1.10 Tolerances and Quality Control: 30-minute Pack

AQA 8552 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Show working for calculations. Unless stated otherwise, all stated tolerance limits are inclusive. Use the units given and distinguish a result for an inspected sample from a claim about every unit. Credit equivalent valid calculation methods and justified inspection or process improvements; award each distinct achievement only once.

1 A batch of 200 birch-plywood panels has a width specification of 300 mm ± 1 mm, inclusive. A stratified sample of 20 panels from different positions in the batch gives the measurements below. State the acceptable range, calculate the sample defective percentage and recommend a next inspection step justified by this evidence and its limits.

Measured width (mm)	Number of sampled panels
298	1
299	4
300	10
301	4
302	1

(Total for Question 1 is 4 marks)

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2 A small workshop finds that laser-cut acrylic covers sometimes exceed a 100.0 mm ± 0.5 mm width limit (inclusive). Records show the errors cluster on one machine after its lens is changed. Propose a justified process improvement and a way to check whether it works, including how to treat boundary measurements.

(Total for Question 2 is 4 marks)

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3 A plywood jig plate must be 120 mm ± 1 mm wide, inclusive. A measurement is 121 mm. Is it acceptable? Explain using the boundary rule.

(Total for Question 3 is 2 marks)

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4 A turned brass bush has an outside diameter of 14.0 mm ± 0.2 mm and an inside diameter of 10.0 mm ± 0.1 mm. Both limits are included. Find the minimum and maximum wall thickness, assuming concentric diameters.

(Total for Question 4 is 3 marks)

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5 A 0.75 m steel rail is specified as 750 mm ± 2 mm, inclusive. Convert both acceptable limits into metres.

(Total for Question 5 is 2 marks)

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6 A plastic latch opening is specified as 32.0 mm ± 0.4 mm, inclusive. The table records four inspected openings. Calculate the proportion of these four that are defective, as a percentage.

Latch	Measured opening width (mm)
A	31.6
B	31.7
C	32.4
D	32.5

(Total for Question 6 is 3 marks)

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7 A batch of 40 recycled-plastic spacers is measured against a 5.0 mm ± 0.2 mm thickness specification, inclusive. The table summarises all measurements in this batch. Calculate the defective proportion as a fraction and percentage, and state one limitation when applying this result to future production.

Measured thickness (mm)	Number of spacers
4.7	2
4.8	7
5.0	20
5.2	8
5.3	3

(Total for Question 7 is 3 marks)

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8 A laser-cut bracket has a 24.0 mm ± 0.2 mm slot, with both limits included. A mating tab is 23.3 mm wide. Calculate the minimum and maximum clearance and decide whether the fit is guaranteed to have clearance throughout the allowed slot range. Treat the tab width as fixed and clearance as slot width minus tab width.

(Total for Question 8 is 3 marks)

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Mark scheme · 1.10 Tolerances and Quality Control: 30-minute Pack

Question 1

acceptable interval is 299 mm to 301 mm inclusive **B1**

1 + 1 = 2 defective sampled panels; 2 / 20 x 100 = 10% defective in the sample **M1**

recommend inspecting more panels from across the batch, or every remaining panel, using a calibrated gauge; credit an equivalent suitable inspection step **B1**

justify further inspection because the sample contains defects and the uninspected panels may also contain defects; the sample does not establish the exact defective total among all 200 panels **B1**

Answer: 299 mm to 301 mm inclusive; 10% of the sample was defective. Inspect the remaining panels with a calibrated gauge because defects were found and the sample cannot establish how many of the uninspected panels conform.

Question 2

check and reset focus/alignment after lens changes, or verify and correct the cutting setup using a first-off piece, because errors cluster after that event; credit an equivalent improvement linked to the evidence **B1**

use a calibrated instrument to accept widths from 99.5 mm to 100.5 mm inclusive, including both boundary values **B1**

record measurements from repeated production runs or a suitable sample before and after the change **B1**

compare before/after defective proportions against the inclusive limits to assess improvement and investigate any out-of-range result; samples indicate performance but do not prove every unit conforms **B1**

Answer: Check and reset focus/alignment after lens changes because errors cluster then. Inspect first-off pieces and compare defective proportions from repeated runs before and after the change, accepting 99.5 mm to 100.5 mm inclusive. Investigate failures; samples do not prove every unit conforms.

Question 3

upper limit is 120 + 1 = 121 mm **B1**

yes, it is acceptable because the stated boundary is included **B1**

Answer: Yes. 121 mm is the included upper limit.

Question 4

minimum wall = (minimum outside - maximum inside) / 2 **M1**

(13.8 - 10.1) / 2 = 1.85 mm **A1**

maximum wall = (14.2 - 9.9) / 2 = 2.15 mm **A1**

Answer: Minimum 1.85 mm; maximum 2.15 mm

Question 5

limits are 748 mm and 752 mm **M1**

divide by 1000: 0.748 m and 0.752 m **A1**

Answer: 0.748 m to 0.752 m inclusive

Question 6

acceptable interval is 31.6 mm to 32.4 mm inclusive **B1**

31.6, 31.7 and 32.4 mm conform; 32.5 mm fails, so 1 of 4 is defective **M1**

1 / 4 x 100 = 25% **A1**

Answer: 25% defective

Question 7

inclusive limits are 4.8 mm and 5.2 mm; 2 + 3 = 5 defective spacers, so defective fraction = 5 / 40 = 1 / 8 (or an equivalent fraction) **M1**

1 / 8 x 100 = 12.5% **A1**

the result describes this inspected batch only; it does not prove every uninspected spacer conforms **B1**

Answer: 1/8, or 12.5%; this batch result does not establish conformity of every unit

Question 8

slot limits are 23.8 mm and 24.2 mm **M1**

clearance = slot width - tab width: 23.8 - 23.3 = 0.5 mm; 24.2 - 23.3 = 0.9 mm **M1**

yes, clearance is guaranteed; the minimum is positive at 0.5 mm **A1**

Answer: Minimum clearance 0.5 mm, maximum 0.9 mm; clearance is guaranteed

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