaging protects consumer goods from tampering or counterfeiting. It often includes features like tamper-evident seals or RFID tags. *(Intelligent)*
- Shelf-Life extension packaging - Shelf-life extension packaging is designed to prolong the shelf life of a product. It does this by using materials that can absorb or release moisture, oxygen, or other gases. This type of packaging can also be used in healthcare to transport products that require controlled atmospheric environments. *(Active)*
- Smart labels - A smart label is a type of label that uses technology to provide more information about the product. This can include things like QR codes or NFC tags. *(Intelligent)*



### Question 8

Describe TWO methods used to extend the shelf life of food products and discuss the implications for packaging for each. (2 x 5 marks)

### Question 8 – A Suggested Solution

- Reducing the temperature slows down chemical activity and development of micro-organisms. Reduce temperature by chilling and freezing, the packaging must be able to cope with conditions.
  - Board must be coated or laminated with a moisture barrier (e.g. PE).
  - Plastics must be able to withstand freezer temperatures (e.g. PP copolymer, PE added to reduce brittleness).
- Increasing the temperature of the product will destroy micro-organisms. Methods include pasteurisation, retorting, sterilisation. Packaging will then need to appropriate barrier to prevent bacterial growth as well as gas and moisture barriers.
  - Glass jars are hot filled and use a lug closure to provide a hermetic seal.
  - Metal cans are retorted at c. 135°C, can incorporates expansion rings, internal lacquer will flex during expansion and contraction.
  - Tetra style packs containing UHT milk have a multi-layer structure includes aluminium to provide an O<sub>2</sub>, CO<sub>2</sub>, UV light and moisture barrier.
- Reduce moisture – remove moisture from the product stops biotic growth. Products can be freeze or air dried.
  - Packaging needs to have an appropriate moisture barrier. Absolute moisture barriers are glass and metal + Al foil > 20 microns.
  - Silica gel crystals can be incorporated into the polymer or in sachets to keep product dry (e.g. tablets).
  - Salting of meats and fish, packaging must have a suitable moisture barrier.
- Change the pH or use chemical preservatives (change environment to reduce growth of micro-organisms). Bacteria are inhibited in acidic conditions (e.g. pickling onions, eggs, fish etc in vinegar). Also use oxygen scavengers (ferric/ferrous oxides).
  - Packaging must withstand the chemical attack of the acid, glass with metal closure which has suitable lacquer to prevent corrosion.
- Modify the atmosphere within the pack either by vacuum packing or changing the gas mixture. This reduces the growth of micro-organisms.
  - Packaging must have appropriate gas and moisture barrier.
  - Vacuum packed cheese and meat removes O<sub>2</sub> to reduce microbial growth and reduce oxidation of fats.
  - Modified atmosphere packaging (MAP), generally substitutes oxygen with another gas such as N<sub>2</sub>, CO<sub>2</sub> and Argon. Red meat is the exception – high level of O<sub>2</sub> to keep oxymyoglobin molecule in the blood look bright red. Packaging needs very good seals, have puncture resistance and appropriate gas and moisture barriers.
- Irradiation destroys micro-organisms using short wavelength radiation. Radiation sources - Cobalt 60, Caesium 137.
  - Packaging must be resistant to radiation, especially polymers as they can go brittle. Some medical packs are sterilised this way.
  - Health and safety aspect.

**END OF EXAMINATION PAPER**