



REPORT ON THE JUNE 2022 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 2022 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 candidates 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) An over-the-counter dissolvable pain relief tablet is packed in a plastic blister pack and sealed with foil. Two blister packs and an information leaflet are packed into a printed folding box board carton.
Discuss how this pack performs the functions of packaging. (11 marks)
- B) A 2kg box of laundry detergent powder is manufactured from folding box board. The boxes are collated in 6's into a corrugated case, which is then palletised and stretch wrapped.
State FOUR hazards that this product may face in the supply chain from the manufacturer to the final consumer (4 x ½ mark), what effect could these have on the product or pack (4 x 1 mark) and how can the manufacturer mitigate these hazards (4 x 2 marks).

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Understanding the role and functions of packaging. Be aware of hazards.

Marker 2 - Part A requires that the pack indicated is evaluated in its ability to undertake the functions of packaging. Both the blister pack, lidding foil and the paperboard carton should be considered. Part B required the identification of 4 hazards the product could face and how these risks could be lowered.

Marker 3 - Part A – The answer required a discussion on how the pack fulfilled the functions of packaging. For example, the sealed blister pack and foil contains the tablets. A carton required to contain blister strips and a patient information leaflet ensures the customer is fully informed. Part B – One major hazard is vibration which could cause scuffing of the packs both primary and secondary. The product could settle and or segregate if not homogenous. Control of these effects is mostly by reducing the ability of the product and pack to move, e.g. tight-fitting packs and shrink-wrap. Control of environment e.g. type of truck used can contribute to reduction in vibration levels.

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

Marker 1 - Generally good performance.

Marker 2 - Few students achieved good marks. Most answers lacked detail, e.g. pack provides protection without stating protection from what? Many answers did not consider how the risk could be managed. In part B few candidates provided suggestions on how the hazards could be mitigated. Few candidates provided this information.

Marker 3 - Generally well answered, important to identify and discuss, as marks lost when no discussion.

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)

- A) Ultra-High Temperature (UHT) treated milk can be packed in either a multi-layer rigid plastic bottle or a laminated paperboard container such as a Tetra Pak.
- Briefly describe each of the two containers and how they could be decorated. (2 x 3 marks)
 - Explain how the different layers within the packs contribute to the properties of the pack for the UHT milk. (2 x 4 marks)
 - Describe how each of the packs are sealed. (2 x 2 marks)
- B) For ONE of the pack types, describe a typical secondary and tertiary packaging solution for this product. (7 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Understand the major packaging materials and how they are combined to form packaging components.

Marker 2 - Part A requires candidates to provide a general description of the two types of pack. This should include the overall format, potentially the manufacturing method used and how the pack is decorated. Candidates were expected to be able to identify the different materials used in the construction of these multi layered packs and to state the function of each layer.

Candidates should describe how the packs are sealed (how they are sealed may be different from how they are opened e.g. tetra carton is heat sealed but may be opened with a screw cap).

Part B required the description of a secondary and tertiary packaging solution for one of these formats.

Marker 3 - The milk is packed in a co-extruded plastic bottle with a screw cap including a heat seal and could be decorated using a printed self-adhesive paper (or plastic) label or a printed shrink sleeve polymeric film. The bottle is a co-extruded HDPE blow moulded bottle, usually with an EVOH layer to form a good oxygen barrier. Often such long-life bottles have a black HDPE layer to prevent UV light affecting the milk. The HDPE has a good moisture barrier, and its stiffness provides support for the pack. The bottle is sealed with an injection moulded plastic (PP) cap with an induction foil seal to give oxygen barrier and provide tamper evidence. Part B – Typical secondary for a laminated paperboard container would be a shrink-wrapped corrugated tray and label, palletised with layer pads and stretch wrapped with ID label.

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

Marker 1 - Students didn't seem to score well in Part B - mostly giving incomplete/sketchy answers rather than answering fully.

Marker 2 - Few students achieved good marks. Most answers lacked detail, students often did not identify the layers on the containers and their respective functions. Many students provided very limited descriptions of the packs and confused opening mechanisms with how the packs are closed. In part B details were often absent however the general approach taken were reasonable.

Marker 3 - There were some poor answers, marks were lost because process and material characteristics were missing or incorrect.

LEARNING OUTCOME 3: UNDERSTAND THE PACKAGING DEVELOPMENT PROCESSES QUESTION 3

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

- A) Identify SEVEN fundamentally different reasons why a company would change the packaging of an existing product. Use examples for each reason. (7 x 1 mark)
- B) a) Describe the key steps required to develop a packed product from concept to product launch. (10 marks)
- b) List SIX disciplines (e.g. departments/functions) that would be involved in this process. (6 x ½ mark)

Markers Feedback:

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

Marker 1 - Understand the packaging development process.

Marker 2 - Part A requires candidates to identify different reasons why a company would change its packaging. Part B required a description of the packaging development process from initial concept to the launch of the product. Some detail is required for each of the steps. The departments / functions within the company who will contribute towards the product development process should be identified.

Marker 3 - Part A - Introduce a new convenience feature e.g. easy pour, non-drip, resealable packs. Improve product protection e.g. alternative cushioning materials such as moulded pulp, starch. Or a change of legislation e.g. banning a material type, allergy warnings. Part B - Identify the key steps with a short description e.g. Packaging material and pack testing - test programme includes product / pack compatibility, design fulfilment, shipping & abuse tests, market testing. Identify who is involved e.g. design, production, and planning.

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

Marker 1 - Generally good scores – but very few scoring very high.

Marker 2 - Most candidates provided reasonable to good answers. Several candidates appeared to overlook the identification of the company departments involved in the new pack development. Marks were also lost due to candidates just identifying 5 – 6 headings for the development process and not providing any supporting detail.

Marker 3 - Part A – well answered. Part B – reasonably well answered but some candidates did not fully describe what was happening at each stage so lost marks.

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

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

- A) Explain the difference between fixed and variable costs. (2 marks)
- B) In the manufacture of plastic containers, identify four of the most important costs and explain whether they are fixed or variable. (4 marks)
- C) Discuss SIX factors you need to consider when ordering packaging components to optimise order quantities. (6 x 1 mark)
- D) How does unacceptable quality affect profit? (3 marks)

Markers Feedback:

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

Marker 1 - Understand packaging costs and quality systems.

Marker 2 - Part A requires candidates to explain the difference in fixed and variable costs. Part B required the candidate to identify 4 of the most significant costs associated with the manufacture of a plastic container and indicate if they are fixed or variable. Part C requires the candidates to discuss factors which should be taken into consideration when deciding on the optimum order quantity for goods. This is likely to include issues which will indicate smaller quantities and larger quantities should be ordered. Part D requires a discussion in how poor quality could impact on profitability.

Marker 3 - Part A & B - Variable costs include raw material and packaging component costs along with labour, storage, and energy. Fixed costs include rent and rates, equipment cost with depreciation plus indirect labour. Part C - Factors include increasing or decreasing order sizes such as with a decreased order size you need less storage space with a reduced chance of redundant stock allowing working capital to be released. Part D - Unacceptable quality can affect profit by loss of sales and brand loyalty, also delisting at retailer.

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

Marker 1 - Generally good answers.

Marker 2 - Most candidates provided reasonable to good answers. Areas for improvement included in Part B focusing on the most important costs rather than those which will be relatively small e.g. lighting and in Part C to discuss the issues rather than just to provide a list.

Marker 3 - Part A - was well answered. Part B – some confusion on the purpose of a specification.

**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) Identify and describe FOUR ways in which plastic packaging can have a positive environmental contribution. (4 x 1 mark)
- B) Identify and describe FOUR ways in which plastic packaging can have a negative effect on the environment. (4 x 1 mark)
- C) Briefly describe THREE end-of-life options that are available to deal with empty corrugated boxes. (3 x 2 marks)
- D) Identify and briefly discuss ONE way of evaluating the environmental impact of a packaging material. (1 mark)

Markers Feedback:

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

Marker 1 - Understand the relationship between packaging and the environment.

Marker 2 - Part A & B requires candidates to describe the environmental positive and negative impacts of plastic packaging. It is likely that some comparison to alternative packaging materials may be made. Part C requires a description of end-of-life options for packaging while part D is a description of a method of evaluating packaging environmental impact.

Marker 3 - Part A & B - Plastics can have a positive contribution by extending shelf life through barrier properties and reduces food waste. It is lightweight and uses little material. Conversely some plastics contain other compounds which can have a toxic effect as the plastic breaks down. Part C - 4 R's with a description e.g. corrugated board is compostable, fibre breaks down, eventually into carbon, oxygen, and hydrogen. Part D - A short description of Life Cycle Analysis or Assessment.

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

Marker 1 - Mostly well answered – but not sure how challenging the question really is though.

Marker 2 - Most candidates provided reasonable to good answers. In general marks were lost for failing to expand on answers. One word/phrase answers are seldom adequate for gain full marks.

Marker 3 - Generally well answered but part C needed more detail in the description.

PIABC LEVEL 5 DIPLOMA IN PACKAGING TECHNOLOGY

Unit 1: Packaging in Today's World

This unit is assessed by a 3-hour examination and candidates 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) Using TWO examples, describe how packaging has changed to meet the needs of changing demographics? (2 x 1 mark)
- B) Discuss how globalization has impacted on packaging. (3 marks)
- C) Using FIVE examples, how can packaging activities be reflected in a company's corporate social responsibility (CSR) programme. (5 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Understand the role of packaging in the modern society.

Marker 2 - Part A - Examples include an aging population, therefore, require easy open packs and larger writing. Single households require convenience products. Part B - Longer supply chains require improved shelf life and a public desire to 'buy local'. Part C - Examples of activity within CSR might be reduced waste and legislative compliance.

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

Marker 1 - Mostly good – but some did not really understand the link between globalization and packaging (change).

Marker 2 - Generally a well answered question, however, important to include the understanding behind the knowledge.

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) Define and briefly describe the primary, secondary and tertiary packaging for a 400g rectangular pack of hard cheese. (3 x 2 marks)
- B) Outline a typical supply chain for this product from cheese manufacturer to retailer. (2 marks)
- C) 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)
- D) What are the most significant environmental hazards faced by the packed product in the supply chain and discuss how they can be minimised or controlled? (3 x 1 mark)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Understand the structure and interactions of elements in the packaging supply chain.

Marker 2 - Part A - The answer must include the definition with a description e.g. 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. Part B - In this answer it was important to note that the chain must include chilled storage and distribution. Part C - A discussion was required about how the different components work together e.g. for secondary packaging having a 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. Part D - Significant environmental hazards include changes in moisture level e.g. the corrugated case may be susceptible to changes in humidity.

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

Marker 1 - Generally quite good – no poor answers.

Marker 2 - In Part A some students defined primary, secondary, and tertiary but did not describe and vice versa! In Part C marks were lost because a full discussion was omitted.

LEARNING OUTCOME 3: UNDERSTAND THE FUNCTIONS OF PACKAGING QUESTION 3

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

- A) Vitamin tablets can be packed in a blister pack and carton or a plastic bottle. Discuss how both of these packaging formats perform the functions of packaging. (13 marks)
- B) A branded shower gel is packed for distribution through a major supermarket. Describe an appropriate primary, secondary and tertiary package for this product and discuss how the functions of packaging are achieved by each. (11 marks)
- C) Discuss the factors which will cause the following packs to degrade:
 - a) Plastic bottle for bleach (2 marks)
 - b) Corrugated case used for delivery of a laptop computer (2 marks)
 - c) Decorated metal chocolate biscuit box (2 marks)

Markers Feedback:

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

Marker 1 - Understand the functions of packaging.

Marker 2 - Part A - A discussion was required on all the functions including preservation in that the materials provide moisture barrier when sealed. Good container seal required if barriers are required from bottle. It also informs so patient information must be provided. With a blister this is normally an additional sheet inserted into a carton while with a bottle a pull-out label could also be used. Traceability information stamped or printed on. Part B - A description of an appropriate primary, secondary and tertiary package for this product followed by how each meets the functions of packaging. For example, with the convenience function, this must be provided at all levels of packaging e.g. appropriate size if consumer pack, easy opening and closing, secondary pack shelf ready provides convenience for retained saving them time and potentially reducing damage. Palletised is easier for distribution to handle than a non-palletised product. Part C - A decorated metal chocolate biscuit box could degrade by exposure to moisture which could promote corrosion. Also, in distribution there could be damage to the tin surface or dent box.

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

Marker 1 - Good general performance – with clear answers.

Marker 2 - Generally good answers but students did not always go through all the different functions so lost marks.

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) Discuss how legislation is being developed and used to address concerns regarding the sustainability of packaging. (7 marks)
- B) Discuss using examples, three relative merits of using legislation or voluntary standards to achieve these sustainability goals. (3 x 2 marks)
- C) Identify FOUR consequences of not complying with legislation and/or voluntary standards. (2 marks)

Markers Feedback:

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

Marker 1 - Know the principles of the key legislation, regulations and standards relating to the packaging supply chain.

Marker 2 - Part A - A discussion on how legislation can be used to address concerns include using deposit return schemes to encourage return of material to generate high quality recycle. A tax on virgin plastics could encourage the use of more recycled content within the component or film. Part B - Examples with a discussion e.g. Legislation can be slower to change, and voluntary standards require co-operation between different material sectors and elements in the supply chain. Part C - Consequences of failing to comply include loss of image, fines, and product recalls.

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

Marker 1 - Good performances - but hardly any excelled.

Marker 2 - Generally well answered but marks lost as the reference to a piece of legislation was vague and without a discussion.

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) 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. (6 x 2 marks)
- B) Describe how the environmental impact of a pack can be assessed. (3 marks)

Markers Feedback:

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

Marker 1 - Understand the factors that affect the impact of packaging on the environment.

Marker 2 - Part A - A discussion was required on moving away from plastics to alternative materials may mean increased energy use of switching to glass from plastics & CO2 production. Increased forestry demand using FSC sources may not be available with switch to alternative sources. Increased transportation costs, e.g. glass bottle rather than plastic. Part B - An appropriate tool needed to be identified e.g. LCA, with an indication of how an assessment should be conducted. Useful to include the strengths and weaknesses.

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

Marker 1 - Some students struggled with Part A, where they are asked for subject matter outside of the textbooks (but very topical).

Marker 2 - Some excellent answers but marks lost in part A when answer lacked depth and discussion.

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

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

Using examples, discuss FIVE key functions of marketing when developing a new product.
(5 x 2 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Understand the relationship between packaging and marketing.

Marker 2 - Key functions include identifying the market sector, for example who are they, how many are out there, where are they and when do they want it. Information is gained by market research.

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

Marker 1 - Nearly all students know this material well.

Marker 2 - Generally good answers but important to give a discussion of the activity with examples.

Unit 2: Packaging Materials and Components (Paper A)

Paper A is worth 70% of Unit 2 and is assessed by a 3-hour examination. Candidates must answer five questions. The paper has seven questions, and the candidates 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 candidates were required to answer two of the following three questions: 1, 2 & 3

QUESTION 1

A carbonated orange drink can be packed in glass and metal containers.

- A) a) Identify the important properties of the drink which may impact on how it is packed. (2 marks)
- b) Briefly describe a glass and metal container to pack this product. (2 marks)
- c) Compare and contrast the relevant properties of these materials. (4 marks)
- B) Discuss the advantages and disadvantages of using glass to contain this product from an operational, environmental, commercial, and aesthetic perspective. (4 x 3 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A required candidates to identify the characteristics of a drink which would need to be considered in the development of the pack. They then identified an example of metal and glass-based containers and compared their relevant properties. Part B required the candidate to consider the use of a glass container for this product and discuss the advantages and disadvantages of this material and format from an operational, environmental, commercial, and aesthetic viewpoint.

Marker 2 - Part A - The question asks for product properties, an appropriate glass or metal pack to hold the product and to compare and contrast the relevant properties of these materials. For example, the product is a liquid containing CO₂, sugar/sweetener, flavourings, colour, and phosphoric acid. Packaging must contain the CO₂, prevent ingress of O₂, not react to acid and reduce the effect of UV light on colour. A typical glass bottle is made by the narrow neck, press and blow process and sealed with a crown closure. Glass is a total barrier to CO₂ and odour egress, O₂ ingress, subject to closure. Also inert – no leaching of or interaction with glass by product. Unless coloured glass does not have a barrier to UV light. Part B - The question asks for a discussion of the advantages and disadvantages of using glass to contain this product from an operational, environmental, commercial, and aesthetic perspective. For example from an operational perspective the advantages are that on filling line, bottle is rigid and has a low centre of gravity, so easier to run. It has resistance to internal pressure and is hygienic. Disadvantages are that it can chip easily, causing line stoppages. It is also noisy to run.

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

Marker 1 - Most candidates answered this question and provided reasonable to good answers. A few candidates did not provide the evaluation in Part B for all of the elements required.

Marker 2 - Part A was generally well answered but lack of detail in part B meant candidates lost marks.

QUESTION 2

Using examples to illustrate your answer, discuss how the properties of each of the following polymers relate to their use in packaging applications:

- a) Low density polyethylene (4 marks)
- b) Polypropylene (4 marks)
- c) Polyethylene terephthalate (4 marks)
- d) Polystyrene (4 marks)
- e) Polyamide (nylon) (4 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Candidates were expected to discuss the properties of the given polymers which are relevant to their application as packaging materials. The discussion should include examples of their applications.

Marker 2 - The question asked to discuss how the properties of each of the following polymers relate to their use in packaging applications. For example, low density polyethylene (LDPE) has a poor gas and odour barrier, fair moisture barrier, is soft and flexible, has a low melting temperature and is slightly translucent. As flexible LDPE - shrink film, bags, sacks, as a coating for heat sealing purposes, e.g. on oriented polypropylene film. Rigid LDPE – small bottles where flexibility is required, snap-on closures/lids. LDPE is used as the mixing vessel for lateral flow tests, it allows the swab to be squeezed to extract throat and nasal secretions.

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

Marker 1 - This was a reasonably popular question with most candidates gaining reasonable marks. The main reason for good-excellent grades were not achieved included:

- Examples and relevant properties were often limited to a single application e.g. PET only discussed in relation to carbonated drinks bottle rather than consideration of applications of film and/or ready meal trays.
- Information provided was incorrect e.g. PET commonly used for extrusion blow moulding.

Marker 2 - Candidates lost marks because of a lack of knowledge on each of the polymer properties and examples were missing or incorrect.

QUESTION 3

- A) For each of the following applications describe and justify an appropriate paperboard material. Comment on how the key properties for each material is achieved.
- Wrap around case for 12 cans of beer (5 marks)
 - Carton for frozen fish fingers (5 marks)
 - Carton for tube of toothpaste (5 marks)
- B) a) Explain the process of beating and refining in the preparation of paper pulp. (1 mark)
b) Briefly discuss how this modifies properties. (2 marks)
- C) Corrugated board can be prone to warping. Explain why this may occur. (2 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - In Part A candidates were expected to select an appropriate paperboard material for each of 3 different applications. For each material they should discuss some important relevant characteristics of the material for the application and describe how those characteristics are achieved. This could include appropriate coatings. Part B required a discussion of both the beating process and the impact of this on the material properties. Part C required a discussion of possible reasons for corrugated board warping.

Marker 2 - Part A - An appropriate paperboard material for a carton for a tube of toothpaste would be white lined chip. Requires good printing surface therefore bleached virgin material provides good printing surface. Cost effective use of recycled content provides economy when additional performance characteristics are not required. Adequate stiffness to maintain shape and closure.

Part B - The answer requires an explanation of beating and refining and how the process modifies the properties. For example, the process bruises and splits fibres by mechanical abuse which increases tensile & burst strength. It reduces porosity and increases density. Part C - To explain why corrugated board can be prone to warping involves an understanding that as paper fibres adsorb moisture, they expand in diameter more than length. Differences in levels of orientation or moisture content in the layers can cause differential expansion.

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

Marker 1 - Few candidates answered this question. Most selected appropriate materials, though some used corrugated board rather than paperboard. Candidates lost marks when they didn't discuss how the board characteristics were achieved.

Marker 2 - Generally good answers.

LEARNING OUTCOME 2: UNDERSTAND THE SYNTHESIS AND PROPERTIES OF POLYMERS

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

QUESTION 4

- A) Briefly describe the following THREE polymerisation processes (3 x 2 marks) and provide an example of one material produced from each (3 x 1 mark):
- Free radical initiated addition polymerisation
 - Co-ordination addition polymerisation (catalyst initiated)
 - Condensation polymerisation
- B) Explain what a copolymer is (1 mark) and describe THREE different structures which are possible (3 x 1 mark).
- C) Give an example of copolymer and its application. (1 mark)
- D) Define THREE of the following FOUR polymer characteristics (3 x 1 mark) and explain how they influence material properties (3 x 1 mark):
- Crystallisation
 - Orientation
 - Glass transition
 - Melt flow index

Markers Feedback:

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

Marker 1 - Part A required a brief description on the 3 main polymerisation processes. For each process, a material which is produced by the process should be identified. (PE is not enough as different grades are produced by different processes). Part B required a definition of a copolymer and a description of 3 different arrangements which are possible. Part C required the identification of a copolymer material and its typical application. Part D required a description of three polymer characteristics and a discussion of how the characteristics impact on properties.

Marker 2 - Part A - One of the polymerisation processes is co-ordination addition polymerisation (catalyst initiated). A catalyst is added to monomers. Catalyst provides reactive sites which enable monomer to attach to the catalyst. Geometry limits where and how catalyst can join. Additional polymers join at the catalyst surface between the catalyst and the first part of the polymer. Monomers continue to join until the polymer break away from catalyst. e.g. HDPE. Part B and C - A copolymer is constructed from 2 or more monomers. The monomers can be arranged in different orders which give rise to copolymer names. A random copolymer appears as AAABBAABBBABBBBAAAABBBBABAABBAA. An example of a copolymer is LLDPE which is used in stretch wrap applications. Part C - Orientation is alignment of polymer molecules either in melted state or from warm solid. Alignment increases tensile strength in orientation direction but reduces tear strength. Improves barrier properties, and clarity.

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

Marker 1 - Most candidates achieved reasonable grades with a few getting high or low marks. There was no specific element which appeared to cause most issues. Marks were lost due to a lack of detail or providing incorrect details.

Marker 2 - Reasonably answered but some candidates did not define and explain the polymer characteristics in Part C and so lost marks.

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 candidates were required to answer two of the following three questions: 5, 6 & 7

QUESTION 5

- A) Identify the FIVE main manufacturing methods for producing rigid, hermetically sealed metal packaging and provide a product example for each. (5 marks)
- B) With the use of diagrams, describe the production of a printed and embossed square metal container with a lid to contain tea. Start with coil material arriving at the factory and finish with containers ready for despatch to the customer. Provide full descriptions of the forming and the seaming processes. (15 marks)



Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A required the identification of 5 types of hermetically sealed metal packs with an example of their application. Part B required a description of the manufacturing system for a printed embossed general line container from reels of material to packs ready to despatch. This should include getting the correct processes and in the correct sequence.

Marker 2 - Part A - The five main manufacturing methods for producing a rigid, hermetically sealed metal pack are: Three piece can e.g. retorted food- baked beans. Shallow drawn can e.g. Pilchards. Draw Redraw (DRD) e.g. 2 piece retorted can for pet food. Draw Wall Iron (DWI) e.g. carbonated beverage and Impact Extrusion e.g. aerosol for deodorant made from aluminium tube. Part B - The question asked for a description to produce a printed and embossed square metal container with a lid to contain tea. A photograph of a typical container was included in the question. The answer required a description of a general line lock seamed container. The bodies and lid of made-up general line containers are constructed from three pieces of pre-decorated and embossed tinplate. It is not a hermetically sealed container and is unlikely to be welded like a 3 piece can as this will leave an unprinted weld line down one face of the body.

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

Marker 1 - Most candidates provided good answers to Part A. A few did not provide examples of use. In Part B several candidates described welded rather than the more likely crimped construction. Candidates lost marks for a lack of detail, omitting operations, or placing the operations out of sequences e.g. printing the formed can rather than the flat sheet.

Marker 2 - Although some candidates correctly identified how such a container could be made and received good marks, some candidates described one of the five main manufacturing methods asked for in Part A and lost marks accordingly.

QUESTION 6

A drinks company wishes to use a paperboard carton pack to promote a bespoke 70cl glass bottled product in airport retail outlets.

A) Propose a suitable design of carton to hold the bottle (2 marks) and justify the grade and properties of board (5 marks). Describe, with the aid of diagrams, the manufacture of this carton from receipt of board to despatch of cartons to the drinks company. (9 marks)

Note: A full description of the printing process is not expected.

B) Identify the likely performance criteria that would be on the carton specification. (4 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - In Part A candidates were expected to prepare a design of carton for a presentation pack for airport retail. This should include the carton type e.g. crash lock base, tuck flop carton, appropriate material should be justified. The manufacture process of the carton from sheet material to finished carton should be described. Part B required the identification of key performance criteria which would be included on the specification of the carton.

Marker 2 - Part A - As the product pack will be bespoke the carton is likely to be hand erected on the line. Therefore, a glued carton with a glued crash lock base would be ideal with a tuck in flap at the top (without slit locks as the top maybe opened multiple times. The glued crash lock is easy to erect and means the bottle cannot fall out of the bottom. The carton material is likely to be made from virgin fibres. As it will hold a glass bottle and needs to be quite strong and rigid, therefore the calliper is likely to be around 600-700 micron (c.400-450 gsm). One option is a solid bleached board (SBB), which is made from bleached chemical pulp, can be clay coated for printing. It is strong with the ability to produce good creases and allow embossing. A full description of the conversion process was required including conditioning of board, printing, die cutting and gluing operations. Part B - The likely performance criteria include fastness to light, product resistance of printed and coated surfaces and resistance to rub and scuff.

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

Marker 1 - Candidates either provided good or poor answers to this question. Some candidates proposed corrugated cases with no details of the flute or case construction, which would not provide the presentation required. In describing the manufacturing process some candidates provided little detail or detail which was not required (e.g. manufacture of corrugated board).

Marker 2 - There were some excellent answers, however, some candidates did not understand board types nor how it was converted.

QUESTION 7

A) Describe in detail the production of an injected moulded 500ml container for fresh cream from granular polymer to finished product. (8 marks)

B) Compare and contrast the processes involved in the manufacture of a fresh cream container by injection moulding and thermoforming and the effect on the properties of the container. (6 x 1 mark)

C) Identify and justify the key performance information to be included on a specification of an injection moulded fresh cream container. (6 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A required a description of the injection moulding process from granules to complete tub/pot. Part B required a comparison of injection moulding and thermoforming as methods for producing pots/tubs for fresh cream. The relative advantages and disadvantages of each process should be considered. Part C required candidates to justify what information they would expect to have on a specification for this container.

Marker 2 - Part A - The question required a detailed description of the production of an injected moulded 500ml container for fresh cream from granular polymer to finished product. All stages needed to be covered from receipt of dry polymer/ additives to the plasticating extruder,

followed by the injection moulding process, before ejecting from the mould. Part B - To compare and contrast the process and properties of a fresh cream container formed by injection moulding and thermoforming, these include injection moulding uses a single machine to produce the finished part. Thermoforming used 2 machines, extruder to produce sheet and thermoformer to produce tub/pot. Injection moulding machines require an expensive complex mould. Thermoform moulds relatively cheap. Part C - Key performance information to be included on a specification of an injection moulded fresh cream container includes container dimensions and tolerances allowed. Fit to lid. Compression strength to ensure product can be stacked. Impact tests to ensure the pack will not rupture during consumer handling.

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

Marker 1 - Few candidates provided excellent answers. In general Part A answers lacked details to achieve high marks. Perhaps candidates were short for time. Part B was generally answered well with key differences being discussed.

Marker 2 - The process of injection moulding was not answered very well, not enough detail. Key performance information does not include general administrative details such as product code, delivery formats etc.

Unit 2: Packaging Materials and Components (Paper B)

Paper B is worth 30% of Unit 2 and is assessed by a 2-hour examination.
Candidates 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) For EACH of the following adhesives:
- Starch
 - Cold seal
 - PVA
 - Acrylic
- a) Describe the characteristics of the adhesive. (4 x 2 marks)
- b) Explain how these characteristics influence the application to a substrate. (4 x 2 marks)
- c) Give an example of the use of the adhesive type and explain why it is suitable. (4 x 2 marks)
- B) Define the following terms and describe their importance to packaging adhesives:
- Viscosity (2 marks)
 - Tack (2 marks)
 - Open time (2 marks)

Markers Feedback:

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

Marker 1 - For the 4 adhesive types, candidates expected to describe the material characteristics, the application to a substrate and justify their use for specific applications. Part B required a definition of adhesive terms and a discussion of their importance.

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

Most candidates provided reasonable answers. For the cold seal few discussed how cold seal is applied and cured and focused on the packer-filler use.

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 soft drink is packed in a glass bottle with an oval shaped label.

- A) a) Discuss FIVE important properties of the paper substrate for an oval wet glue paper label. (5 x 1 mark)
- b) How would these properties be assessed? (5 x 1 mark)
- B) Describe the production process for an oval wet glue paper label from concept to labels ready for despatch. (10 marks)
- C) Discuss the advantages and disadvantages of the following as alternative methods of decoration:
- Pressure sensitive labels (5 x 1 mark)
 - Shrink sleeves (5 x 1 mark)

Markers Feedback:

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

Marker 1 - Part A required a discussion of 5 paper substrate properties for the material used for the label and a description of how each of these characteristics are measured. Part B required a description of label manufacture from concept to the labels packed ready to be despatched to the packer-filler. This includes both the design and production of the label. Part C required the

discussion of the advantages and disadvantages of PSL or shrink sleeves as alternatives to wet glue paper labels.

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

Marker 1 - Most candidates provided reasonable answers to good answers. In Part A some answers included performance of print and coatings instead of just focusing on the paper stock. In Part B some candidates provided little detail regarding the pre-press process while others included label application which was not required. Part C was generally answered well.

**LEARNING OUTCOME 6: UNDERSTAND CLOSURE SYSTEMS
AND THE FACTORS THAT AFFECT SEALS
QUESTION 3**

(This question is worth 30 marks for this paper)

- A) A glass bottle can be sealed/closed in a variety of ways. Describe SIX methods of sealing a glass bottle including how the seal is achieved. (6 x 3 marks)
- B) The following standard nomenclature for container closure dimensions "HEITS" is often used to describe key dimensions on a container closure. Identify each dimension and explain its importance in achieving an effective closure system. (5 x 1 mark)
- C) Using SEVEN examples, describe how tamper evident closures systems can be achieved. (7 marks)

Markers Feedback:

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

Marker 1 - Part A required a description of 6 methods for achieving an effective seal on a glass bottle. The achievement of an effective seal must be included. Part B required the principal dimensions of a screwed container finish to be identified and their relevance in achieving an effective closure. Part C required the description of 7 types of tamper evident closure.

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

Marker 1 - Most candidates answered this question well, with several achieving very high marks. Some candidates did not discuss the effective sealing when describing closure types.

Unit 3: Packaging Processes

This unit is assessed by a 2-hour examination and candidates 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) Briefly describe the key stages in the design and development process to launch a new more environmentally sustainable plastic drinks pack with significant recycled content from initial concept to launch. (10 marks)
- B) Identify and briefly describe the tests which would be required to ensure that the product has the greatest chance of being successful. (10 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A - The question asks for a brief description of the key stages to design and develop a new sustainable plastic drink pack. The stages include defining the objective then developing the packaging brief. Developing solutions (could include material type e.g. PET or HDPE bottle, its wall thickness and recycled content). Packaging material and pack testing (will it meet all the required functions). Finalising specifications (defining standards of acceptability with line performance standards). Launch and review. Part B - A number of tests can be carried out for example, its environmental impact should be evaluated. Another test could be the determination of suitability in the market. Test market the product or undertake consumer research with focus groups etc.

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 discussed in enough detail nor with a link to the sustainable drink pack.

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) Define and explain the following printing terms:
- Hue (1 mark)
 - Brightness (1 mark)
 - Saturation (1 mark)
- B) Explain how printing processes use the process colours (CMYK) to produce photographic images. (5 marks)
- C) Describe, with aid of diagram, the offset lithographic printing process for a 3-colour and varnished carton. (12 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A - Define and explain e.g. Hue - the dominant wavelength, the colour's position in the spectrum. The name of the colour and the quality that differentiates, for example red, blue green. Part B - Answers needed to include an explanation how process colours are applied using dot shapes of different sizes and proportions. Also, the colours are laid down at different angles to avoid moire patterns and an explanation of the importance of a key colour to emphasise shadows and highlights. Part C - This needed a fully annotated diagram of the offset lithographic process with dampening and ink rollers in the right order, and cylinders rotating in the right direction! Also required was an understanding of planographic printing where the image areas are treated to attract oil and repel water and non-image areas attract water and repel oil.

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

Marker 1 - Reasonably well answered, but marks were lost in Part C because candidates got very muddled about the sequence of the process.

LEARNING OUTCOME 3: UNDERSTAND PACKAGING MACHINERY AND PACKAGING LINE OPERATIONS

This Learning Outcome is worth 40% of the marks for this unit and candidates were required to answer both questions worth 20% each

QUESTION 3

- A) Describe the packing operation for packaging six individual apple pies (pre-baked in single aluminium trays) from receipt of packaging components to product ready for despatch to customer. (14 x 1 mark)
- B) Outline how accumulators can improve the efficiency of a filling line. (3 marks)
- C) Discuss the relative merits of shrink and stretch film to stabilizing pallet loads (3 x 1 mark)

Markers Feedback:

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

Marker 1 - Part A - The question asks for a description of the packing operation for packaging six individual apple pies (pre-baked in single aluminium trays) from receipt of packaging components to product ready for despatch to customer, so it was a little bit of a surprise when some candidates wrote about baking the pies then inserting them into aluminium trays! As pies are generally round, a collation device is often needed to hold them in place e.g. vacuum formed tray, before the collated pies are placed in a carton (it maybe flow wrapped too) then coded, check weighed with secondary and tertiary collations. Part B - Accumulators isolate a section of the line. Each section can operate even if other sections have stopped for a period of time. Part C - For example, the use of shrink film means that it requires heat application which can slow the process and, generally, uses more material than stretch film. Shrink hoods provide more weather protection than stretch wrap.

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

Marker 1 - As noted above, there were some confused answers for Part A. Parts B and C were generally well answered.

QUESTION 4

Frozen prawns are automatically packed into film based 1kg bags.

- A) Describe how the correct amount of product can be metered. (6 x 1 mark)
- B) The frozen prawns are filled on a vertical form fill seal bagging machine. Describe the operation of this equipment and any specific considerations required for this product. (10 x 1 mark)
- C)
 - a) Describe the factors to be considered to ensure a good heat seal. (2 x 1 mark)
 - b) How can this seal be assessed? (2 x 1 mark)

Markers Feedback:

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

Marker 1 - Part A - Although the frozen prawns could be manually weighed, it is most likely that a multi head weighing machine would be used. Part B and C - A straight forward description of the VFFS process was required with particular emphasis on film tensioning and the time temperature/ pressure combinations considering the appropriate film, prevention /limitation of contamination of seal area, especially as this is a frozen product. Seal strength can be assessed by tensile testing or internal pressure.

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

Marker 1 - Generally well answered.

LEARNING OUTCOME 4: UNDERSTAND HOW QUALITY SYSTEMS IMPACT ON PACKAGING

QUESTION 5

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

- A) Provide a definition of quality and explain how it is useful for a packer filler. (4 marks)
- B) Discuss how a quality management system could be used to ensure that a manufacturer of corrugated cases meets the needs of the users. (12 marks)
- C) It has been said "You cannot inspect quality into a product." Briefly discuss if this is correct. (4 marks)

Markers Feedback:

1. Summary of what was expected in the answer

Marker 1 - Part A - A simple definition is that it must be fit for purpose. The product / packaging must perform several functions. If it fails in any function, then the packed product fails. The product can meet the specification but if the specification is wrong the pack may still fail to meet consumer's needs. Part B - A good answer will identify and describe the role of the quality system in ensuring the fitness of purpose of the product. The QMS will require a wide range of issues to be expected such as understanding the product requirements and ensuring the design is appropriate for the application. Identification and sourcing of appropriate quality raw materials. Auditing of suppliers, incoming quality control of materials. Examples should be provided relating to products. Part C - A discussion was required around the statement. Once a product is complete, inspection will not change its characteristics. However, it can equally be argued that 100% inspection of glass bottles and the removal of damaged or out of specification bottles will change the quality of the product delivered to the consumer.

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

Marker 1 - Generally well answered.