



PIABC LEVEL 5 DIPLOMA IN PACKAGING TECHNOLOGY
(Qualification No. 610/0740/7)

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

K/650/2134 UNIT 2 (PAPER B)

UNDERSTANDING PACKAGING MATERIALS AND COMPONENTS

INSTRUCTIONS TO CANDIDATES

Write your answers in the answer book provided.

Wherever possible, use diagrams to illustrate your answer.

This is a closed book examination.

100 marks are available in total for this examination.

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

Leave time at the end to check your answers.

This examination paper is worth 50% of the total marks for Unit 2

Examination Time: 2 Hours

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

SECTION 1

TWO QUESTIONS - 20 MARKS EACH

Question 1

A bottle of wine is labelled with a glue applied metalised paper label, which has been printed and embossed.

- A) Describe an appropriate paper for this application. (2 marks)
- B) Discuss the material properties to be considered when specifying, manufacturing and applying this label. (6 marks)
- C) Discuss the advantages and disadvantages of shrink sleeves compared to self-adhesive (pressure sensitive) paper labels. (12 marks)

Suggested Solution

- A) Material used:

The specialist wet glue papers are usually high-quality bleached kraft paper, 55-100 gsm. Recycled paper grades also available. Paper would be highly calendered and probably metallised, although a foil or metallic ink could be used instead

- B) Material properties to consider include:

- Surface smoothness - A smooth surface is required to achieve a good print finish which may then be foil blocked or embossed.
- Opacity
- Stiffness
- Porosity
- Water absorbency
- Wet strength
- Mould inhibitor
- Grain direction
- Degree of curl

- C) Advantages and disadvantages of shrink sleeves compared to PSL paper labels:

- The shrinksleeve covers the whole body but expensive
- Good for awkward shaped containers Will form to container contours and provide all round decoration
- Sleeves are usually reverse printed, so scuffing is minimised
- Difficult to emboss
- Specialised inks required (ability to shrink)
- Specialised print reprographics
- Proprietary and patented technologies
- Can be a UV barrier to the product
- Can enhance gas barrier
- Not water absorbent

PIABC Level 5 Diploma in Packaging Technology
Unit 2 (Paper B) – Understanding Packaging Materials and Components
Sample Examination Paper (with Suggested Solutions)

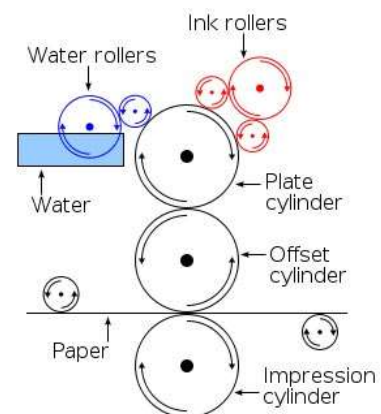
- Can incorporate tamper evident effect. Tamper evidence is via a single application
- Difficult to tear
- Not many suppliers so competition on price maybe harder to achieve
- Specialised equipment to shrink
- Orientation critical. Orientation usually in one major direction only
- Does not curl on application
- No waste to remove
- Shelf life of label- it can preshrink in storage
- Not from renewable resource
- No requirement to specify an adhesive
- Can be applied to a damp surface
- Tooling can be expensive

Question 2

- 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)
- B) Describe, with aid of diagram, the offset lithographic printing process for a 3-colour and varnished carton. (12 marks)

Suggested Solution

- A)
- 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.
 - Brightness - Degree of reflectance of a surface. Amount a surface reflects light will affect its brightness, bright vs dark. For example – surfaces reflect the three primary colours but not necessarily 100%. The surface which reflects the most will have the greater brightness.
 - Saturation - how strongly coloured the object is, for example how much ink has been applied
- B)
- The process colours are applied using dots.
 - The colours are mixed in various proportions to give the appearance of a different colour e.g. yellow / magenta = orange.
 - The number of dots per inch and dot shape and size (dots per cm) give variation in shade (depth of colour)
 - Colours laid down at different angles to prevent moire pattern
 - Key colour is black or another dark colour e.g. blue used for text, emphasises shadows and highlights in halftones and for line work.
- C)
- Sheet fed
 - High viscosity paste inks, oil based
 - Train of rollers to meter even amount of ink to plate
 - Planographic aluminium printing plate
 - Image areas are treated to attract oil and repel water
 - Non-image areas attract water and repel oil
 - Plate is dampened first, then inked
 - Inked plate transfers image to blanket
 - Image is transferred from blanket to substrate by an impression cylinder
 - Drying between ink stations, UV or IR
 - 3 colours plus a varnish requires 4 stations
 - Sheets stacked
 - Quality checks



SECTION 2

SIX QUESTIONS - 10 MARKS EACH

Question 3

- A) Describe how an effective closure is achieved for each of the following packs:
- A locking tuck flap carton (3 marks)
 - A flexible retortable pouch (3 marks)
- B) Identify TWO types of child resistance packaging and explain how child resistance is achieved.

Suggested Solution

A locking tuck flap carton: Used on paperboard cartons. Two small flaps will fold in from each side. Large flap from back will fold over to front completely closing opening. End of flap will tuck into carton and will be held in place by friction. An additional locking tongue can pass through the closing flap to prevent reopening. Can be a tamper evident device which is damaged on removal. Closure achieved by folding in flap in correct order.

A flexible retortable pouch: Heat seal. The inner material needs to be a thermoplastic e.g. PP which needs to be heated to a temperature beyond the retorted temperature (e.g. 130-135) so that pouch will remain sealed. Outer layer should have a higher melting point to retain integrity while inner is sealed. Once the melted plastic has welded together it is cooled to achieve seal strength. Achieved by applying direct heat to the seal area while holding it closed with pressure for the required time.

Child resistant closures include:

- Push and turn closure - Inner cap operates as standard screw closure. Outer shell only engages with the inner when depressed. User needs to push down and then turn to open closure.
- Squeeze and turn screw cap closure - Flexible plastic cap, usually PP, is squeezed on opposite sides which releases the cap lugs from locking stops on the neck of the bottle. User must then turn to release. Both require two unrelated actions to be conducted together which children find difficult to coordinate, however, adults find relatively easy.
- Blister Pack - Blister packs have foil-based lid film which is of sufficient thickness and temper. The foil will deform before puncturing. Contents must be pushed through from the back of the pack. Children do not apply this lateral thinking and therefore find accessing contents difficult.
- Flip top with tamper band - Child resistant flip top closures - Have a tamper evident mechanism to be removed, often with a band which is attached to both the container and the bottle. Closure needs to be rotated until indicator arrows align to permit opening of the container. Requires hand/eye co-ordination to open container.

Question 4

- A) Describe, with the use of an example, the Diffusion theory of adhesion. (2 marks)
- B) Define Open Time describe its importance to packaging adhesives. (2 marks)
- C) Describe the characteristics of a Starch adhesive. (2 marks). Explain how these characteristics influence the application to a substrate. (2 marks). Give an example of the use of the adhesive type and explain why it is suitable. (2 marks)

Suggested Solution

Diffusion Theory

Molecular diffusion between two surfaces. Surfaces can merge and produce a bond e.g. Two polymers above Tg polymer molecules can migrate between surfaces or solvent welding uses solvent to loosen polymer chains and encourage diffusion. Polymer hardens as solvent evaporates.

Open Time

Is the time window from application of the adhesive for which the adhesive will have sufficient tack to provide form an effective seal. If the open time is too short the materials to be stuck may not be able to be brought into contact with the adhesive quickly enough to form effective seal, if too long the bond may move before adhesive has set.

Starch Adhesive

Characteristic

- Generally low solids content,
- Flows readily, thus easy to apply via simple roller systems.
- Requires heat to evaporate off liquid, i.e. long heated section on corrugated machine.

Influence on application method

- High volume of liquid adhesive required, thus need constant availability, i.e. often made to order on site in starch kitchen.
- Gelatinises very rapidly to give high initial bond.
- Substrates firmly held together, thus easy to transport through machine at high speed (over bridge of corrugator).
- Readily supports micro-organism growth, therefore, need to keep application area clean.

Examples and Suitability

- Corrugated board making, tube-winding, paper sack making.
- Low cost. Readily penetrates paper surface. Biodegrades with substrate. Only appropriate if usage environment is dry.

Question 5

- A) Describe SIX common printing defects. (6 marks)
- B) Briefly describe TWO methods of transferring ink to a substrate using digital printing techniques. (2 x 2 marks)

Suggested Solution

Printing defects – description required:

- Colour variation
- Hickies
- Misregistering
- Scumming
- Bleeding
- Feathering
- Ghosting
- Screen clash
- Dot gain
- Poor print adhesion (rub resistance)

Transferring ink to a substrate using digital printing techniques:

- Xerography/Laser
Toner transferred to charged areas of drum, charge developed by laser. Toner transferred to paper, heated to fix image.
- Continuous inkjet
Piezo electric crystal pulses out drops of ink. Ink directed by voltage to gutter and recycling or to form image.
- Drop on demand.
Piezo electric cell activates to pulse out droplet as require. Ink cell is heated to cause vapour which expands to eject droplet as required.

Question 6

- A) For the following packs discuss a suitable label type, substrate and method of application. A different label type must be used. (2 x 3 marks)
- Tub containing a fatty spread (e.g. margarine)
 - Can of food
- C) Briefly describe two tests that can be used to evaluate the performance of printed labels as part of the development process. (2 x 2 marks)

Suggested Solution

- Tub containing a fatty spread (e.g. margarine) - Polymer based In Mould label. Can provide excellent coverage of tub and can decorate around corners. Not easily removed. Can be recycled with tub. Needs to be applied in tub manufacturer.
- Can of food – Wrap around paper label. One end secured to can with adhesive, wrapped around and other end secured to label.

Test methods include – description required:

- Product resistance of label material and print
- Print adhesion
- Rub/scuff resistance
- Adhesion of label to required substrate
- Surface slip – important for application
- Colour fastness – fading
- Paper label porosity

Question 7

A hot melt adhesive is used to secure the end flaps of a printed high gloss corrugated carton. There are reports of the flaps opening. Returned samples show that all of the adhesive is on one flap and that it has peeled cleanly off the other flap.

Fully discuss the possible reasons for this failure and suggest possible solutions. (10 marks)

Suggested Solution

Possible reasons include:

- Failure is an adhesive failure between flap and adhesive. Adhesive has been able to adhere to the flap.
- Adhesive may have been applied too cool: Check temperature control
- Environmental conditions may have cooled adhesive excessively: Monitor conditions. Check adhesive performance under different conditions.
- Flap may not be closed quickly enough. Measure open time and check performance at different open times.
- Check adequate pressure applied to the joint.
- Check flaps are held securely closed long enough for adhesive to set.
- Adhesive may have trouble sticking to flap, Remove print/varnish in adhesive area.
- Perforate seal area to provide more mechanical key
- Adhesive must be placed on the right place on the flap
- Quantity of adhesive used.

Question 8

Describe, with the aid of a diagram, how aluminium can be combined with paper to form a flexible packaging material by:

- Wet bond lamination (5 marks)
- Vacuum metallisation (5 marks)

Your answer should include a reference to the thickness of the aluminium in both processes and an explanation of why a vacuum is required in the metallisation process.

Suggested Solution

- Wet Bond Lamination – Both are reel fed materials. The aluminium foil, with a calliper of between 6-10 microns, is unwound and coated with a wet adhesive. The highly calendared smooth paper is unwound and the materials are pressed together in nip rollers. The joined materials are passed through a drying oven to dry the adhesive by evaporation through the paper layer. (Important to note that one material must be porous). Material is re-wound.
- Vacuum metallisation – the reel fed highly calendared smooth paper and aluminium wire are placed in a vacuum chamber. A vacuum is applied. The aluminium wire is chopped into small parts and placed in a ceramic boat which is heated to melt the aluminium which will then evaporate in the absence of oxygen. The reel of paper is unwound and passed over a chilled roller over the shutter. The shutter controls the amount of aluminium vapour condensing on the paper along with the speed of exposed paper. The thickness of aluminium is measured in angstroms before the metallised paper is rewound.

END OF EXAMINATION PAPER