



## **REPORT ON THE JUNE 2021 EXAMINATIONS**

### **PIABC LEVEL 3 CERTIFICATE IN PACKAGING**

(QN: 600/0455/1)

**AND**

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

(QN: 600/0017/X)

This report is concerned with the June 2021 examinations of both the PIABC Level 3 Certificate in Packaging (QN: 600/0455/1) and the PIABC Level 5 Diploma in Packaging Technology (QN: 600/0017/X).

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# PIABC LEVEL 3 CERTIFICATE IN PACKAGING

## Unit A: The Fundamental Principles of Packaging

This Unit is assessed by a 2-hour examination in which students must answer five questions.

### LEARNING OUTCOME 1: UNDERSTAND THE ROLE AND FUNCTIONS OF PACKAGING

#### QUESTION 1

(This question is worth 25% of the marks for this unit)

A pack of cream consists of a printed plastic pot, a heat-sealed printed plastic lidding film and a clear lid. Six packed pots are then placed into a plastic tray, with a labelled shrink-wrapped cover. They are then palletised with the use of layer pads, wooden pallet, and stretch-wrap film. For this packed product:

- A) List the main functions of packaging and explain how these are each performed by the primary and secondary packaging elements in the above example. (13 marks)
- B) List SIX potential hazards in the transit of goods from the point of production to the placement of the packs on retailer's shelves. For EACH hazard listed, describe the possible problems and suggest what actions might take to reduce the probability of occurrence. (6 x 2 marks)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Understanding the role and functions of packaging. Be aware of hazards that need controlling.
2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*  
Cannot draw conclusions on papers marked.

### LEARNING OUTCOME 2: UNDERSTAND THE MAJOR PACKAGING MATERIALS AND HOW THEY ARE COMBINED TO FORM PACKAGING COMPONENTS

#### QUESTION 2

(This question is worth 25% of the marks for this unit)

Baby food with a long shelf life can be packed in glass and metal containers.

- A) Describe the TWO types of containers, closure mechanisms and how they are decorated. (2 x 3 marks)
- B) Identify the production processes involved to manufacture all the primary packaging components (2 x 3 marks) and explain the functional characteristics of the materials used which make them suitable to pack the product (2 x 3 marks).
- C) For ONE of the pack types; describe a typical secondary and tertiary packaging solution for this product. (7 marks)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Describe performance characteristics of the major materials; understand how materials are combined in packages.
2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*  
Marks were lost on not being able to describe the possible decoration methods, the potential production methods, and the functional characteristics.

## LEARNING OUTCOME 3: UNDERSTAND THE PACKAGING DEVELOPMENT PROCESSES

### QUESTION 3

(This question is worth 20% of the marks for this unit)

- A) Using examples, identify SIX different reasons why a company might wish to change the physical packaging (as opposed to just artwork changes) of an existing product? (6 x 1 mark)
- B) Identify and discuss the SIX key steps in the process of packaging development, from concept to launch. (6 x 1½ marks)
- C) Identify FIVE departments/functions that are likely to participate in the process above and discuss their responsibilities in the development programme. (5 x 1 mark)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Packaging development process – the stages, the stakeholders, the keystones.
2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*  
Students answered well and in detail. Clearly a well taught/learned objective.

## LEARNING OUTCOME 4: UNDERSTAND PACKAGING COSTS AND QUALITY SYSTEMS

### QUESTION 4

(This question is worth 15% of the marks for this unit)

- A) Identify TEN costs associated with the production of a pack of chocolate bars wrapped in a plastic flow wrap and collated in a case on a pallet and state which are fixed and variable. (10 x 1 mark)
- B) Define profit. (2 marks)
- C) How does unacceptable quality affect profit? (3 x 1 mark)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Packaging costs and quality systems throughout supply chain – and understand the connection between cost and quality.
2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*  
Students failed to define profit yet were able to answer the rest of the question without difficulty.

## LEARNING OUTCOME 5: UNDERSTAND THE RELATIONSHIP BETWEEN PACKAGING AND THE ENVIRONMENT

### QUESTION 5

(This question is worth 15% of the marks for this unit)

- A) Discuss what is meant by an 'environmentally responsible' pack. (2 marks)
- B) From an environment perspective, discuss FIVE advantages (5 x 1 mark) and FIVE disadvantages (5 x 1 mark) of using glass as a packaging material for carbonated beverages.
- C) Identify THREE tools/techniques commonly used for assessing the impact of packaging on the environment. (3 x 1 mark)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Discussion what is an 'environmentally responsible' pack. From an environment perspective, discussion on advantages/disadvantages of using glass as a packaging material for carbonated beverages. Finally, identification of tools/techniques commonly used for assessing the impact of packaging on the environment.

# PIABC LEVEL 5 DIPLOMA IN PACKAGING TECHNOLOGY

## Unit 1: Packaging in Today's World

This unit is assessed by a 3-hour examination and students must answer six questions.

### LEARNING OUTCOME 1: UNDERSTAND THE ROLE OF PACKAGING IN THE MODERN SOCIETY

#### QUESTION 1

(This question is worth 10% of the marks for this unit)

- A) Packaging has had to respond to significant consumer lifestyle changes. Identify FIVE of those changes and, for each, give an example of how packaging was developed to meet that change. (5 marks)
- B) Using FIVE examples, how can packaging activities be reflected in a company's corporate social responsibility (CSR) programme. (5 marks)

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Marker 1: Understand the connection (and role) of packaging in society. Be aware of globalization and its impacts on packaging. Evaluate impact of CSR on packaging.  
Marker 2: Odour protection is a key hazard for chocolate.  
Marker 3: A) Students should identify 5 significant lifestyle changes. For each change they should discuss how packaging has changed to support or respond to these changes. B) Students should identify 5 packaging activities which can support their CSR program.
2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*  
Marker 1: Most students seem well prepared – and gave a variety of mostly correct answers. The poorly prepared students were tested by the question – demonstrating the limits of their knowledge.  
Marker 2: Q1. B. – Answers were examples of CSR rather than packaging activities. Non-one mentioned odour as a hazard. Overall, a majority answered well.  
Marker 3: Most students provided reasonable answers. Some marks were lost for providing issues which were closely related (e.g. minimising packaging and light weighting).

### LEARNING OUTCOME 2: UNDERSTAND THE STRUCTURE AND INTERACTIONS OF ELEMENTS IN THE PACKAGING SUPPLY CHAIN

#### QUESTION 2

(This question is worth 20% of the marks for this unit)

- A luxury box of chocolates is supplied through a major supermarket chain. For this product:
- A)
    - a) Define the terms primary, secondary and tertiary packaging. (3 x ½ mark)
    - b) Describe suitable primary, secondary, and tertiary packaging for the chocolates. (3 x 1½ marks)
  - B)
    - a) Describe a typical distribution chain from the packer/filler to the supermarket. (2 marks)
    - b) Discuss the causes and effects of the principal hazards that this packed product may be exposed to during this distribution cycle. (6 x 1 mark)
  - C) The manufacturer is evaluating the potential for direct postal/courier delivery of the chocolates. Discuss which hazards in this distribution could be different (3 marks) and how the packaging may be changed to ensure it is delivered in good condition (3 marks).

#### Marker Comments:

1. *Summary of what was expected in the answer*  
Marker 1: Be able to describe the packaging supply chain- and how it interacts with other parts – evaluate the role/importance of packaging in mitigating hazards in supply chain.  
Marker 3: A) A def. of pack levels and description of the levels appropriate for the given product.  
B) A brief description of the distribution systems. A discussion of the hazards (6) which may be

encountered. C) A discussion of how going from retailer distribution to postal delivery will change the hazards and how the pack should be adapted to cope with this.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: Sound scoring –very rare to see maximum scores – but in general the students did well (and were well prepared in this area).

Marker 2: Q2. B. – No one mentioned odour – therefore unable to award full marks. Think about product. Overall, a majority answered well.

Marker 3: Most students provided conventional pack designs and common distribution channels. Some answers lacked detail on the distribution channel. Most discussions of the hazards were good. Some did not provide a discussion on enough hazards. The impact on moving to a postal delivery had a variety of answers. Poorer answers failed to address the specific changes that a postal delivery will have.

### **LEARNING OUTCOME 3: UNDERSTAND THE FUNCTIONS OF PACKAGING**

#### **QUESTION 3**

(This question is worth 30% of the marks for this unit)

For EACH of the following products:

1. 50ml hand sanitiser gel
2. 500g fresh chicken
3. 1kg sugar
4. A computer monitor

- A) Identify THREE key functions which the primary packaging is required to meet and explain why these functions are important. (4 x 3 marks)
- B) Propose suitable PRIMARY and SECONDARY packaging for each product and explain how your proposals meet the functions you have identified. (4 x 2½ marks)
- C) For the proposed pack formats, discuss the most probable causes and effects of packaging deterioration in the journey from the end of the packaging line to the point of disposal. (4 x 2 marks)

#### **Marker Comments:**

1. *Summary of what was expected in the answer*

Marker 1: Explain functions of packaging and the resultant roles that packaging plays.

Understand, identify, and describe the potential hazards that cause deterioration.

Marker 2: Factors concerning environment other than carbon footprints.

Marker 3: For each identified product the candidate was expected to: A) Identify 3 key functions that the packaging needs to supply for this product. The reason why the functions are important for the products need to be explained. B) Propose primary and secondary packs and explain how they meet the function identified. Novel packs are not required. C) Discuss how the distribution journey could cause the pack to deteriorate. The cause and effect of the deterioration of the packs.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: The question seeks detail and thought – well prepared students tend to score well, whilst the question seems to separate the not so well prepared.

Marker 2: Q3. B. – Many students believed that secondary packaging for sugar should be corrugated boxes. Low range of suitable examples. Students repeated the same point several time in answers and as such lost points. For example, they had to list 7 functions – they would bullet point them, but several bullet points were the same topic just described differently. Overall, a majority answered well.

Marker 3: Most students scored highly. Marks were lost for discussing deterioration of the product rather than the pack or discussing minor issues while ignoring key considerations.

## LEARNING OUTCOME 4: KNOW THE PRINCIPLES OF THE KEY LEGISLATION, REGULATIONS AND STANDARDS RELATING TO THE PACKAGING SUPPLY CHAIN

### QUESTION 4

(This question is worth 15% of the marks for this unit)

- A) Identify a piece of legislation which applies to packaging that aims to protect the consumer or end user from harm (1 mark). Describe ONE specific requirement of this legislation and discuss how it fulfils this aim (2 marks). **Note: Please state which country's legislation is being cited.**
- B) Legislation has an important role in ensuring honesty in trade. Discuss THREE ways that packaging could potentially contribute towards dishonesty in trade. (3 x 1 mark)
- C) Discuss the difference between using legislation or standards in achieving good practice. (5 x 1 mark)
- D) For a globally supplied product, discuss the possible consequences of failing to comply with legislation. (4 marks)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

Marker 1: Know the principles of the key legislation – and be aware of the requirements to obey and the punishments if not obeyed.

Marker 3: A) Students should identify one piece of legislation, which applies to packaging, that protects consumers from harm. Details of 1 specific clause must be detailed. B) Students should discuss 3 ways that packs could contribute to dishonesty (e.g. wrong weights stated, misleading ingredients (picture or text), false health claims). C) A wide range of differences could be included (e.g. legislation minimum standards, legislation has weight of law for enforcement, slow to change, standards can be aspirational, international, etc.). D) Legal and commercial consequences should be considered (e.g. fines and imprisonment as well as loss of business and increased costs (e.g. insurance)).

##### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Marker 1: Again, the well-prepared students did quite well and scored the first 50% of points easily. The unprepared students tended to waffle and waste exam time as well as score poorly.

Marker 2: Q4. D. – No one mentioned legislation being national and different across the world.

Marker 3: Students repeated the same point several time in answers and as such lost points. For example, they had to list 7 functions – they would bullet point them, but several bullet points were the same topic just described differently. Overall, a majority answered well.

Most students provided good answers. Some marks were lost for a lack of relevance to packaging.

## LEARNING OUTCOME 5: UNDERSTAND THE FACTORS THAT AFFECT THE IMPACT OF PACKAGING ON THE ENVIRONMENT

### QUESTION 5

(This question is worth 15% of the marks for this unit)

- A) Using examples; discuss SEVEN environmental factors that need to be considered when making packaging choices. (7 x 1 mark)
- B) Identify FOUR methods of managing consumer packaging after its first use (4 x ½ mark) and describe the relevant considerations for each method (4 x 1½ marks).

#### Marker Comments:

##### 1. Summary of what was expected in the answer

Marker 1: Evaluate environmental impact for a given product – know the different ways to measure impacts – be able to describe the 'end of life' options for packaging.

A) Students should discuss SEVEN environmental packaging considerations which need made when developing a new pack (e.g. disposal options use of resources and energy, pollution of air,

water and soil). Examples should be provided for each. B) Required discussion of the end-of-life options: reduce, reuse, recycle, recovery, composting and landfill. The issues associated with each option should be discussed.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: A real spread of scores – a few scored heavily- most scored quite well – a few did poorly. From the responses I saw, I would say that this question was possibly the least well prepared for.

Marker 2: Q5. A. – Answers were mainly about sustainability rather than environmental factors. Students repeated the same point several time in answers and as such lost points. For example, they had to list 7 functions – they would bullet point them, but several bullet points were the same topic just described differently. Overall, a majority answered well.

Marker 3: Most students provided reasonable answers. More care was required providing examples. More discussion of disposal options was required from several students to achieve full marks.

## **LEARNING OUTCOME 6: UNDERSTAND THE RELATIONSHIP BETWEEN PACKAGING AND MARKETING**

### **QUESTION 6**

(This question is worth 10% of the marks for this unit)

- A) a) Identify the 4P's of marketing. (4 x ½ mark)  
b) Explain the relationship between packaging design and each of the 4P's. (4 x 1 mark)
- B) Using examples; identify the characteristics of a strong brand and discuss how this is supported by the packaging used. (4 x 1 mark)

#### **Marker Comments:**

1. *Summary of what was expected in the answer*

Marker 1: Functions of marketing – relationship to packaging – impact of packaging on promotion.

A) Identification of 4 Ps and then a description on how each is influenced by packaging or influences packaging. B) A discussion of the characteristics of a strong brand and how packaging supports these characteristics.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: Only 10 points in total – but nearly all students scored strongly.

Marker 2: Q6. A. – Explanations of the “P’s” were not good. Product – students answered about the selling of the pack contents rather than if the packaging was compatible with the product or if the packaging needed a certain feature. Place – students talked about if on shelf at eye level rather than retail shelf or vending machine or e-com etc. Relevance – all students talked about relevance to marketplace – whereas marketing brief talked about brand values. Students repeated the same point several time in answers and as such lost points. For example, they had to list 7 functions – they would bullet point them, but several bullet points were the same topic just described differently. Overall, a majority answered well.

Marker 3: Most students provided acceptable answers. Part A was generally answered well. To improve marks students must ensure that they return to the packaging focus of the question.

## Unit 2: Packaging Materials and Components (Paper A)

Paper A is worth 70% of Unit 2 and is assessed by a 3-hour examination. Students must answer five questions. The paper has seven questions, and the students have the option to answer two out of three questions for both Learning Outcomes 1 and 3.

### LEARNING OUTCOME 1: UNDERSTAND THE PROPERTIES OF MATERIALS WHICH MAKE THEM SUITABLE FOR PACKAGING

*This Learning Outcome is worth 40% of the marks for this paper and students were required to answer two of the following three questions: 1, 2 & 3*

#### QUESTION 1

- A) Discuss how the selection of raw materials, additives and pulp processing can influence the characteristics of paper. (14 marks)
- B) Identify and describe how SIX paper properties can be measured. (6 x 1 mark)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

A) Discussion on how the selection of raw materials, additives and pulp processing can influence the characteristics of paper: Material selection includes hardwood which have shorter fibres (1 – 1.5 mm) which will produce weaker papers. Additives include fillers e.g. chalk which improve the print surface and reduce cost. In pulping chemical separation produces little damage to fibres increasing strength. Removal of lignin and other materials reduced yield. Can provide strong and bright white papers. With beating and refining increased beating will increase tensile strength, burst strength and uniformity. B) Identification and description how SIX paper properties can be measured: Measuring paper properties include the Cobb test method for water absorbency and ply bond strength using the Scottbond Method.

##### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Some good answers important to link selections to characteristics.

#### QUESTION 2

- A) Identify and describe the function of the raw materials commonly used in container glass manufacture. (5 marks)
- B) The following products are usually packed in glass packaging:
  - a) Refillable carbonated soft drink bottle
  - b) Perfume
  - c) Jam
  - d) Ampoules for injectable drugs
  - e) Sparkling wineFor each of the above products, discuss why glass is the preferred material and what other materials could be used. (5 x 3 marks)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

For each of product, a discussion why glass is the preferred material and what other materials could be used. For a refillable carbonated soft drink bottle, the properties of the pack must be able to have good gas barriers to CO<sub>2</sub> and O<sub>2</sub> and can have UV barrier depending on the product. It needs to be strong for internal pressure, durable and easily cleaned with strong chemical & high temperatures. Also has a quality image. Better chemical resistance than any alternative, easily reclosed / no damage caused by opening. Not degraded by environment therefore high return / reuse rate possible. Other materials – PET.



2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Generally good marks but important to include detail.

### QUESTION 3

Discuss the properties of the following polymeric materials and explain why they are suitable for the given application, including any limitations:

- High density polyethylene (HDPE) as used for extrusion blow moulded bottle to contain bleach. (4 x 1 mark)
- Metallised biaxially oriented polypropylene (BOPP) film as used for the packaging of potato-based snack food. (4 x 1 mark)
- Polyethylene terephthalate (PET) as used for an injection stretch blow moulded bottle to contain carbonated water. (4 x 1 mark)
- An ionomer (e.g. Surlyn) as coextruded onto high density polyethylene (HDPE) for the manufacture of a vertical form fill seal bag for a dusty dry cereal product. (4 x 1 mark)
- A thermoformed sheet of polyvinyl chloride (PVC) coated with polyvinylidene chloride (PVDC) as used for moisture sensitive tablets packed on a high-speed blister line. (4 x 1 mark)

#### Marker Comments:

1. *Summary of what was expected in the answer*

Discussion on the properties of a selection of polymeric materials and explanation on why they are suitable for the given application, including any limitations. For example: An ionomer (e.g. Surlyn) as coextruded onto high density polyethylene (HDPE) for the manufacture of a vertical form fill seal bag for a dusty dry cereal product. Ionomer is a copolymer of a polyolefin with a polar molecule such as methacrylic acid and has a metal ion added. It has a very wide sealing range due to its chemical structure. Will seal through dust and particulates due to its chemical structure and excellent melt flow. Has a much better seal strength to itself than to HDPE and can therefore provide a peel seal, peeling away from the HDPE when sheared. Has very good extensibility and puncture resistance at very thin layers. Is resistant to sharp products piercing it. Gives very good performance at a very low coat weight (4gsm) rendering it cost effective even though the polymer is expensive. Has good moisture barrier, especially in combination with HDPE which is important for many dried food products. Acceptable for direct food contact. Has a much lower melt temperature than HDPE, ensuring the HDPE does not stick to the sealing bars.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Some good answers but marks lost because not enough detail was included.

## LEARNING OUTCOME 2: UNDERSTAND THE SYNTHESIS AND PROPERTIES OF POLYMERS

### QUESTION 4

(This question is worth 20% of the marks for this paper)

- A) Explain the difference between thermoset and thermoplastic polymers in terms of structure (2 x 1 mark) and properties (2 x 4 marks).
- B) Additives are added to base resins to change their properties. Identify FIVE types of additives (5 x ½ mark) and for each discuss their use (5 x 1½ mark).

#### Marker Comments:

1. *Summary of what was expected in the answer*

A) Explanation on the difference between thermoset and thermoplastic polymers in terms of structure and properties. The primary physical difference is that thermoset plastics always remain in a permanent solid state, whereas thermoplastics can be remelted back into a liquid. Thermoset plastics contain polymers that cross-link together during the curing/moulding process to form an irreversible chemical bond. The cross-linking process eliminates the risk of the product

remelting when heat is applied, making thermosets ideal for high-heat and chemically resistant applications. Thermoset plastics are often used for sealed products due to their resistance to deformation. More resistant to high temperatures than thermoplastics. Highly flexible design. Thick to thin wall capabilities. B) Additives include slip agents. Freshly extruded film has a high drag - it will not slide easily. Slip agents are small molecules which work their way through the film and sit on the surface. They lower the drag, but they take about 72 hours to work. Anti-fogging agents stop bags from misting up in the fridge. Very useful for film for chilled foods.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Some reasonable answers but part B was not well answered.

**LEARNING OUTCOME 3: UNDERSTAND THE CONVERSION OF RAW MATERIALS INTO PACKAGING MATERIALS AND PACKAGING COMPONENTS**

*This Learning Outcome is worth 40% of the marks for this paper and students were required to answer two of the following three questions: 5, 6 & 7*

**QUESTION 5**

- A) Identify the FIVE main processes for forming rigid metal packaging. (2 marks)
- B) Describe with the aid of a diagram the manufacture of an unprinted drawn and redrawn metal can body from reel stock to despatch for a retorted food product. (12 marks)
- C) What quality checks and tests you would carry out in the manufacture of the can body? (6 marks)

**Marker Comments:**

1. *Summary of what was expected in the answer*

A) Identification of the FIVE main processes for forming rigid metal packaging: Processes include a three-piece can, draw, draw wall iron, impact extruded and draw and redraw. B) Description of an unprinted drawn and redrawn metal can body from reel stock to dispatch for a retorted food product.

Marker 3: The answer requires an annotated diagram with each stage fully described. C) The quality checks and tests you would carry out in the manufacture of the can body include dimensional accuracy including capacity, fit to closure/container and seal integrity, product resistance and integrity of coatings.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Some good answers but marks lost because the detail was not included at the different stages.

**QUESTION 6**

Dried fruits are stored in a gusseted base resealable closure pouch. The pouch is constructed from a polyethene (PE) and metallised polyethylene terephthalate (PET) laminate.

- A) Describe the production of blown polyethene (PE) film from polymer granules to reels of film ready for lamination. (12 marks)
- B)
  - a) Describe how polyethylene terephthalate (PET) film is metalized. (2 marks)
  - b) How is the thickness of the metallised layer controlled? (1 mark)
- C) Describe and explain the important requirements of the lamination process for combining the metallised polyethylene terephthalate (PET) and Polyethylene (PE). (2 marks)
- D) Describe how the closure is added and gusseted pouch is formed. (3 marks)

**Marker Comments:****1. Summary of what was expected in the answer**

A) Description of the production of blown polyethylene (PE) film from polymer granules to reels of film ready for lamination. The description should include how the polymer and additives are metered into a hopper and mixed, followed by a full description of the plasticating extruder, blowing and reeling with an explanation what is happening at each stage. B) Description how polyethylene terephthalate (PET) film is metalized. Film is placed in vacuum chamber. The aluminium is heated, evaporates and passes through a shutter. Film is unwound and passes over chilled roller and the aluminium vapour condenses on the film surface. Film is rewound. The thickness of the metallised layer controlled controlled by opening in the shutter and speed of the film being drawn across the shutter. C) Description and explanation of the important requirements of the lamination process for combining the metalised polyethylene terephthalate (PET) and Polyethylene (PE) requires the solvent to be removed before materials brought together or solvent less adhesives used. D) Description on how the closure is added and gusseted pouch is formed. Material is unwound. Zip is applied to material with adhesive. Film folded and gusseted base fold included. Pouch sides are heat-sealed and individual pouched cut from reel material.

**2. Overall comment on students' performance, quality of answers and how students could answer better in the future**

A mix of good and poor answers but marks lost because a full description was not given.

**QUESTION 7**

- A) Describe the manufacturing process of a double walled die cut 4-colour printed corrugated case from reels of paper to finished packs ready for despatch. Printing process does not need to be described in detail. (14 marks)
- B) Identify and briefly explain how this manufacturing process can introduce quality issues for this case. (6 marks)

**Marker Comments:****1. Summary of what was expected in the answer**

A) Description of the manufacturing process of a double walled die cut 4-colour printed corrugated case from reels of paper to finished packs ready for dispatch. Printing process did not need to be described in detail. The process needs to cover the process in the correct sequence. The use of an annotated diagram can help. For example, the first stage includes the description of the first single facer including conditioning of paper of suitable grade. Corrugation of fluting, application of starch adhesive, pressure application to form bond. Carried over bridge. B) Identification with a briefly explanation on how this manufacturing process can introduce quality issues for this case. Issues include too much adhesive causing surface roughness "washboard" effect. Differences in conditioning can cause warping and excessive pressure can crush flutes causing damage and strength reduction.

**2. Overall comment on students' performance, quality of answers and how students could answer better in the future**

Students lost marks because they did not describe the process of manufacturing double wall corrugated sheet board in the correct sequence. Also, students described the printing, die cutting and gluing in the wrong sequence.

## Unit 2: Packaging Materials and Components (Paper B)

Paper B is worth 30% of Unit 2 and is assessed by a 2-hour examination. Students must answer three questions.

### LEARNING OUTCOME 4: UNDERSTAND THE RAW MATERIALS, PROPERTIES AND APPLICATIONS OF PACKAGING ADHESIVES

#### QUESTION 1

(This question is worth 30 marks for this paper)

- A) Describe the mechanical and diffusion theories of adhesion. (2 x 3 marks)
- B) Identify FOUR types of adhesive. For EACH material describe its characteristics, suggest typical applications, and discuss how the adhesive bond is achieved. (4 x 4 marks)
- C) The flaps of a paperboard carton are sealed with an adhesive. The flaps have been found to have opened. Discuss the possible reasons for this failure. (8 x 1 mark)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

A) Description of mechanical and diffusion theories of adhesion - Diffusion - Molecular diffusion between two surfaces. Surfaces can merge and produce a bond e.g. Two polymers above  $T_g$  polymer molecules can migrate between surfaces or solvent welding uses solvent to loosen polymer chains and encourage diffusion. Polymer hardens as solvent evaporates. B) Identification of four types of adhesive and for each material describe its characteristics, suggest typical applications, and discuss how the adhesive bond is achieved. Starch: Starch from range of sources, starch granules in water must be heated to gelatinise material. Typical application in construction of corrugated board. Bond is achieved by loss of moisture into the environment of substrate. C) Reasons for failure could be that flaps not held closed to enable adhesive to set, too much adhesive impacting on set time and contamination of the sealing area.

##### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Generally, well answered. Important to fully discuss the reasons for failure.

### LEARNING OUTCOME 5: UNDERSTAND THE DIFFERENT TYPES OF LABELS AND THE MATERIALS USED

#### QUESTION 2

(This question is worth 30 marks for this paper)

- A) For the following containers, identify and describe an appropriate decorated label type, including the material(s) and adhesives used, with the factors to consider in its manufacture, component application and use. **You can only use one label type once.** (3 x 9 marks)
  - A 500ml returnable glass bottle for a high-volume beverage
  - A 1-litre non-symmetrical plastic bottle for bubble bath
  - A 3ml glass vial for an injectable medicine
- B) Describe THREE tests that can be used to evaluate the performance of printed labels as part of the development process. (3 marks)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

A) Identification and description an appropriate decorated label type, including the material(s) and adhesives used, with the factors to consider in its manufacture, component application and use for a number of containers using a different label type for each. For example: a 3ml glass vial for an injectable medicine - Identify – A polymeric self-adhesive label (a lightweight paper self-adhesive label could also be used). Polymeric face material (e.g. PET or PP which is likely to be printed with details of the medicine) with an acrylic or rubber adhesive. May have a glassine or PET carrier web, coated with a silicone or fluoropolymer release coating. Some of the factors to

consider include an adhesive which needs to be permanent. Requires a high tack due to small diameter of vial, as important to stop label butterflying when label is applied. Ensure the adhesive can withstand the storage conditions expected (e.g. for storage in deep freeze temperatures). Label likely to be batch coded so varnish free area required for ink jet or foil coding. B) Briefly description of three tests that can be used to evaluate the performance of printed labels as part of the development process. Test methods include product resistance of label material and print, adhesion of label to required substrate and colour fastness – fading.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Part B was answered poorly with some students misunderstanding what a glue applied label is.

## **LEARNING OUTCOME 6: UNDERSTAND CLOSURE SYSTEMS AND THE FACTORS THAT AFFECT SEALS**

### **QUESTION 3**

(This question is worth 30 marks for this paper)

- A) Describe, with the use of appropriate diagrams, the closure system, including materials, design, and application method, for the following closure mechanisms and give an example where each closure type is used:
- Roll on pilfer proof closure (7 marks)
  - Induction heat seal with wad closure (7 marks)
  - Crown closure (7 marks)
- B) Identify THREE types of child resistance packaging and explain how child resistance is achieved. (3 x 2 marks)
- C) Briefly describe how child resistant packaging is assessed. (3 marks)

#### **Marker Comments:**

1. *Summary of what was expected in the answer*

A) Crown cork closures are typically made from metal, such as tin-free steel, with suitable coatings on both the inside and outside. They have a sealing wad inside the closure which may be cork, a compressible plastic, or a flowed-in liner of soft plastic material (plastisol) around the inner circumference of the cap. The closure is preformed and then placed over the neck of the container, often using magnets, and the outer circumference is compressed around the lip of the bottle and the edges tucked under a retaining ring on the lip to secure the closure in place, leaving a characteristically ribbed effect. Crown corks are typically used for sealing glass bottles containing carbonated beverages and are ideally suited to withstand the internal pressure of such products. B) One example is a child resistant flip top closures – Usually has a tamper evident mechanism which needs to be removed, often with a band which is attached to both the container and the bottle. Closure needs to be rotated until indicator arrows align to permit opening of the container. Requires hand/eye co-ordination to open container. C) Description of how child resistant packaging is assessed - Children of specified ages 42-51 months given time to try to open containers. Each child is given a pack and asked to open it, after five minutes they watch a silent demonstration and then they try to open the pack for a further five minutes. For the pack to pass the test, 85% of the panel must fail to open it before the demonstration and 80% must fail to do so after it. Children are then given demonstration on how to open container and then provided more time to gain access. Adults, 50-70 years old, are provided with complete packs including opening instructions. After a period of familiarization 90% of the panel must open and properly reclose the pack in one minute or extract one unit in one minute depending on the type of pack and the standard.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Generally, very well answered.

## Unit 3: Packaging Processes

This unit is assessed by a 2-hour examination and students must answer five questions.

### LEARNING OUTCOME 1: UNDERSTAND THE PACKAGING DESIGN AND DEVELOPMENT PROCESS

#### QUESTION 1

(This question is worth 20% of the marks for this unit)

A brand is approaching its 50<sup>th</sup> anniversary (in 18 months' time) and wishes to mark the occasion by developing and launching an innovative celebratory pack.

With reference to this project, discuss the packaging development process from initiation through to launch. In your answer you must clearly identify and describe the different phases; the main participants and their responsibilities; the decisions that may be taken; and the key project milestones. (20 marks)

#### Marker Comments:

##### 1. Summary of what was expected in the answer

Marker 1: The following processes should be identified (brief, research, design concepts, design development, testing and refinement, specifications, final concept, launch). Milestones include concepts selected for evaluation, one selected to take forward and final solution approved, specifications agreed, contracts established and product ready for commercial production. Main participants include marketing, R&D, packaging technologist, engineering, purchasing, production, planning, quality assurance, finance etc.

Marker 2: The answer could be formulated in many ways. All good answers would require:

- A discussion of the roles of the various parts of an organisation contribution to the development of a pack.
- A description of the design/development process starting with the product need and finishing with successful product launch.
- Key milestones in the product timeline should be determined. The decision required to move the project forward should be described.

##### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Marker 1: Generally, well answered but marks lost because the different stages were not fully discussed.

Marker 2: Most students provided good answers for the people included and the process involved. The milestones were in general poorly answered.

### LEARNING OUTCOME 2: UNDERSTAND THE MAIN PRINTING AND DECORATION PROCESSES USED IN PACKAGING

#### QUESTION 2

(This question is worth 20% of the marks for this unit)

A) Identify and justify printing processes for the following applications:

- Corrugated case (2 marks)
- Aluminium soft drinks can (2 marks)
- Hemispherical screw on cap for personal care (2 marks)
- A wrapper for a leading brand of chocolate-based snacks (2 marks)
- Paperboard tray for a small bakery to brand their packs (2 marks)

**Note to students: You are expected to use a different printing process for each of the above.**

B) Describe SIX common printing defects. (6 x 1 mark)

C) Briefly describe TWO methods of transferring ink to a substrate using digital printing techniques. (2 x 2 marks)

### Marker Comments:

#### 1. Summary of what was expected in the answer

Marker 1: A) Identification and justification of a printing: An aluminium soft drink can would be printed using off set letterpress. No registration marks therefore all colours must be collected on blanket roller and transferred together onto can. High line speeds are possible. B) Description of SIX common printing defects - colour variation, ghosting and poor print adhesion (rub resistance). C) A method of transferring ink to a substrate using digital printing techniques includes continuous inkjet where a piezo electric crystal pulses drops of ink out. Ink directed by voltage to gutter and recycling or to form image.

Marker 2: A) Students were expected to identify and justify a suitable printing process for each pack type. B) Students were expected to describe SIX different print defects. C) Students were expected to describe TWO alternative methods of transferring ink onto a substrate with digital printing technologies.

#### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Marker 1: Reasonably well answered but it is important to fully describe what is being asked in the questions.

Marker 2: Most students answered Part B well. Part A some answers lacked the justification element of the question. Part C was generally answered poorly when answered. Students need to ensure that they complete the justification in questions when asked.

## LEARNING OUTCOME 3: UNDERSTAND PACKAGING MACHINERY AND PACKAGING LINE OPERATIONS

### QUESTION 3

(This question is worth 20% of the marks for this unit)

- A) Describe the packing line for packaging individually wrapped chocolate ice cream bars, which are sold in a multipack carton of six bars, from receipt of packaging materials to finished packed products ready for despatch. (14 marks)
- B) Discuss the factors which contribute to this line's overall equipment effectiveness (OEE) and for each factor provide an example how the OEE could be improved. (3 x 2 marks)

### Marker Comments:

#### 1. Summary of what was expected in the answer

Marker 1: A) A detailed description of the line was needed and should include how the material is brought to line and checked, how the bar is wrapped using HFFS and a cold seal adhesive and why. Important to include batch coding with weight and metal checks. B) Factors which contribute to this line's overall equipment effectiveness (OEE) providing an example how the OEE could be improved: Line availability - The amount of time the line is available for production. Improved maintenance, faster line setup e.g offline equipment preparation can improve availability. Line speed - Identification and removal of bottle necks. Increasing speed of line. Addition of accumulators, removal of causes of minor stoppages. Quality - Specification of materials, equipment maintenance, running the line slower may increase quality output. Training. Marker 2: A) Requires a description of the packaging line from receipt of raw materials to finished product. The description should include major equipment items, online and offline quality checks and process. Good answers must provide an overview of the whole line. B) Requires a description of OEE and discussion how each of the THREE elements could be improved.

#### 2. Overall comment on students' performance, quality of answers and how students could answer better in the future

Marker 1: A straightforward question meant good marks were gained but it was important to explain what was happening at each stage.

Marker 2: Most students provided reasonable answers to Part A. Typical, commonly used techniques were correctly selected. In Part B several students did not describe what OEE is.

#### QUESTION 4

(This question is worth 20% of the marks for this unit)

- A) Describe and justify an appropriate method for ensuring that the required amount of product is placed into the following packs. **Use a different system for each.**
- Carbonated beer filled into glass bottle (3 marks)
  - Crisps into bag (3 marks)
  - Custard powder into a container (3 marks)
- B) Describe, with the aid of a diagram, the operation of a vertical form fill seal packaging machine for packing bags of carrots. (11 marks)

#### Marker Comments:

1. *Summary of what was expected in the answer*

Marker 1: A) A description with justification of an appropriate method for ensuring that the required amount of product is placed into stated packs using different systems for each. For example: the carbonated beer filled into glass bottle would be filled using constant level pressure filling. Container pressed into filling head to release pressurised liquid. Container filled to overflow height. Excess material removed. Pressure required to maintain carbonation. High speed filling. B) A description of the process for the operation a vertical form fill seal packaging machine for packing bags of carrots using a fully annotated diagram.

Marker 2: A) Students were expected to identify a suitable system for getting the correct quantity of product. To describe how this works and justify its selection. B) Students were expected to sketch and describe the operation of a VFFS machine for bagging carrots. This should include the formation and filling of the bags.

2. *Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: Some good answers but marks lost because there was not enough detail.

Marker 2: Few students provided excellent answers. In Part A many students focused on how to fill the product rather than controlling the amount of product filled. In Part B a wide variety of descriptions were provided ranging from poor with minimal correct detail to excellent.

#### LEARNING OUTCOME 4: UNDERSTAND HOW QUALITY SYSTEMS IMPACT ON PACKAGING

#### QUESTION 5

(This question is worth 20% of the marks for this unit)

- A) Discuss what is meant by QUALITY in a quality management system. (2 marks)
- B) Identify (5 x ½ mark) and discuss FIVE core areas which need to be addressed in a quality and process control manual (5 x 1½ marks).
- C) Discuss the factors that need to be considered to determine the cost of quality. (8 marks)

#### Marker Comments:

1. *Summary of what was expected in the answer*

Marker 1: A) Discussion on what is meant by QUALITY in a quality management system: a totality of characteristics and features which bear upon the ability of a product or service to meet customers' requirements or expectations. B) A quality and process control manual should include a Quality Policy which demonstrates management commitment to process and a focus on quality improvement. It also needs Document Control & Records which ensures the required records are kept is an important part of quality management. Document control is required to ensure that appropriate versions of all documents are available where and when required. C) Factors include the prevention costs which can include all the costs associated with assuring the product is made correctly. These can include training costs, costs associated with purchase of high-quality raw materials, costs involved with maintaining or upgrading machinery to produce more reliable products and costs involved in ensuring that the customer's expectation and wants are fully addresses in the development of the product. Need to discuss all the appraisal costs in ensuring that the product produced is the product that was expected to be produced. All inspection costs,



labour equipment required to conduct inspection. Also discuss the failure costs both internal (before product leaves factory) and external (after product leaves).

Marker 2: A) Required a def of quality, that may be used in a QMS rather than a common everyday def. B) Students were required to identify and discuss FIVE areas or sections which would be expected to be found in a QMS/control manual. For each area the relevance and importance of this to achieving quality should be highlighted. C) Students were expected to provide a description of quality cost. One common classification in prevention, appraisal, internal failure, and external failure. Examples of costs for each should be discussed. Alternative classifications may be acceptable.

*2. Overall comment on students' performance, quality of answers and how students could answer better in the future*

Marker 1: Some good answers but students lost marks by not identifying and discussing the core areas which need to be addressed in a quality and process control manual.

Marker 2: Part A was generally answered well. Most students provided reasonable examples for Part B, however some lacked detail or were very specific (e.g. tolerances). Few students identified the PAF framework for Part C and provided a wide range of examples with limited order. Some confused prevention and appraisal costs.

**PIABC Limited**  
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