



REPORT ON THE NOVEMBER 2020 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 November 2020 examinations of 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 was assessed by a 2-hour examination in which candidates needed to answer all five questions on this paper.

LEARNING OUTCOME 1: UNDERSTAND THE ROLE AND FUNCTIONS OF PACKAGING

QUESTION 1

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

- A) Name and explain SIX functions of packaging. (6 x 2 marks)
- B) Name THREE mechanical or environmental hazards that can be associated with warehouse and distribution operations. Give an example of the effect this can have on a packaged product and show how packaging can protect against that hazard. (3 x 3 marks)
- C) Briefly describe FOUR considerations that must be considered into account when using modified atmosphere packaging (MAP). (4 x 1 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Contain, protect, inform, sell, and provide convenience. Answers should describe how packs performs these roles. Part B – Candidates could select any 3 hazards relevant to warehouse and distribution. For each hazard identified the candidate must describe the impact the hazard has on the product and should describe how the typical pack types provide protection to the product. Part C – Candidates should describe factors such as the barrier characteristics of the materials, seal quality, puncture resistance, equipment required, etc. Marker 2: Understanding of the fundamental functions of packaging. Being able to apply these functions to any given packaging format. Understand the connection between packaging and mitigation of hazards.

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

Marker 1: Question was answered well. Candidates need to ensure to provide detail to support answers.

Marker 2: Generally, very good.

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

QUESTION 2

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

Single serve portions of jam (preserve) can be packed in rigid glass and semi rigid plastic containers.

- A) Considering the needs of the product:
 - a. For the two packs above, briefly describe the pack and identify how they are closed and decorated. (2 x 3 marks)
 - b. Identify and briefly describe the production processes involved to manufacture the different components of the two packs. (2 x 3 marks)
 - c. Explain the functional characteristics of all the materials used which make them suitable to pack jam (preserve). (2 x 3 marks)
- B) For ONE of the pack types; describe a typical secondary and tertiary packaging solution to collate, distribute and dispense the containers of jam (preserve) to the hotel and catering industry. (7 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part Aa – Requires a description of each pack, materials type, closure type and material and decoration method. Ab – Requires the brief description of the production process for each element of the packs (e.g. container lid and label). A detailed description of the

production process is not required. However, the correct process must be described (e.g. tin plate lug closure for glass jar). Ac – Characteristics of each material should be described not just the principal container but lid and label. Part B – The description of the secondary pack may include a printed corrugated case, possibly die cut – shelf ready. Printing or labelling should be included. Tertiary would include pallet, stretch wrap and label.

Marker 2: Understanding the general performance attributes of different materials.
Understanding how materials work together to provide solutions.

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

Marker 1: Candidates focused on main container and provided little detail on lids and labelling.

Marker 2: Average to good. The marked papers seemed to only consider primary packaging and therefore dropped unnecessary marks in Parts Aa, Ab and Ac.

LEARNING OUTCOME 3: UNDERSTAND THE PACKAGING DEVELOPMENT PROCESSES QUESTION 3

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

- A) Using product and pack examples of your choice; briefly discuss SIX reasons why a company may need to change the packaging for an existing product. (6 x 1 mark)
- B) Outline the process of package development from concept to product launch, discussing SIX key steps in this process. (6 x 1 ½ mark)
- C) Identify FIVE departments/functions that could contribute to a packaging development team (5 x ½ mark) and briefly state their responsibilities in this process (5 x ½ mark).

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Answer required 6 reasons for change of pack or a given product. Answer needed to justify why the change is required. Part B – The description of a package development model from concept to product launch. A good answer would provide details of activities undertaken at each stage. Part C – The role of 5 departments in development process needed to be briefly described.

Marker 2: Understand the packaging development process, both as an independent function of business and as part of the whole. Understand the stakeholders, departments, and functions that in packaging development.

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

Marker 1: Question was answered well. Candidates need to provide description in addition to headings.

Marker 2: Good – sound answers on the whole.

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

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

- A) Briefly describe the difference between fixed and variable costs. (1 mark)
- B) A diary company producing cheese would incur fixed and variable costs in the daily operations of their business.
 - List FOUR examples of VARIABLE COSTS. (4 x ½ mark)
 - List FOUR examples of FIXED COSTS. (4 x ½ mark)
- C) Identify and describe FOUR factors that need to be considered in determining optimum stock holding levels. (4 x 1½ mark)
- D) What is the purpose of a specification and why is it important? (4 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Definition of fixed and variable costs. Part B – Examples of fixed and variable costs. Some indication of why the costs are fixed or variable would be useful. Part C – A brief description of 4 issues to be considered in determining the optimum stock holding (e.g. space availability, delivery times, etc.) Part D – The answer should focus on the purpose of the specification rather than the information to be included.

Marker 2: Understand contributing factors to costs in supply chain. Understand types of costs. Understand costs of quality and implications.

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

Marker 1: Generally, answers failed to detail differences in fixed and variable costs and confused these with costs which could change and those who's price was fixed.

Marker 2: Generally sound. A few unnecessary marks lost in B, C and D through not giving enough different examples.

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

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

- A) Describe THREE ways packaging can reduce product waste. (3 x 2 marks)
- B) Identify FIVE ways that manufacturers can reduce the environmental impact of packaging. (5 x 1 mark)
- C) Identify TWO tools/techniques commonly used for assessing the impact of packaging on the environment (2 x 1 mark) and briefly describe ONE of them (2 marks).

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Three examples of how packaging can reduce waste. Examples should be diverse not just 3 different preservation methods. Part B – Five different ways to reduce environmental impact of packs required a short explanation of how the impact is achieved. Part C – Two techniques need to be identified and an overview of one of these described. Key principles must be included.

Marker 2: Understand both the benefits and costs of packaging with regards to the wider environment. Understand how this can be studied and evaluated.

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

Marker 1: Acceptable answers provided however answers lacked detail or explanation (e.g. Part B requires a fuller explanation than Reduce, Reuse and Recycle).

Marker 2: A high scoring question on the paper.

PIABC LEVEL 5 DIPLOMA IN PACKAGING TECHNOLOGY

UNIT 1: PACKAGING IN TODAY'S WORLD

This unit was assessed by a 3-hour examination and the candidates needed to answer all six questions on this paper.

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

QUESTION 1

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

- A) Using FOUR different examples; explain how packaging has developed in response to changes in society. (4 x 1 mark)
- B) Briefly describe how packaging policy can contribute towards a company's corporate social responsibility. Illustrate your answer with THREE different examples. (3 x 2 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand the impacts of societal development on packaging needs. Understand globalisation with regards to packaging response. Understand where packaging development and use fits into CSR.

Marker 2: Part A - Factors to consider include: An ageing population require easy open packs and working parents use convenience foods. Part B - A factor to consider includes: The use of minimal or optimisation of the packaging. Reducing excessive packaging will reduce pressure on resources used and reduce the number of materials which consumers must dispose of, either to recycling or landfill.

Marker 3: Part A – Candidates should describe how packaging responds to change in society. They should use 4 examples to illustrate their answer. Part B - Candidates are expected to discuss how decisions on the packaging used by a company can contribute to CSR.

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

Marker 1: Scored exceptionally high throughout majority of students.

Marker 2: Generally, a well answered question.

Marker 3: Most candidates provided reasonable answers. Where marks were lost it was usually for failing to demonstrate the link between the packaging action and the CRS issues.

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

QUESTION 2

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

- A) Define the terms primary, secondary and tertiary packaging and give ONE example of each. (3 x 1 mark)
- B) For EACH of the following packaging components, briefly describe the stages in the supply chain from raw material to packaging components ready for despatch to the packer/filler. (3 x 2 marks)
 - 1. Paper label for wet glue application
 - 2. Steel can (unprinted)
 - 3. Stretch wrap film
- C) Twelve (12) 300ml glass bottles containing a carbonated liquid beverage with paper labels and a metal crown closure are collated (in a 3 x 4 matrix) within a corrugated board outer. The pack is mainly sold through retail outlets. For the product described above; identify the THREE main mechanical hazards that would typically be experienced within the supply chain. Briefly outline the causes and effects and what can be done to mitigate them. (11 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand for any component/material, the supply chain history. Understand hazards and mitigation by packaging use.

Marker 2: Part A - Definition of primary can include Primary (bottles, cans, product labels, caps, flow wrap, pouches etc.). Part B - The stages for a paper label could include Forest (trees felled) delivered to Paper mill (logs chipped, wood pulp (and/or recycle pulp), paper sheet, coated) shipped to Converter – printed, cut, collated, wrapped, and despatched to packer filler. Part C - One mechanical hazard is shock caused by falls from vehicles, shunts, drops and impacts which could break the bottle and dent the outer. This is minimised by reducing the amount of handling and use cushioning materials.

Marker 3: Part A – Candidates should define the different levels of packaging and provide an example of each. Part B – Candidates should briefly identify the main stages in the production of the items. For example: Paper Label – forestry operations, wood pulped, paper formation, printing and cutting and application. Part C – The cause and effect on the product of 3 mechanical supply chain hazards should be discussed (e.g. shock vibration, compression or puncture). The methods which can be put in place to mitigate the effect should be discussed.

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

Marker 1: Generally good, but some overly simplistic answers to Part B.

Marker 2: In Part B some students discussed the supply chain beyond the converter explaining, for example how labels were applied to a container which was not asked for.

Marker 3: Most candidates answered Part A very well and scored full marks. The level of detail provided in Part B varied greatly, Simplistic answers such as metal factory – can factory failed to score many marks. Some candidates lost marks for failing to consider the whole supply chain of the main elements. Part C was generally reasonable however some answers failed to consider the specific product.

LEARNING OUTCOME 3: UNDERSTAND THE FUNCTIONS OF PACKAGING QUESTION 3

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

- A) Twelve eggs are packed in a labelled hinged pulped pack. Twenty-four of these packs are placed in a shelf ready corrugated case and the cases palletised.
Discuss how this packaging format performs the functions of packaging and include the potential benefits of using shelf ready packaging for the retailer. (14 marks)
- B) Products can be preserved by the use of increasing the temperature or modifying the atmosphere; discuss the implications for the product and the packaging used in these processes. (2 x 5 marks)
- C) Describe the factors which contribute to the deterioration of metal packaging and how can they be prevented or reduced. (6 x 1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Know the functions of packaging and apply to any example. Know the factors that can adversely affect packaging and its preferences.

Marker 2: Part A - One function includes Protection from mechanical hazards (shock, vibration, compression, and puncture). The pulp tray will cushion moderate levels of disturbance and the hood will limit vertical movements within the tray. The secondary packaging further adds strength and integrity and vibration/shock resistance. Part B - Increasing temperature destroys microorganisms, carried out by Retorting (cans and jars), Pasteurisation (milk, beer), Hot filling (jams), Packaging must be resistance to the high temperatures. Seal integrity is paramount. Part C - Factors to consider include a reduction in relative humidity - via desiccants or application of a vacuum, plus barrier packaging to prevent further ingress of moisture. Also, protective coatings such as grease, oil, paint, lacquer, enamel, tinplate, plastic.

Marker 3: Part A – Candidates should describe how the functions of packaging are performed by the given packs. Both primary and secondary packaging should be considered. Part B – The implications for the preservation methods indicated should be discussed. The impact on the product and pack are important areas. The application of the heat treatments before and after packaging should be considered. Part C – Candidates should discuss how metals (steel) corrodes and the steps which can be taken to limit the processes.

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

Marker 1: Generally good scores with clear understanding of questions' demands.

Marker 2: Reasonable answers but students did not always go through all the different functions so lost marks.

Marker 3: Most candidates provided reasonable answers. Marks were lost in Part A for failing to consider both primary and secondary packs or ignoring some of the functions. Few candidates in Part B identified pre- and post-packaging thermal processing and how these impacts on the product and packaging. Most answers lacked sufficient details to gain full marks. In Part C few candidates provided enough detail on the mechanism of corrosion and preventative measures to gain full marks.

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

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

- A) Identify and discuss the scope and implications to a company of a specific piece of legislation intended to reduce the impact of packaging on the environment. (6 marks)
- B) Identify and discuss the scope and implications to a company of a specific piece of legislation intended to ensure product safety. (6 marks)
- C) Identify SIX possible consequences of failing to comply with legislation. (6 x ½ mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Identify key legislation pertaining to packaging use and disposal. Understand consequences of not complying with legislation.

Marker 2: Part A - A broad understanding of the scope and purpose of the legislation with some clear examples of specific requirements. For example, environmental legislation to reduce the amount of packaging and maximum limits for contaminants such as heavy metals. Part B – Identification and discussion on the scope and implications to a company of a specific piece of legislation intended to ensure product safety. Part C - This could include fines, imprisonment, Impact on reputation with loss of sales.

Marker 3: Part A - The candidate was expected to identify a relevant piece of legislation intended to reduce the impact of packaging. Once identified they were required to describe the broad intent of the legislation and then discuss some specific requirements. Part B – As above. Part C – Candidates should identify 6 possible consequences of a company failing to comply with legislation.

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

Marker 1: Mostly good answers. A couple of students failed to answer appropriately though.

Marker 2: Generally good answers.

Marker 3: Answers ranged from excellent to very poor with most candidates scoring reasonably. Candidates lost marks for failing to provide examples of specific requirements required by the legislation.

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

QUESTION 5

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

- A) Briefly discuss environmentally sustainable development and its implications for packaging. (5 x 1 mark)
- B) Recovery of packaging waste can include:
- Recycling
 - Energy Recovery
 - Composting
- Discuss EACH of these from an environmental perspective including considerations about the choice of packaging materials. (3 x 3 marks)
- C) What is the difference between a biodegradable and a degradable material? (1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand environmental impacts of packaging. Understand all major 'disposal' route and impacts of packaging design.

Marker 2: Part A - Discussion may include the impact of our personal values, choices and behaviours on the wider world and consideration of sustainable development in the context of scarce resources and needs of future generations. Part B - Energy recovery involves the collection and sorting (e.g. impact of contamination and removal of non-combustible material), with the capital investment. (e.g. cost of incineration facility and availability of input material) and consideration of the site of facility and its environmental impact (e.g. regulatory approval and local resistance). Part C - Biodegradable materials break down such that most of the finished compost ultimately decomposes into CO₂ biomass and water. Degrading by microbes. Degradable materials break down into smaller particle over time.

Marker 3: Part A – This question required a general discussion on environmentally sustainable development. The implications for packaging should then be discussed. Wide range of topics could be considered including packaging role in reducing food waste, definition of sustainable development, impact of materials, energy. Part B – Requires a discussion of the issues which need to be considered with each of the issues which need to be considered with each of these disposal methods for packaging discussions. Part C – The difference between degradable and bio-degradable should be discussed.

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

Marker 1: Part C was very poorly answered by almost all candidates. Mixed performance on Part A and B.

Marker 2: Reasonable answers but marks lost when answer lacked depth.

Marker 3: Few candidates provided good answers to Part A though most were able to discuss several concerns. Answer to Part B were reasonable with many different issues raised. Part C was poorly answered with few students able to describe the differences.

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

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

- A) i) Define marketing. (1 mark)
ii) Identify and briefly describe FOUR key activities of marketing. (4 x 1½ marks)
- B) Consistency of communication is important for a product's brand image. Explain how this can be achieved using examples of packaging to illustrate your answer. (3 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand the function of marketing and how marketing impinges upon packaging design and development.

Marker 2: Part A - One definition of marketing is the management process responsible for identifying, anticipating, and satisfying customer requirements profitably. An activity could include determining the price i.e. - what is the total cost, what about development costs and what price will the market pay. Part B - Communication must be consistent across advertising and packaging to maintain brand image, across the product range and throughout the product's life.

Marker 3: Part A – Candidates should provide a concise definition of marketing. They should identify the 4 key marketing activities and describe the activities involved in these. Part C – Candidates should use examples to describe how branded products achieve consistency of communications.

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

Marker 1: Good results on the whole.

Marker 2: Generally good answers.

Marker 3: Most candidates provided reasonable answers. Some lacked the detail discussions required for higher marks.

UNIT 2: PACKAGING MATERIALS AND COMPONENTS (PAPER A)

Paper A is worth 70% of Unit 2 and was assessed by a 3-hour examination.

Candidates needed to answer five of the seven questions on this paper.

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

This Learning Outcome was worth 40% of the marks for this paper.

Candidates were required to answer two of the following three questions (1, 2 & 3).

QUESTION 1

- A) Identify THREE properties of steel (3 x ½ mark) and explain why these properties make it an appropriate choice for use as a packaging material (3 x ½ mark).
- B) Identify the structure and performance differences of black plate, tin plated steel, and tin free steel (3 x 2 marks). Justify, using examples, the use of these materials for packaging applications (3 x 1 mark).
- C) Using examples; identify and describe EIGHT properties of aluminum foil when used as a packaging material. (8 x 1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Comparison of steel and aluminium with regards to packaging applications.

Marker 2: Part A - Steel has exceptional gas, moisture, and light barrier (subject to appropriate internal coatings). It is also easy to recycle. Part B - Tin-free steel (Electro chrome coated steel) is blackplate with chrome & chromic oxide electrolytically applied. Considerations include that it is less expensive than tinplate. Same strength properties as tinplate. It needs lacquer / plastic laminate or coating on both surfaces to complete corrosion protection system as natural resistance is poor. Chrome, chromic oxide surface is very hard and brittle and needs to be removed locally to permit satisfactory welding. It will also damage soft forming / cutting tools unless coated with lacquer. For this reason, TFS cannot be used for wall ironed cans. Part C - Properties include its appearance, it has a bright, specular metallic gloss which makes pkg look premium. Also has excellent barrier properties e.g. foil greater than 20µ gives 100% barrier to all gases, moisture, grease and UV light.

Marker 3: Part A – Candidates need to identify 3 different properties of steel which make it a useful packaging material. For each property they should explain why steel is useful. For e.g. magnetic. Easily removed from mixed waste streams for recycling. Part B – For each material the candidate should describe the different layers and coatings found within the material and explain why these materials are appropriate for specific applications. Part C – Candidates should identify and describe 8 properties of aluminium foil packaging. Examples of packaging which are relevant to the properties should be provided.

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

Marker 1: Generally competent and clear understanding of question.

Marker 2: Some good answers but generally a poor understanding of the structure and performance differences in Part B.

Marker 3: Most candidates provided good answers. Marks were lost for clearly justifying the use of the materials for particular applications or providing incorrect justifications.

QUESTION 2

Fruit jams and preserves are often packed in glass jars.

- A) Identify the ingredients used to manufacture of a glass jar and describe their function. (6 marks)
- B) Discuss why glass is the preferred material for this type of product. (6 marks)
- C) Identify and discuss how the disadvantages of glass can be overcome. (4 marks)
- D) Fruit jams and preserves are also packed in flexible film and rigid plastics. Briefly discuss the advantages of these materials/formats for this product. (4 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand how glass is made. Understand the benefits and risks of using glass. Compare glass to plastic – advantages and disadvantages.

Marker 2: Part A - For example Soda Ash acts as flux lowers melting temperature but makes glass water soluble. Part B - One aspect is that glass can be heat sterilised and hot filled in excess of 100C as is normal for this product. Part C - Glass can suffer from fracture / chipping. The container design can reduce the likelihood of damage events by having stable designs. Part D - Rigid plastic with a heat-sealed lid can be used for single serving packs. Laminated films can provide good shelf-life but cannot be reclosed. Significant weight saving on single serving glass jars.

Marker 3: Part A – The 6 main ingredients used in flint container glass manufacture need to be identified and their function described. Part B – Requires a discussion of the reasons why most jams are packed in glass containers. Part C – This question requires the negative properties of the use of glass as packaging to be identified and the methods used to reduce the impacts of these characteristics. Part D – Alternative formats and materials for packing jams need to be identified and discussed. The advantages of these formats over glass should be discussed.

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

Marker 1: Candidates generally answered well. The 'choose 2 from 3' format of the papers allowed for a more involved response – as 'glass technology' is often weak area for some candidates.

Marker 2: Generally, well answered.

Marker 3: Most candidates provided good answers to this question. A few candidates scored poorly failing to discuss/identify the why elements of the questions. One candidate provided information on forming process which was not relevant and failed to provide the required detail.

QUESTION 3

- A) Discuss the properties of the following materials in relation to the packaging applications given:
- A polypropylene flip top closure for a shower gel bottle. (4 x 1 mark)
 - An amorphous polyethylene terephthalate injection stretch moulded bottle for carbonated water. (4 x 1 mark)
 - A high-density polyethylene extrusion blow moulded bottle for engine oil. (4 x 1 mark)
 - A microperforated biaxial orientated polypropylene bag of salad leaves. (4 x 1 mark)
- B) Identify and briefly justify an appropriate material for these applications:
- A dissolvable film for agricultural chemicals. (1 mark)
 - A heat sealable multi-layer film to provide high barriers to moisture and gas. (1 mark)
 - A ready meal tray for reheating in either oven or microwave. (1 mark)
 - A vacuum bag for a leg of lamb. (1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Reasonably wide knowledge of a range of materials performances. Advantages v. disadvantages of selected materials/functions. Understand how to use performances to provide packaging solutions.

Marker 2: Part A - For example, a HDPE bottle for engine oil has a high melt flow index suitable for extrusion blow moulding. It has good seal strength on bottle bottom and is a cost-effective material. Good impact strength and has reasonable chemical resistance but can suffer from ESC. Part B - A dissolvable film for agricultural chemicals is PVOH as it is readily dissolves in water.

Marker 3: Part A – For each item, the candidate should provide a discussion as to why the material(s) are appropriate for each application. While there may be one key property for some packs, a discussion of a range of characteristics is expected. Part B – An appropriate material for each application needs to be identified and justified.

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

Marker 1: Part A – Those that legitimately answered Q3, did well. Part B – Couple of candidates did not seem to realise they only need to answer two questions from Q1 – Q3.

Marker 2: Average answers as generally candidates did not understand how material properties related to the application.

Marker 3: Most candidates provided fair/reasonable answers. There were few very high scoring candidates. Answers often limited discussion to a couple of different issues.

**LEARNING OUTCOME 2: UNDERSTAND THE SYNTHESIS
AND PROPERTIES OF POLYMERS
QUESTION 4**

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

- A) Describe the polymerisation of low-density polyethylene (LDPE). (6 marks)
- B) Compare and contrast how the polymerisation of high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) differs from that of LDPE. What is the impact on the materials' properties? (2 x 3 marks)
- C) Explain the meaning of the following polymer characteristics and describe how they can influence their properties:
- Crystallisation (2 marks)
 - Orientation (2 marks)
 - Glass transition (2 marks)
 - Melt flow index (2 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand basic principles of polymer chemistry and a fair knowledge of the similarities/differences between LDPE/LLDPE/HDPE.

Marker 2: Part A - A description initiation, propagation, and termination process for the manufacture of LDPE was required. Part B - For example LLDPE is a copolymer of ethylene and a higher molecular weight monomer (e.g. pentane). The molecular chain will contain different monomers. Produces regular short chain branching with similar properties to LDPE. Slightly better transparency and elongation to break. 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.

Marker 3: Part A – Candidates are expected to provide a description of the free radical additional polymerisation of LDPE. The initiation, propagation and termination phases need to be described. Part B – The candidates should describe how the catalyst assisted polymerisation of HDPE and co-polymerisation of LLDPE differ from LDPE and the impact this has on the properties of materials. Part C – candidates are required to explain the given terms and describe how this impacts on the material properties.

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

Marker 1: Generally good, but maximum marks often missed through lack of details in some answers. They obviously knew the topic but missed out key points regularly.

Marker 2: Some reasonable answers but parts B and C were not well answered.

Marker 3: Few candidates scored very highly, with Part B being where marks were lost. A number of candidates failed this question as they could not provide accurate definitions of terminology or describe the polymerisation of LDPE in any detail.

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

This Learning Outcome was worth 40% of the marks for this paper.

Candidates were required to answer two of the following three questions (5, 6 & 7).

QUESTION 5

- A) Outline the production process for a collapsible aluminium tube for a solvent based adhesive (7 marks), including how its quality is assured (3 marks).
- B) Identify and explain the importance of each of the criteria which should be stated on the component specification. (10 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand of how collapsible aluminium tubes are manufactured and filled and quality assured. Understand component specifications and the importance/application of the detail.

Marker 2: Part A - The process starts with aluminium slug, without hole (thin section for membrane), Lubricate, Tooling, Impact extrusion process, Neck forming, Trimming, Cleaning, Internal coating and sealing medium applied to open end, External decoration, Application of correct closure at correct torque. Packing + ID for traceability, Check dimensions and copy. Part B - Key criteria with explanations to include Name, Unique ID, Date and revision status, Material – aluminium and why, Dimensions and tolerances (not actual), Internal coatings for product protection and compatibility, External coatings for decoration and information, Neck details for efficient closure, Packing details for protection during transit to packer-filler, Performance requirements on filling line.

Marker 3: Part A – Candidates are expected to describe all the process involved in the production of a collapsible aluminium tube for an adhesive. This should include key quality assurance takes. Part B – Candidates are required to identify and justify what should be included on a specification for this product. Items could include general specification information in addition to issues specific to the product.

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

Marker 1: One candidate performed well with a grasp for the detail and the question. The others, however, either did not understand the question or did not comprehend the term 'collapsible aluminium tube'.

Marker 2: Part A was not particularly well answered.

Marker 3: An unpopular question only attempted by a few candidates. Answers were often limited to the forming process rather than the whole production process.

QUESTION 6

- A) Describe, with the aid of diagrams, the manufacturing process for a thermoformed container to hold a soft spread product such as margarine or butter. In your answer describe the process from receipt of a reel of material to despatch of finished container to the filler. (10 marks)
- B) Justify a suitable material for the container. (2 marks)
- C) Compare and contrast the process to manufacture the above container by thermoforming and injection moulding. (8 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understanding of thermoforming and injection moulding – similarities and differences – advantages and disadvantages of both. Understand interface between production methods and material choice.

Marker 2: Part A - An annotated diagram showing the process with explanations was required. Part B - The material most likely to be used is a cast polypropylene as it has good moisture barrier and a fair oxygen barrier with good forming characteristics and good strength at a lower weight. Part C - Thermoforming is not suitable for all materials, is a more expensive material but less expensive tooling. Injection Moulding is suitable for all materials, uses less expensive materials but more expensive tooling.

Marker 3: Part A – Candidates should describe the manufacturing process for the thermoformed container from reels of materials to product ready for despatch to the packer filler. The focus should be on the thermoforming process however the whole process should be included. Part C – PP is the most likely materials. However other materials can be justified. Material selection must be justified. Part C – Thermoforming and injection moulding process should be compared. The advantages/disadvantages of each process should be highlighted.

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

Marker 1: Wide range of performance! Some answered well, others clearly did not understand the technology or the question – especially Parts A and C. Diagrams generally poor or missing (despite being asked for!).

Marker 2: A mix of good and poor answers as students either understood the process or not.

Marker 3: Most candidates provided reasonable answers. The candidates who scored poorly failed to provide any detail on the manufacturing processes.

QUESTION 7

- A) Describe the manufacturing process of a single wall corrugated board from reels of paper to sheet board. (9 marks)
- B) Discuss how the manufacture of double walled board is different from single walled board. (2 marks)
- C) A case can be described as an RSC 0201 case with dimensions of 350 x 250 x 300 mm. Discuss what this means. (3 x 1 mark)
- D) Discuss FOUR performance characteristics which would be found on a corrugated case specification and how they would be measured. (4 x 1½ marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: An explanation of the process(es) involved in corrugated board manufacturer.

Marker 2: Part A - Description required of process. Part B - The first single facer is the same as with a single wall board. A second single facer produced as second single faced material. The tips of both single faced materials are coated with adhesive. The two single faced materials and the outer liner are joined in a single process and heated to cure the adhesive. Part C - A case will have all flaps the same length so that the longer flaps will meet when the case is closed. The dimensions are the internal dimensions of the case. The case will have an open top 350 x 250 mm and the case height will be 300 mm. Part D - One performance characteristic would be burst strength which is the pressure required to push a diagram through the material.

Marker 3: Part A – This question requires the candidate to describe the manufacturing process for corrugated board. Part B – How double walled corrugated board is constructed. Part C – This question requires a description of the information which can be determined from the box description (RSC0201 350x250x300). Answers should include what the dimensions mean and the shape on RSC0201. Part D – Few performance specifications for a corrugated case should be identified and how they are measures described. For e.g. box compression, water absorbency, edge crush, flat crush, etc.

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

Marker 1: Those that answered well, answered very well. However, some lost a lot of marks by others confusing 'single-wall' with 'single-face' or clearly not understanding the process at all.

Marker 2: Students lost marks because they did not describe the process of manufacturing corrugated sheet board. Some candidates then continued to describe the case making or die cutting operation which was not required.

Marker 3: Some candidates who answered this question were confused by the difference in single faced corrugates and single walled corrugated, resulting in poor marks.

UNIT 2: PACKAGING MATERIALS AND COMPONENTS (PAPER B)

Paper B was worth 30% of Unit 2 and was assessed by a 2-hour examination.

Candidates needed to answer all three questions on this paper.

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

QUESTION 1

(This question was worth 30 marks for this paper)

- A) Using examples, what are the differences between the mechanical and specific (chemical) adhesion theories? (2 x 3 marks)
- B) Define the following terms and describe their importance to packaging adhesives:
- Tack (3 marks)
 - Open time (3 marks)
 - Viscosity (3 marks)
- C) Describe the factors that affect the choice of an adhesive type for a packaging application. (6 marks)
- D) What is a hot melt adhesive? (1 mark)
- E) Identify the constituent parts of a typical hot melt adhesive used on a typical automated packing line for sealing corrugated cartons and explain their properties. (8 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Description of mechanical and chemical theories of adhesion. In particular, how the bond is achieved. Part B – Definition Tack (the ‘initial’ stickiness was important), Open Time and Viscosity. Part C – A wide range of factors could be considered including temperature range, humidity, application speed, cost, taint or odour, surface characteristics.

Part D – Simple definition of what a hot melt is. Part E – Some detail is required on the constituents of hot melts – polymers, waxes, resins, anti-oxidants, stabilisers, etc. A description as to why they are needed for the application is expected.

Marker 2: Understanding of the theories of adhesion. Demonstrate knowledge of the different adhesive groups/types. Understand why different adhesion required for different applications/substrates and environments.

Marker 3: Part A - Using appropriate examples, a comparison was required to show the differences between both theories. For example, specific adhesion theory propose that bonding takes place when minute regions of positive and negative charge are brought into intimate enough contact that they can mutually attract one another, much as two magnets would. Mechanical adhesion relies on surface irregularities to help in the formation of the bond. Part B - Viscosity is the measure of the ability of the liquid adhesive to withstand shear forces, an indication of how runny the adhesive is. Viscosity is affected by temperature and solvent content. Viscosity is an important characteristic as the delivery systems will be set up for a liquid of a particular viscosity. Changing viscosity may result in more or less adhesive applied. Part C - Factors to include the chemistry & physical nature of surfaces to be bonded plus method of application, machine speed, pot life. Part D – Brief description of a hot melt. Part E - The constituent parts of a hot melt adhesive include Polymers - for strength, Resins - for tack and adhesion, Wax - as diluent to improve melt flow properties and reduce cost. (also used to control open time) and Stabilisers – e.g. Antioxidants to prevent oxidation.

2. Overall comment on students’ performance, quality of answers and how students could answer

Marker 1: Generally, well answered question. Definitions were sometimes lacking detail or became confused (e.g. are high viscosity materials runny or thick?).

Marker 2: Generally good performance and clear understanding.

Marker 3: Generally, well answered but an understanding of the constituent parts of a hot melt adhesive could have been better answered.

LEARNING OUTCOME 5: UNDERSTAND THE DIFFERENT TYPES OF LABELS AND THE MATERIALS USED
QUESTION 2

(This question was 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 (excluding paper manufacture). (10 marks)
- C) Discuss the advantages and disadvantages of the following as an alternative method of decoration:
- Pressure sensitive labels (5 x 1 mark)
 - Shrink sleeves (5 x 1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – A discussion of 5 materials properties of the paper used in the label is expected (e.g. porosity, stiffness, water, absorbance, whiteness and smoothness). The properties must be described, and the method of measurement discussed. Part B – The manufacturing process from concept through to label ready despatch should be described. It should include design, material selection, process selection, pre-press activities, plate manufacture, proofing, printing, die cutting, QC and packing. Application to container is not required. Part C – Wet glue paper labels should be compared and contrasted with both PSL and shrink sleeves.

Marker 2: Knowledge of many label types, their application, and advantages/disadvantages with regards to each other.

Marker 3: Part A - Properties include porosity, stiffness, and surface smoothness. Part B - A description of a wet glue paper label NOT a pressure sensitive paper label. Part C - Pressure sensitive labels are quick and clean to apply but there is a lot of waste from backing liner. Shrink sleeves can be reverse printed to reduce scuffing and increase gloss. No adhesive is required and can incorporate tamper evidence. However, are polymer based and requires all round label application which may increase material usage.

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

Marker 1: Part A – Material properties were not all related to the paper substrate (e.g. some candidates included dimensions and print colour/quality). The assessment was sometimes confused (e.g. measuring porosity with Cobb test). Part B – Some good answers, however some candidates discussed application of label to bottle. Part C – Generally answered well.

Marker 2: Good scores in Parts A and C. Poorer performance in Part B – most candidates did not follow process through to despatch.

Marker 3: Part B was answered poorly with some candidates misunderstanding what a glue applied label is.

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

(This question was worth 30 marks for this paper)

- A) Describe, with the use of appropriate labelled diagrams, the closure system (including materials, design, and application method) for the following seal types and give ONE example of use for EACH closure type:
- Roll on pilfer proof closure (5 marks)
 - Induction heat seal (5 marks)
 - Crown closure (5 marks)
- B) Describe FOUR different tamper evident closure systems, explaining how tamper evidence is achieved and give an example of where each may be used (4 x 2 marks). **(Note: Examples provided in Part A are not acceptable.)**
- C) Describe THREE types of child resistance packaging and explain how child resistance is achieved. (3 x 2 marks)
- D) Outline how child resistant closures are assessed. (1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Part A – Requires a discussion on mechanical and chemical theories of adhesion. How adhesion is achieved must be included. Part B – Each of the terms must be defined and how these characteristics relate to packaging application should be discussed. Example: Tack is the stickiness of the initial bond. Important for holding the joint closed while the adhesive cures to full strength. Too low tack joints may pull apart before curing. Too high may prevent adjustment of joint. Part C – A brief description of a range of factors which should be considered in selecting an adhesive (e.g. materials to be joined, end use conditions, permanent or temporary joints, etc.). Part D – Brief definition of what a hot melt adhesive is. Part E – Hot melts are a blend of different materials. The materials in the blend should be identified and their function described.

Marker 2: Knowledge of major closure systems and methodologies. Understand the applicability and appropriateness of each system. Understand how closures are tested and evaluated.

Marker 3: Part A - Induction heat seals can comprise of a closure/ paper or expanded plastic/ aluminium foil and a heat seal coating. The closure is applied and passed through an alternating magnetic field generating eddy currents in the foil, which melt the heat seal coating. Provides a seal and tamper evidence for products like coffee jars. Part B - The identification, description and use for examples including shrink sleeve bands, break-band closures (metal and plastic) and blister packs. Part C - Push and twist cap is a modified screw cap closure. Inner cap operates as standard screw closure. Outer shell only engages with the inner when depressed. Requires two unrelated actions to be conducted together which children find difficult to coordinate however adults find relatively easy. Part D - 3-part assessment: Children of specified ages given time to try to open containers. Numbers permitted to gain access are limited. Children are then given demonstration on how to open container and then provided more time to gain access. Adults of over certain ages are provided with complete packs including opening instructions and must be able to gain access in given time.

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

Marker 1: Question generally well answered. Several candidates described the application method of hot melts in Part E rather than their constituents. Definitions of open time and tack often lacked clarity and detail (e.g. tack was identified as stickiness, but missed that this was only the initial bond before curing).

Marker 2: Exceptionally good.

Marker 3: Generally, well answered.

UNIT 3: PACKAGING PROCESSES

This unit was assessed by a 2-hour examination and the candidates needed to answer all five questions on this paper.

LEARNING OUTCOME 1: UNDERSTAND THE PACKAGING DESIGN AND DEVELOPMENT PROCESS

QUESTION 1

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

A major brand owner has suggested there is an opportunity to repackage a ready meal product in a biodegradable tray.

Describe the packaging development process for this product from concept to a successful product established in the market. Highlight key project milestones. (20 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: A knowledge of the design/development process, as applied to the potential use of biodegradable tray for ready meals.

Marker 2: The answer should describe a packaging development process from concept to product launch. The general process should include descriptions of activities which would be particular to this product. Any reasonable breakdown of the process is acceptable but likely to include activities associated with:

- Setting project goals and management processes
- Market research
- Ideal development and feasibility assessment
- Development and evaluation of concepts
- Capital requirements
- Budgets
- Sample evaluation
- Line modifications
- Production trials and product assessment
- Contacts agreed
- Specifications and QC established
- Product and marketing planning
- Stock developed
- Marketing campaign
- Distribution and launch
- Post launch assessments

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

Marker 1: Good, but only a few captured all/most of the key steps.

Marker 2: All candidates provided good general discussions of NPD processes. Only a few provided an additional focus on the specific projects required for excellent marks.

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

QUESTION 2

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

- A) Discuss the factors that might change the perceived colour of an object. (5 x 1 mark)
- B) Describe, with the aid of an annotated diagram, the printing of a 2-colour screen printed sheet of corrugated board for use as a point-of-sale display. Start with the artwork approval and finish with acceptable quality sheets of board ready for despatch to the retailer. (10 marks)
- C) Short run, bespoke printed display boards for point of sale can also be printed by an alternative method. Identify a suitable process and comment on the advantages and disadvantages over screen printing. (5 marks)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand colour (perception). Understand screen printing process – ability to describe pictorially. Contrast and compare screen printing to other methods of print.

Marker 2: Part A – Answer should consider factors related to light sources, material surface, eyesight and the brain processing of the image. Part B – A description of a 2-colour screen print process including the manufacture of the plates from images to create open areas where the ink is transferred. The pushing of the ink through the screen in direct contact with the board. Drying of ink. Packing for despatch. Part C – Wide web digital printing could be used. The advantages and disadvantages of this process should be discussed for this application.

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

Marker 1: Generally, very good quality responses, showing clear understanding.

Marker 2: Most candidates provided reasonable answers. The main reasons for losing marks were candidates failing to demonstrate the depth of knowledge, rather than providing incorrect information.

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

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

- A) Describe a production line for packing sliced cooked meats, from the supply of packaging materials into the store to finished product ready to despatch to the customer. (14 x 1 mark)
- B) A key performance indicator for the packer filler is the overall operating efficiency (OEE). Discuss what OEE is (2 marks) and how it can be improved (4 marks).

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: General understanding of the flow of work in a manufacturing process. Knowledge of how efficiencies are measured and improved.

Marker 2: Part A – The answer requires a description of the packing line and associated operations. The main operations should be described in an appropriate sequence. On-line and off-line quality checks should be included. Part B – A definition of OEE and description of how it could be calculated should be included. A discussion of how OEE could be improved is required.

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

Marker 1: Good

Marker 2: Most candidates provided good answers. Some candidates failed to include quality checks in the description of the line. A few candidates included details which were inappropriate in an otherwise reasonable description of the line operations.

QUESTION 4

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

- A) Gravity, vacuum, or pressure can be used to fill liquids into containers. Describe these filling methods and discuss their relative merits. (3 x 3 marks)
- B) a) Describe the operation of a thermoform fill and seal machine, which is used to produce and pack single serving pots of milk for the catering market. (6 marks)
- b) What are the advantages and disadvantages of the above process compared to using bought in preformed pots? (5 x 1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Knowledge of, and comparison of, different filling methods. Knowledge of the key process methods of thermoform F/S machines. Advantages/Disadvantages FFS v. Preformed.
Marker 2: Part A – The description of the 3 filling systems should provide a general description of the process including details on how the level control can be achieved. The description should include a discussion of the limitations and benefits of the various process. Part B – a) A description of the thermoform fill seal equipment operation is expected including pot formulation, filling, sealing, and cutting from the base web. b) The relative merits of TFFS and use of pre-formed pots should be discussed. Issues could include space requirements, transport costs, hygiene, and quality control.

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

Marker 1: Mostly good. One student however didn't realise what thermoformed fill and seal was!
Marker 2: Most candidates provided reasonable answers but failed to include the level of detail to gain high marks. The methods for ensuring the fill height were often not considered in Part A and the methods used to thermoform the pots in Part B.

LEARNING OUTCOME 4: UNDERSTAND HOW QUALITY SYSTEMS IMPACT ON PACKAGING QUESTION 5

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

- A) Provide a definition of quality (2 marks) and discuss how it is useful for a packaging manufacturer (2 marks).
- B) a) Discuss, using examples, the cost of quality. (8 marks)
b) How does this cost of quality relate to the budget of the quality department? (2 marks)
- C) From a quality perspective, justify SIX items of information you would use in specifying a shelf-ready corrugated case. (6 x 1 mark)

Examiners Comments

1. Summary of what was expected in the answer

Marker 1: Understand quality and quality systems with regards to packaging use and manufacture. Describe the cost(s) of quality. Know how to specify key material components.
Marker 2: Part A – A definition of quality. Any common definition used in quality is acceptable. Part B - Quality costs commonly described as prevention, appraisal, and failure. These should be discussed with the aid of examples. How these costs relate to the Quality Dept. should be identified. Part C – A discussion of any 6 items is acceptable. The justification as to why they should be included.

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

Marker 1: Good scoring across almost all students.
Marker 2: Most candidates provided good answers. Marks were lost by just providing examples of costs without providing general discussions as well.