1.2 Timber and manufactured boards

AQA 8552 · Calculator allowed · about 50 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions.

1 A permanent right-angle corner in a timber storage frame needs to withstand a 250 N test load. The making time limit per corner is 12 minutes. Trials using the actual frame material and the same adhesive give: plain butt joint, 180 N and 6 minutes; dowelled butt joint, 280 N and 9 minutes; mortise and tenon joint, 360 N and 18 minutes. Select a joint using both limits and explain why each other option fails a limit. State one assembly control for the selected joint and explain its purpose.

(Total for Question 1 is 4 marks)

2 A timber tray for indoor use must retain visible grain and withstand occasional water splashes. These are the supplied finish trials on its timber: finish O, oil, leaves grain visible but fails the splash test; finish V, clear varnish, leaves grain visible and passes the splash test after full curing; finish P, opaque paint, hides the grain and passes the splash test after full curing. All three cost £3 per tray and all curing times fit the schedule. Choose a finish and explain why each other finish is unsuitable. Describe one preparation step before applying the chosen finish and explain its purpose.

(Total for Question 2 is 4 marks)

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3 A small outdoor storage box has the following fictional specification: total material, joint and finish cost at most £38; thickness increase in the workshop damp-cycle test at most 1.0 mm; joints must allow dismantling for repair; opaque colour is acceptable. Three panel kits, each large enough for the box, were tested after applying finish F as instructed: kit P, exterior plywood, £24, thickness increase 0.6 mm; kit I, interior MDF, £15, thickness increase 3.2 mm; kit T, solid timber, £28, thickness increase 0.8 mm. These figures apply only to these kits and this test. Two joint systems fit all kits and pass the box load test: screws into replaceable blocks, £6, removable; permanently bonded joints, £3, cannot be dismantled. Finish F is exterior paint, £6 per box, with trial evidence of rain protection when all faces and edges are coated and the coating is inspected and repaired annually. Finish G is an interior clear coating, £4 per box, with no suitability for outdoor rain exposure. Choose a panel kit, joint system and finish. Calculate the total cost, explain why each other panel kit fails a requirement with the suitable joint and finish, and justify the joint and finish choices. Include the maintenance needed for the finish.

(Total for Question 3 is 6 marks)

4 A straight timber handle is 240 mm long. It will be pulled along its length. In this question, grain direction means the main direction of the wood fibres. Identical samples from the available batch failed at 820 N when pulled parallel to the grain and at 190 N when pulled across the grain. Explain how the grain should run in the handle, using the data, and give one reason for rejecting a blank with a large knot near the middle.

(Total for Question 4 is 3 marks)

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5 A timber panel measures 250 mm across the grain and 600 mm along the grain before drying. For this batch and drying cycle, the workshop predicts shrinkage of 2.0% across the grain and 0.1% along the grain. Calculate the final width across the grain and the final length along the grain. Treat each percentage as a reduction from the original dimension.

(Total for Question 5 is 4 marks)

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6 The workshop uses moisture content (%) = ((wet mass - oven-dry mass) / oven-dry mass) x 100. A small offcut from a batch has a wet mass of 560 g and an oven-dry mass of 500 g. The indoor cabinet specification requires a batch moisture content from 8% to 10%, inclusive, before final sizing. Assume this offcut represents the batch. Calculate its moisture content, decide whether it meets the specification, and explain one suitable action before final sizing.

(Total for Question 6 is 4 marks)

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7 An indoor shelf has a maximum permitted deflection of 5 mm under its specified load and a material budget of £16. Three finished shelf samples have identical dimensions and supports. All other requirements are met. Sample C (chipboard): deflection 8 mm, cost £8. Sample M (MDF): deflection 4 mm, cost £10. Sample P (plywood): deflection 2 mm, cost £15. Select the cheapest sample that meets both limits. Justify your choice, explain why the cheapest sample overall is rejected, and calculate the saving compared with the other compliant sample.

(Total for Question 7 is 5 marks)

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8 A maker needs eight timber rails, each 580 mm long. Stock is sold only in 2400 mm lengths at £18 per length. Each rail needs one saw cut that consumes 3 mm of stock, so count 583 mm per rail. No end trimming or joining of offcuts is permitted. Calculate the maximum number of rails from one stock length and the minimum total purchase cost for eight rails. Show how you deal with whole rails and whole stock lengths.

(Total for Question 8 is 4 marks)

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9 A solid timber panel is 300 mm wide across the grain when fitted into grooves in a rigid frame. The maximum space for its width, measured between the bottoms of opposite grooves, is 305 mm. The panel is expected to expand by 1.5% of its original width in damp conditions; assume the 305 mm space stays unchanged. Calculate the expanded panel width. Propose how to retain the panel in the grooves while allowing this movement, and explain a risk of gluing all four panel edges rigidly to the frame.

(Total for Question 9 is 4 marks)

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Mark scheme · 1.2 Timber and manufactured boards

Question 1

Select dowelled butt joint and relate it to both limits: 280 N ≥ 250 N and 9 ≤ 12 minutes. **B1**

Reject plain butt joint because its 180 N failure load is below 250 N. **B1**

Reject mortise and tenon because 18 minutes exceeds 12 minutes, even though its load result passes. **B1**

One appropriate assembly control with purpose: dowelling jig/accurate marking for matching holes; dry assembly to check fit before glue; or clamp/check diagonals/use a square to hold the corner square during curing. Accept another valid control linked to its purpose. Do not credit a named tool alone. **B1**

Answer: Choose the dowelled butt joint: 280 N exceeds 250 N and 9 minutes is within 12 minutes. The plain butt joint fails the load requirement (180 N). The mortise and tenon fails the time limit (18 minutes). Use a dowelling jig to align matching holes so the dowels and faces fit accurately; a suitable alternative is to clamp square during adhesive curing.

Question 2

Choose V/clear varnish, linked to both visible grain and passing the splash test after curing. **B1**

Reject O/oil because it fails the stated splash test. **B1**

Reject P/opaque paint because it hides the grain. **B1**

One suitable preparation step with purpose: sand with the grain to reduce visible cross-grain scratches; remove dust for a clean coating; or ensure timber is dry and clean for adhesion. Accept another sound surface preparation step linked to finish quality. No credit for an unsupported cost advantage. **B1**

Answer: Choose V/clear varnish, which retains visible grain and passes the splash test after curing. Reject O because it fails the splash test; reject P because it hides the grain. Sand with the grain and remove dust to obtain a clean, smooth surface without trapped dust or conspicuous scratches.

Question 3

Select P/exterior plywood and explain that I/interior MDF fails the damp-cycle requirement (3.2 mm > 1.0 mm); P passes at 0.6 mm. The cheaper kit I must not be accepted on cost alone. **B1**

Method for total cost of selected system: kit cost + £6 for removable screw system + £6 for exterior finish. Allow follow-through for a different selected kit. **M1**

£36 total for P with screws and F, within £38. **A1**

Reject T because £28 + £6 + £6 = £40, exceeding £38. Accept equivalent comparison showing it is £2 over budget. **B1**

Screws into replaceable blocks allow dismantling/repair, while permanent bonding fails this requirement. **B1**

Finish F has evidence for rain exposure; G is unsuitable for outdoor rain. State coating all faces and edges plus annual inspection and repair to maintain protection. Accept equivalent wording describing the complete specified finishing and maintenance system. **B1**

Answer: Choose P, screws into replaceable blocks and finish F. Total = £24 + £6 + £6 = £36, within £38. P also meets the thickness increase limit (0.6 mm ≤ 1.0 mm). I fails the damp-cycle limit because 3.2 mm > 1.0 mm. T would cost £28 + £6 + £6 = £40, exceeding £38. Screws permit dismantling for repair; permanently bonded joints do not. Finish F is supported for rain exposure, unlike G: coat all faces and edges and inspect/repair the coating annually.

Question 4

Grain/fibres running along the length of the handle, parallel to the pull. **B1**

Links this orientation to the higher measured failure load: 820 N rather than 190 N. Accept the equivalent comparison without both figures. **B1**

Large knot interrupts/deflects fibres or creates local weakness, linked to increased splitting or failure risk. Accept a loose knot could fall out and leave a weakened section. Do not accept that every knot always causes failure. **B1**

Answer: Run the grain along the 240 mm length. The supplied batch withstood 820 N parallel to the grain compared with 190 N across it. A large knot can interrupt or deflect the grain, creating a weak area where the handle may split or fail.

Question 5

Method for width: 250 x (1 - 2.0/100), or finds 5 mm reduction then subtracts from 250. **M1**

Final width 245 mm, with unit. Accept 245.0 mm. **A1**

Method for length: 600 x (1 - 0.1/100), or finds 0.6 mm reduction then subtracts from 600. **M1**

Final length 599.4 mm, with unit. **A1**

Answer: Width = 250 - (250 x 2.0 / 100) = 245 mm. Length = 600 - (600 x 0.1 / 100) = 599.4 mm.

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Question 6

Method: (560 - 500)/500 x 100. Accept 60/500 x 100.	**M1**
12%, with percentage unit.	**A1**
Does not meet specification because 12% is above the 10% maximum.	**B1**
Continue controlled drying/conditioning and recheck before final sizing, linked to reaching the specified moisture range or reducing subsequent shrinkage/fit problems. Accept delay final sizing while the batch dries and monitor moisture. Do not accept merely oven-dry the whole batch to 0%.	**B1**

Answer: Moisture content = ((560 - 500)/500) x 100 = 12%. The batch is above the 10% maximum. Continue controlled drying/conditioning and recheck until within 8-10% before final sizing, reducing the risk of later shrinkage affecting the fit.

Question 7

Select M/MDF as the cheapest compliant sample.	**B1**
Justifies compliance using both 4 mm ≤ 5 mm and £10 ≤ £16; accept equivalent words.	**B1**
Reject C/chipboard because its 8 mm deflection exceeds 5 mm, despite the lower price.	**B1**
Method for saving between the two compliant samples: £15 - £10.	**M1**
£5 saving. Accept a correct standalone £5 for this accuracy mark; do not require the words saving.	**A1**

Answer: Choose M. Its 4 mm deflection is within 5 mm and its £10 cost is within £16. Reject C because 8 mm exceeds 5 mm. P also complies, but M saves £15 - £10 = £5.

Question 8

Method: divides 2400 by (580 + 3), or compares multiples of 583 with 2400.	**M1**
Four complete rails per length; rounds down or shows 2332 ≤ 2400 < 2915.	**A1**
Method for cost: number of lengths = ceiling(8/4) = 2, then 2 x £18. Allow follow-through from a positive whole-number yield if whole stock lengths are rounded up correctly.	**M1**
£36 minimum total purchase cost.	**A1**

Answer: 2400/583 = 4.1166..., so four complete rails fit in one length (4 x 583 = 2332 mm; five need 2915 mm). Eight rails need 8/4 = 2 stock lengths. Total purchase cost = 2 x £18 = £36.

Question 9

Method: 300 + (300 x 1.5/100), or 300 x 1.015.	**M1**
304.5 mm expanded width, with unit.	**A1**
A floating panel retained in grooves, with expansion clearance and edges free of glue. Accept an equivalent arrangement using retaining beads and clearance if it still securely retains the panel and permits sideways movement.	**B1**
Rigid edge gluing restrains expansion, causing stress that could split/buckle the panel or open frame joints. Accept any valid linked failure mechanism; do not credit merely saying water dissolves glue.	**B1**

Answer: Expanded width = 300 x 1.015 = 304.5 mm, which fits within the 305 mm space between groove bottoms. Retain the panel in grooves with sufficient expansion clearance and without gluing its edges to the frame, so it can float. Rigid edge gluing could restrain expansion and split/buckle the panel or force frame joints apart.

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