

Pearson BTEC Level 1/Level 2 Tech Award

Supervised Window:

Monday 3 February 2020 – Thursday 6 February 2020

Supervised hours: 2 hours

Paper Reference **21141K**

Engineering

Component 3: Responding to an Engineering Brief

Set Task: Part 1

Instructions for teachers

Instructions

- **Part 1** of the set task is out of 30 marks.
- This *Instructions for teachers* booklet is specific to each series and this material must **not** be issued to learners.
- The set task should be undertaken by learners in the period timetabled by Pearson.
- The practical demonstration, carried out by the teacher, must take place immediately before the start of the supervised session and does not make up part of the two supervised hours.

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Instruction for teachers

Part 1 Set task

Part 1 of the set task requires learners to carry out a practical activity and then complete a task and answer booklet. This must be completed in the assessment period timetabled by Pearson.

The teacher instructions provided in this booklet give information on the process for the practical activity. It is the responsibility of centres to resource and trial the practical activity before it is undertaken by learners in the supervised period.

The teacher instructions will be available for secure download from the Pearson website four weeks prior to the start of the assessment period and these must be kept securely at all times.

Practical activity

Learners must not see the teacher instructions. A separate task and answer booklet will be available for learners at the beginning of the supervised period. The set task brief provides all the necessary information for learners to conduct the practical activity and includes a table for learners to record their results and observations.

Centres will be required to supervise learners when they carry out the practical activity. However, teachers cannot provide guidance during this supervised period. Activity 1a should take approximately one hour. Activity 1b, Activity 1c and Activity 1d should also take approximately one hour.

Learners **must complete the activity independently** and record their results and observations independently. They must do this in the task and answer booklet provided. Learners will need to refer to their results and observations obtained when carrying out activities.

Learners must observe safe practice when carrying out practical activities. It is the responsibility of centres to carry out risk assessments for all practical activities.

Preparation of practical activity

Instructions for the preparation of the practical activity and the equipment needed will be provided for each assessment. Items should only be assembled by the teacher where this is specifically stated in these instructions.

Practical activity preparation and set up

The scenario is about an organisation that designs structural steel frameworks. This practical activity is in two parts.

You are required to carry out a demonstration using the instructions below for learners to observe. Your demonstration must ensure that learners are aware of the appropriate health and safety procedures for this practical activity. You should remind learners that they should make notes during the set up and demonstration.

You are required to fully test each aspect of the practical activity to ensure that the chosen equipment provides valid results for your learners. You should ensure that, when a single ruler is used, it deflects approximately 45° at maximum deflection without showing any signs of stress/fracture.

This is a practical activity to measure the angle of deflection caused by a mass at different distances from a support.

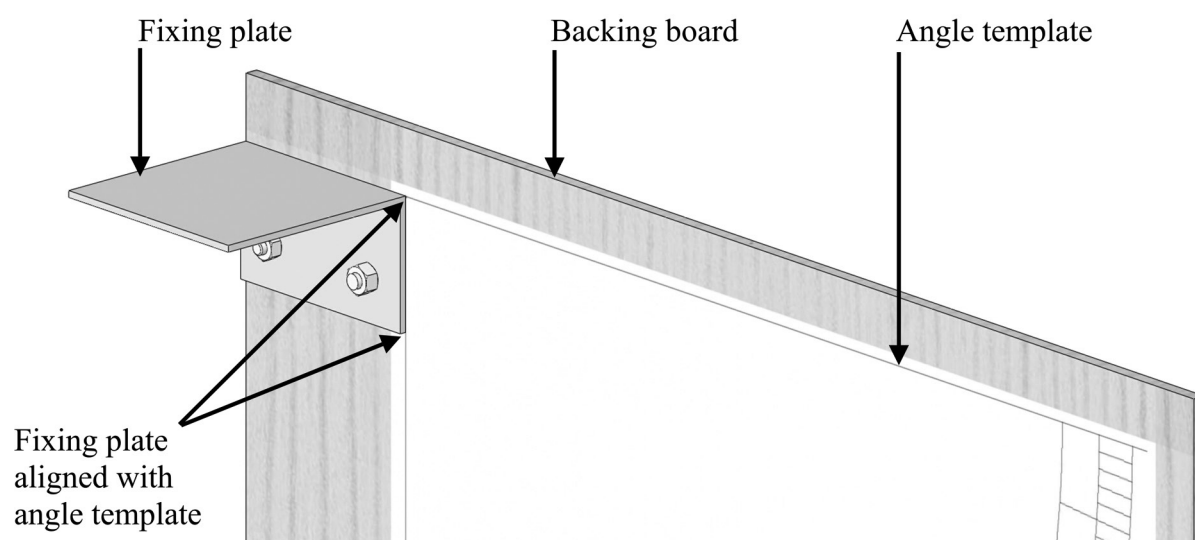
List of equipment

- Shatter resistant 300 mm plastic rulers (two rulers per learner).
- A flat rigid backing board, e.g. a piece of MDF, hardboard or plywood. This should be approximately A3 in size and at least 3 mm thick.
- A method of holding the rigid backing board vertically, e.g. supports, engineer's vice.
- A fixing plate and appropriate method of attaching it to the rigid backing board.
- A method of holding the ruler(s) to the top of the fixing plate, e.g. G clamp, paper binder clip.
- Angle template (located at the end of this booklet).
- A mass and hanger (approximately 100 grams) that will cause a single ruler to bend to approximately 45° when the mass is at the maximum distance from the support.
- A method of suspending the hanger from the ruler, e.g. string, cable tie
- A method of preventing the mass and hanger from sliding (e.g. paper binder clip, Blu-Tack®).

Instructions for preparing the backing board

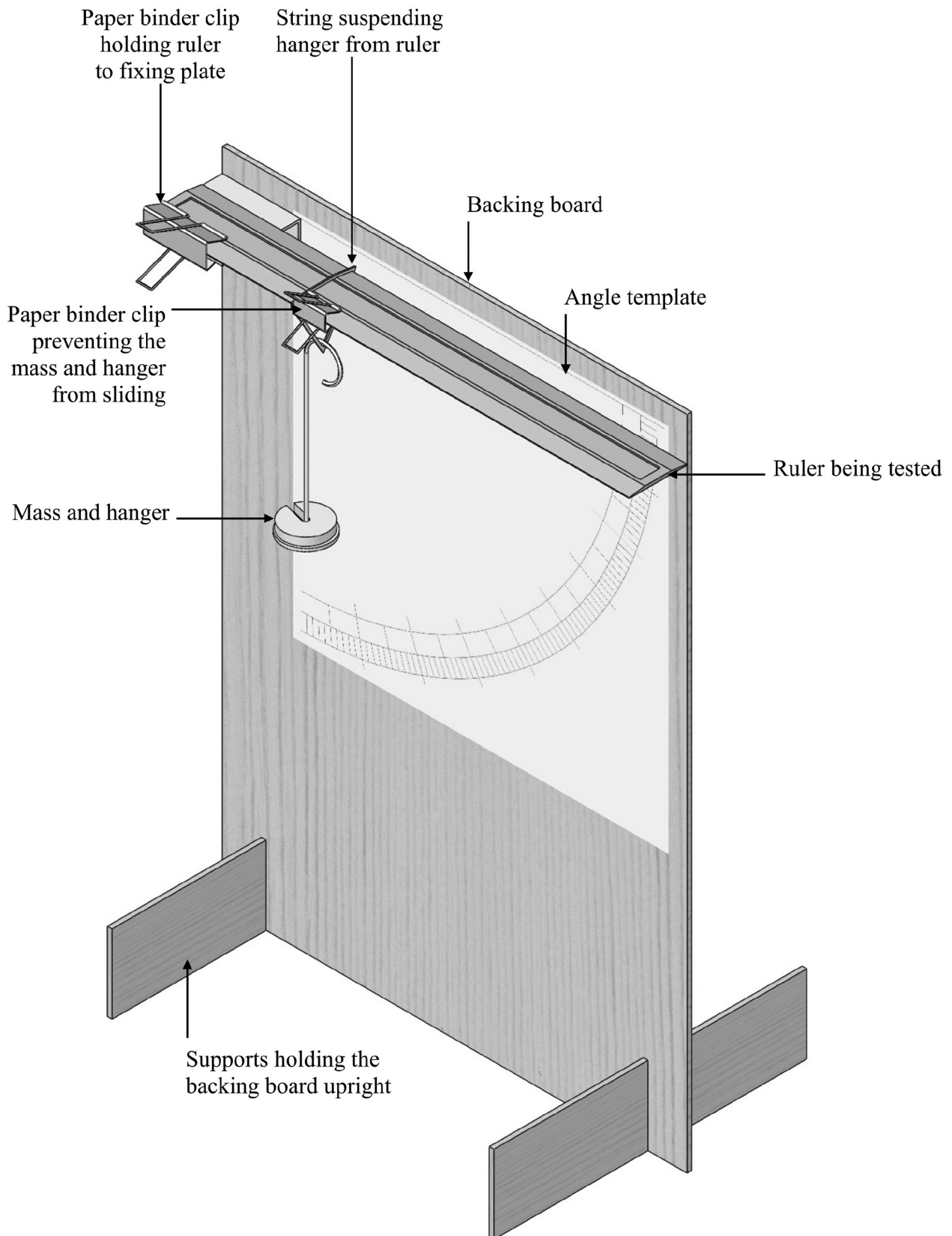
The angle template should be reproduced, using A4 paper (without scaling).

This template should then be attached securely to the backing board, as shown below. The top surface of the fixing plate should be aligned horizontally with the angle template as shown below.



Instructions for setting up the equipment

- Attach one ruler to the fixing plate, for example using the method shown below.
- Place the suspended mass and hanger over the end of the ruler.

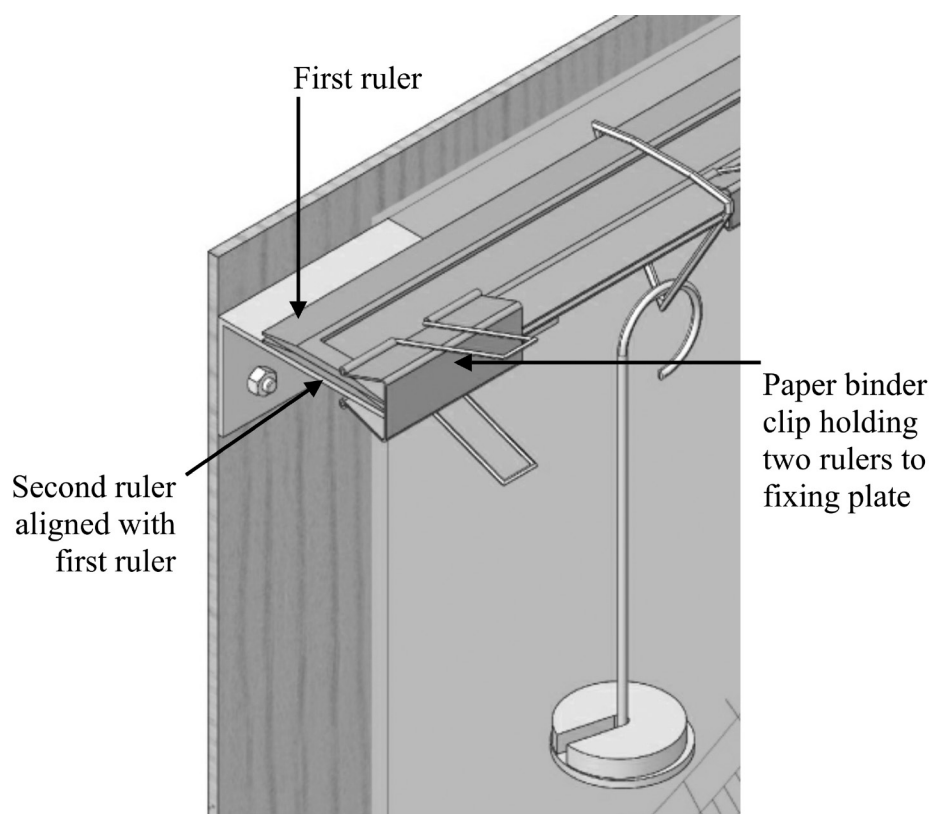


Instructions for demonstrating the first part of the practical activity

1. Slide the mass and hanger along the ruler to a suitable suspension point near the fixing plate.
2. Attach the method of preventing the mass and hanger from sliding.
3. Measure the distance from the right-hand edge of the fixing plate to the mass and hanger suspension point.
4. Record this distance.
5. Measure the angle of deflection of the ruler using the angle template.
6. Record the angle of deflection.
7. Remove the method of preventing the mass and hanger from sliding.
8. Move the mass and hanger to a new suspension point.
9. Repeat steps 2 to 8 as many times as required.
10. Repeat if necessary, to allow all learners to view.

Instructions for modifying the equipment

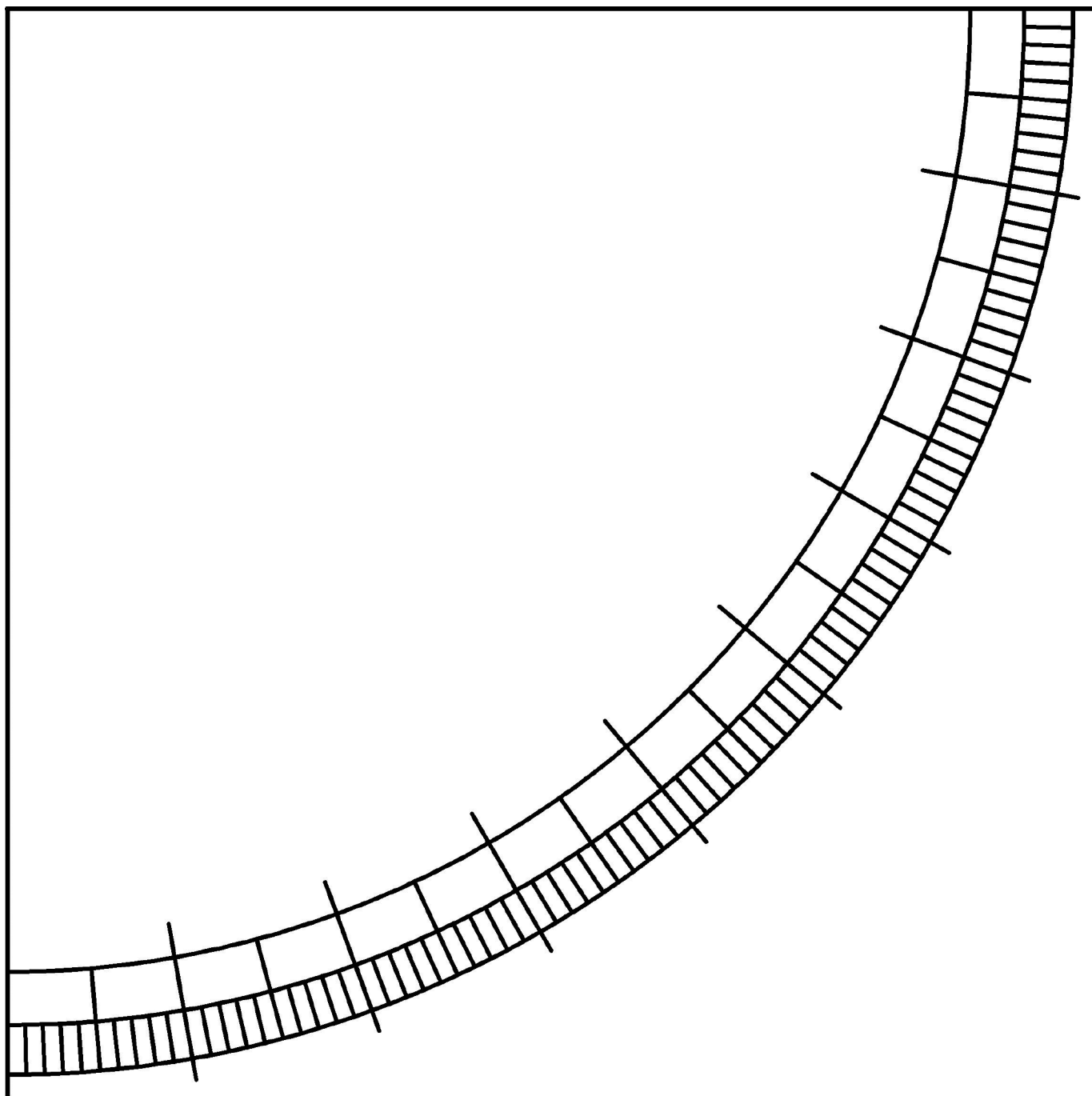
- Carefully remove the method of preventing the mass and hanger from sliding.
- Carefully remove the mass and hanger.
- Remove the method of fixing the ruler to the fixing plate.
- Align the end of the second ruler with that of the first ruler.
- Attach the two rulers to the top of the fixing plate, making sure this is in the same position as previously used.



Instructions for demonstrating the second part of the practical activity

1. Slide the mass and hanger along the rulers to a suitable suspension point near the fixing plate.
2. Attach the method of preventing the mass and hanger from sliding.
3. Measure the distance from the right-hand edge of the fixing plate to the mass and hanger suspension point.
4. Record this distance.
5. Measure the angle of deflection of the rulers using the angle template.
6. Record the angle of deflection.
7. Remove the method of preventing the mass and hanger from sliding.
8. Move the mass and hanger to a new suspension point.
9. Repeat steps 2 to 8 as many times as required.
10. Repeat if necessary, to allow all learners to view.

Angle template



Please check the examination details below before entering your candidate information

Candidate surname					Other names					
Pearson BTEC Level 1/Level 2 Tech Award	Centre Number					Learner Registration Number				
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Monday 3 February 2020 – Thursday 6 February 2020										
Supervised hours: 2 hours					Paper Reference 21141K					
Engineering Component 3: Responding to an Engineering Brief Set Task: Part 1 Task and Answer Booklet										
You must have: HB or B pencil, eraser, drawing instruments and calculator								Total Marks		

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** activities.
- Answer the activities in the spaces provided
– *there may be more space than you need.*
- This is **Part 1** of the set task.
- This task and answer booklet contains material for the completion of **Part 1** of the set task under supervised conditions.
- **Part 1** of the set task is out of 30 marks.
- This task and answer booklet is specific to each series and this material must be issued only to learners who have been entered to take the task in the specified series. This booklet should be kept securely until the start of the 2 hours supervised assessment period.
- This set task should be undertaken in the period timetabled by Pearson.

Information

- The total mark for this paper is 60.
- The marks for **each** activity are shown in brackets
– *use this as a guide as to how much time to spend on each activity.*

Advice

- Read each activity carefully before you start to answer it.
- Try to answer every activity.
- Check your answers if you have time at the end.

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Instructions for teachers

This assessment is made up of two parts. **Part 1** consists of a practical activity.

Both parts of the set task are completed during a one-week period timetabled by Pearson. **Part 1** is to be completed in one session of two hours within the first four days of the timetabled period. **Part 2** is to be completed in one session on the Friday of the timetabled period.

The practical activity requires a demonstration by the teacher. This should be carried out immediately before the start of the supervised session and does not make up part of the two supervised hours. Learners are allowed to make notes up to a maximum of two sides of A4 during this demonstration, which they may use when they carry out the set task.

These notes **do not** form part of the final submission.

The learners' practical activity is undertaken in the supervised hours given. Learners will need access to the materials as listed in the *Instructions for teachers* booklet.

Learners must then complete the activity using this task and answer booklet. Learners should take calculators into the supervised session.

This is a formal external assessment and must be conducted with reference to the instructions in this task and answer booklet, and the *Information for Conducting External Assessments (ICEA)* document, to ensure that the supervised session is conducted correctly and that learners have the opportunity to carry out the required activities independently.

Teachers are responsible for maintaining security and for reporting issues to Pearson.

In particular:

- only permitted materials can be brought into the supervised environment
- materials must be kept securely and no items removed from the supervised environment
- learners must not have access to computers or the internet.

After the session, the teacher will confirm that all learner work has been completed independently as part of the authentication submitted to Pearson.

Outcomes for submission

Part 1 task and answer booklet should be kept securely and submitted with the **Part 2** task and answer booklet.

Each learner must complete an authentication sheet. Practical activity notes from the demonstration will be retained securely by the centre after the completion of **Part 2** and may be requested by Pearson if there is suspected malpractice.

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Instructions for learners

Before the practical activity begins you will have a demonstration by your teacher. Observe the demonstration carefully in order to complete the practical activity. You should take notes, maximum of two sides of A4, and refer to your notes to complete the practical activity, as given in the set task information.

Check that this equipment has been provided for you:

- an assembled cantilever test rig
- one additional ruler.

Read the set task information carefully.

You must plan your time and submit all the required evidence at the end of the supervised session. Your centre will advise you of the timing for the supervised session.

You will complete this set task under supervision.

You must work independently throughout the supervised session and must not share your work with other learners.

You may use a calculator when carrying out the activities.

You must **not** have access to computers or the internet.

Outcomes for submission

You must complete the activities in this task and answer book.

You must complete an authentication sheet.



P 6 4 6 9 1 A 0 3 1 6

Set task information

Engineering brief

Many modern buildings are strengthened by steel frameworks. Some steel frameworks are visible, as shown in the photograph.

Engineers need to understand how the individual parts that make up the complete framework will react to different loads being placed on them. You have been asked to research the effect of changing the position of a mass on a cantilever.



(Source: image-illustration by EFKS/shutterstock.com)

Figure 1

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Within your organisation you have been asked to investigate how moving a mass along a cantilever will cause it to bend.

The following equipment has been provided for you:

- an assembled cantilever test rig
- one additional ruler.

You can refer to your notes from the teacher demonstration.

Appropriate health and safety procedures for this practical activity must be followed at all times.



P 6 4 6 9 1 A 0 5 1 6

Follow this testing process and record your results in Activity 1a.

1. Slide the mass and hanger to a suitable suspension point.
2. Attach the method of preventing the mass and hanger from sliding.
3. Measure the distance from the right-hand edge of the fixing plate to the mass and hanger suspension point.
4. Record this distance.
5. Measure the angle of deflection of the ruler using the angle template.
6. Record the angle of deflection.
7. Remove the method of preventing the mass and hanger from sliding.
8. Move the mass and hanger to a new suspension point.
9. Repeat steps 2 to 8 as many times as necessary.
10. Note anything you have observed during the practical activity.
11. Carefully remove the method of preventing the mass and hanger from sliding.
12. Carefully remove the mass and hanger.
13. Remove the method of fixing the ruler to the fixing plate.
14. Align the end of the second ruler with that of the first ruler.
15. Attach the two rulers to the end of the fixing plate, making sure the fixing plate is in the same position as before.
16. Repeat steps 1 to 10 as many times as necessary.

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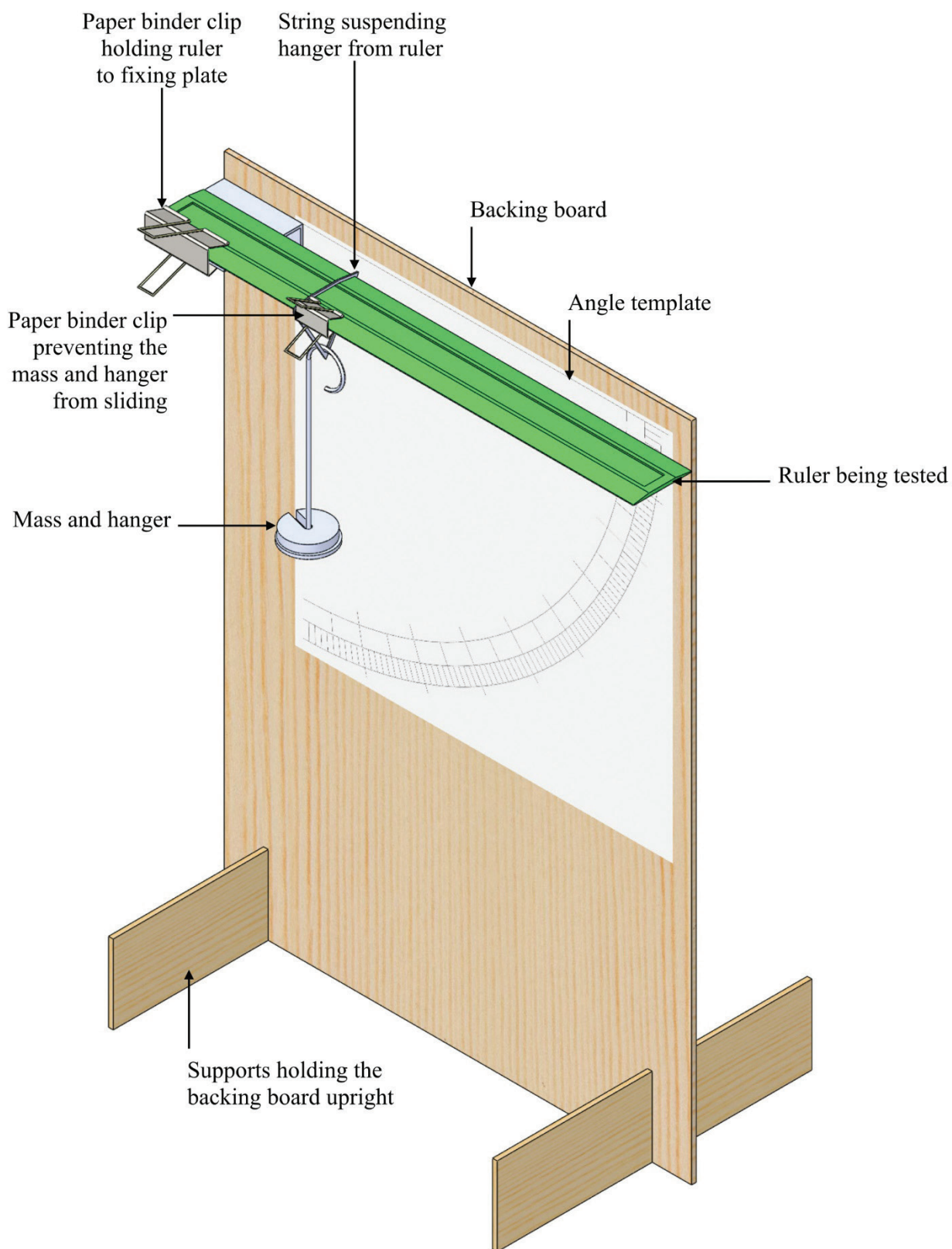
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Your centre may be using equipment that looks different from the drawing below.



You should spend 45 minutes carrying out your practical activity and recording results in the tables for Activity 1a.



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(Total for Activity 1a = 6 marks)

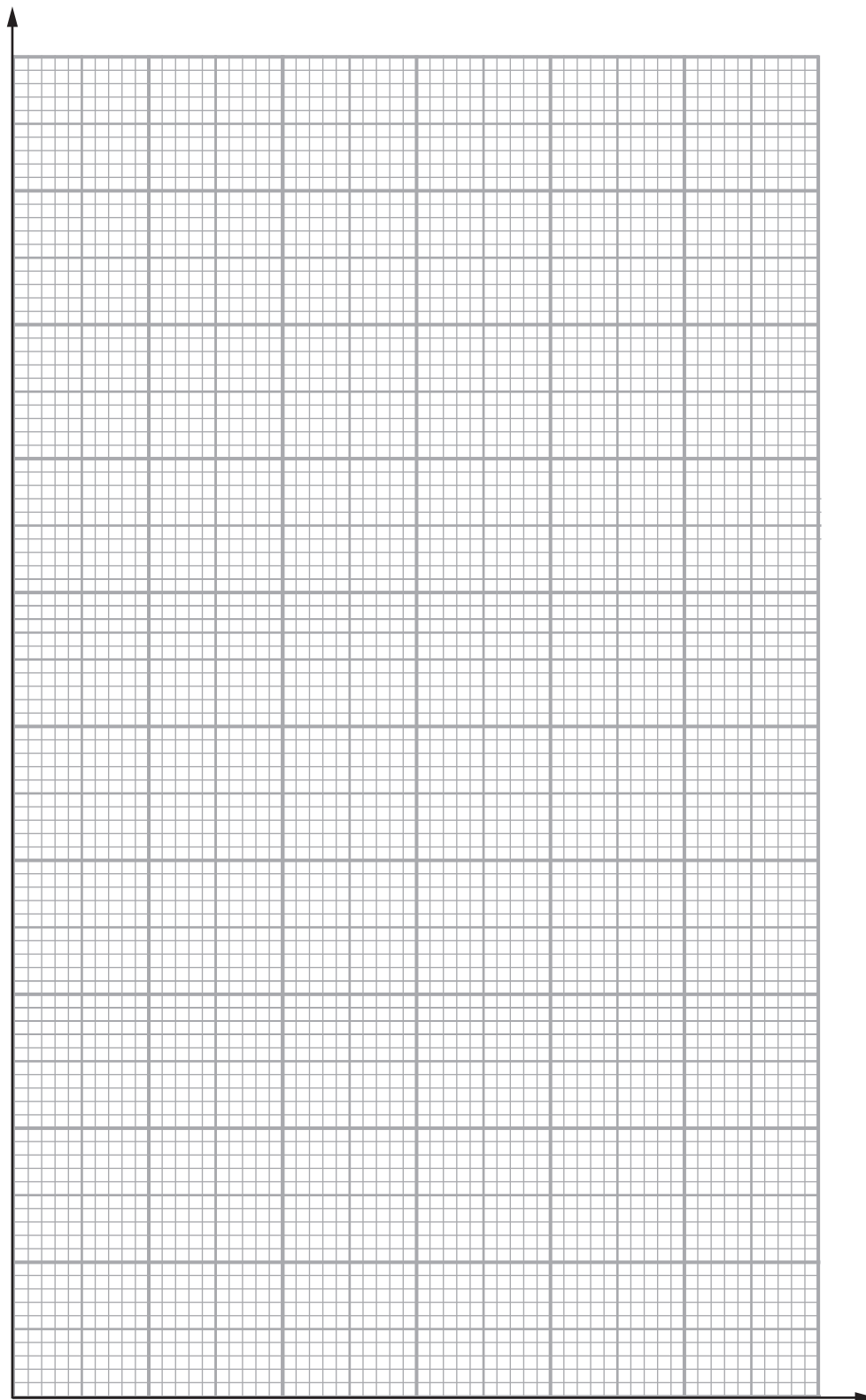


Activity 1b: Processing results

Draw a graph of mass and hanger distance against the corresponding angle of deflection and plot a line of best fit for both one ruler and two rulers.

Use the headings and units from your tables in Activity 1a to label each axis.

One ruler



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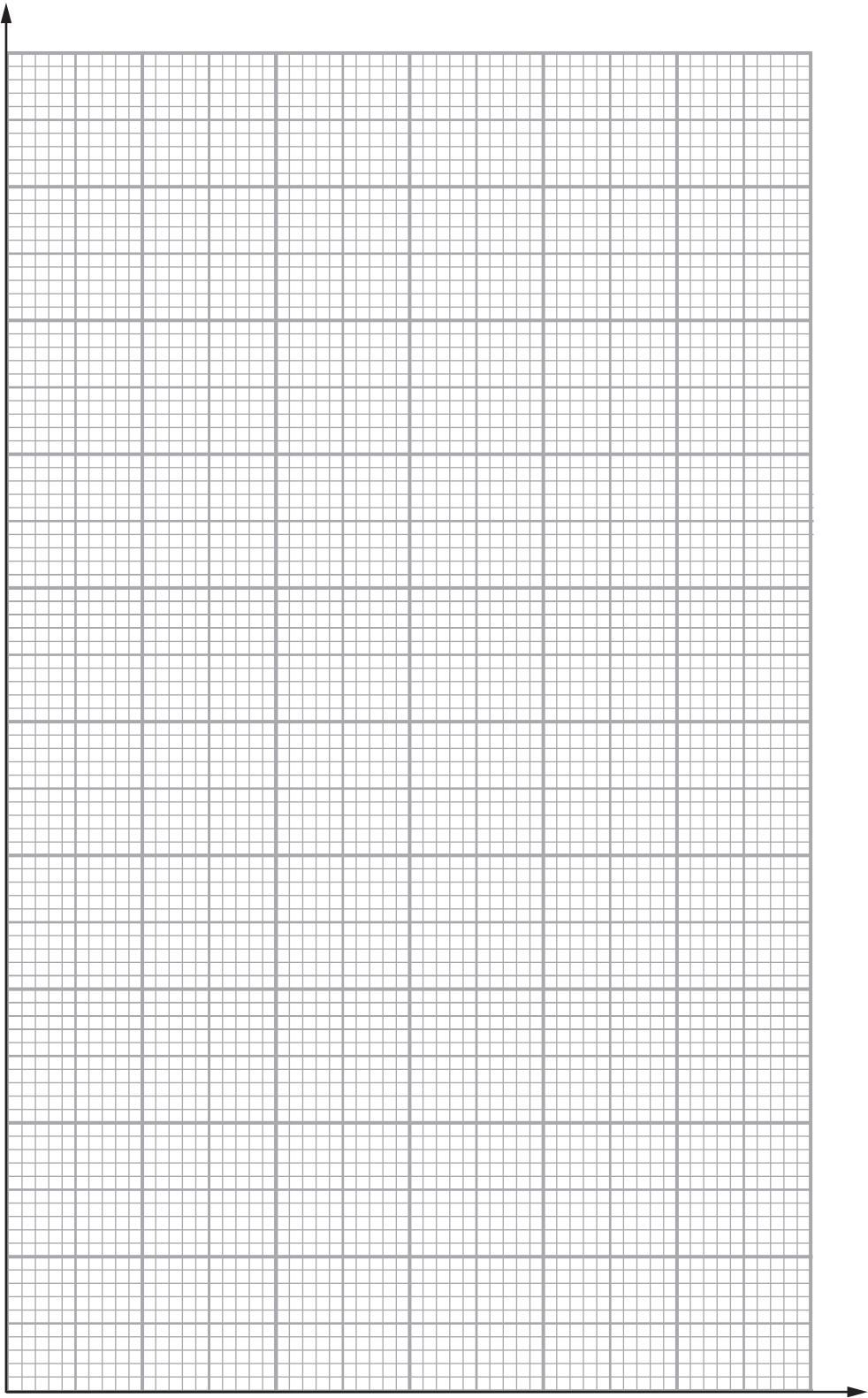
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Two rulers



You should spend 20 minutes completing Activity 1b.

(Total for Activity 1b = 8 marks)



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Activity 1c: Drawing conclusions

Compare the patterns in your tables and graphs.

What conclusions can be drawn from your data?

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Handwriting practice area with 24 horizontal dotted lines.

You should spend 20 minutes completing Activity 1c.

(Total for Activity 1c = 8 marks)



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Handwriting practice area with 20 horizontal dotted lines.

You should spend 20 minutes completing Activity 1d.

(Total for Activity 1d = 8 marks)



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Candidate surname

Other names

**Pearson BTEC
Level 1/Level 2
Tech Award**

Centre Number

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Learner Registration Number

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Friday 7 February 2020

Morning
(Supervised hours: 1 hour 30 minutes)

Paper Reference **21141K**

Engineering

**Component 3: Responding to an Engineering Brief
Set Task: Part 2 Task and Answer Booklet**

You must have:

HB or B pencil, eraser, drawing instruments and calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** activities.
- Answer the activities in the spaces provided
– *there may be more space than you need.*
- This is **Part 2** of the set task.
- This task and answer booklet contains material for the completion of **Part 2** of the set task under supervised conditions.
- **Part 2** of the set task is out of 30 marks.
- This task and answer booklet is specific to each series and this material must be issued only to learners who have been entered to take the task in the specified series. This booklet should be kept securely until the start of the 1.5 hour supervised assessment period.
- This set task should be undertaken in the period timetabled by Pearson.

Information

- The total mark for this paper is 60.
- The marks for **each** activity are shown in brackets
– *use this as a guide as to how much time to spend on each activity.*

Advice

- Read each activity carefully before you start to answer it.
- Try to answer every activity.
- Check your answers if you have time at the end.

Turn over ►

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Instructions for teachers

This assessment is made up of two parts. **Part 1** consists of a practical activity. **Part 1** must be taken before **Part 2**. **Part 2** consists of two written activities.

Both parts of the set task are completed during a one-week period timetabled by Pearson. **Part 1** is to be completed in one session of two hours within the first four days of the timetabled period. **Part 2** is to be completed in one session on the Friday of the timetabled period.

This task and answer booklet contains **Part 2** of the set task. Learners **must** not take any notes from **Part 1** into **Part 2**.

Part 2 must be completed under supervised conditions within a 1.5 hour supervised session.

Learners must complete **Part 2** of the set task using this task and answer booklet. Learners should take calculators into the supervised session.

This is a formal external assessment and must be conducted with reference to the instructions in this task and answer booklet, and the *Information for Conducting External Assessments (ICEA)* document, to ensure that the supervised session is conducted correctly and that learners have the opportunity to carry out the required activities independently.

Teachers are responsible for maintaining security and for reporting issues to Pearson. In particular:

- only permitted materials can be brought into the supervised environment
- at the end of the session, materials must be kept securely and no items removed from the supervised environment.

After the session, the teacher will confirm that all learner work has been completed independently as part of the authentication submitted to Pearson.

Outcomes for submission

Part 1 and **Part 2** task and answer booklets should be submitted to Pearson at the same time.

Each learner must complete an authentication sheet.

Practical activity notes from the demonstration will be retained securely by the centre after **Part 2** and may be requested by Pearson if there is suspected malpractice.



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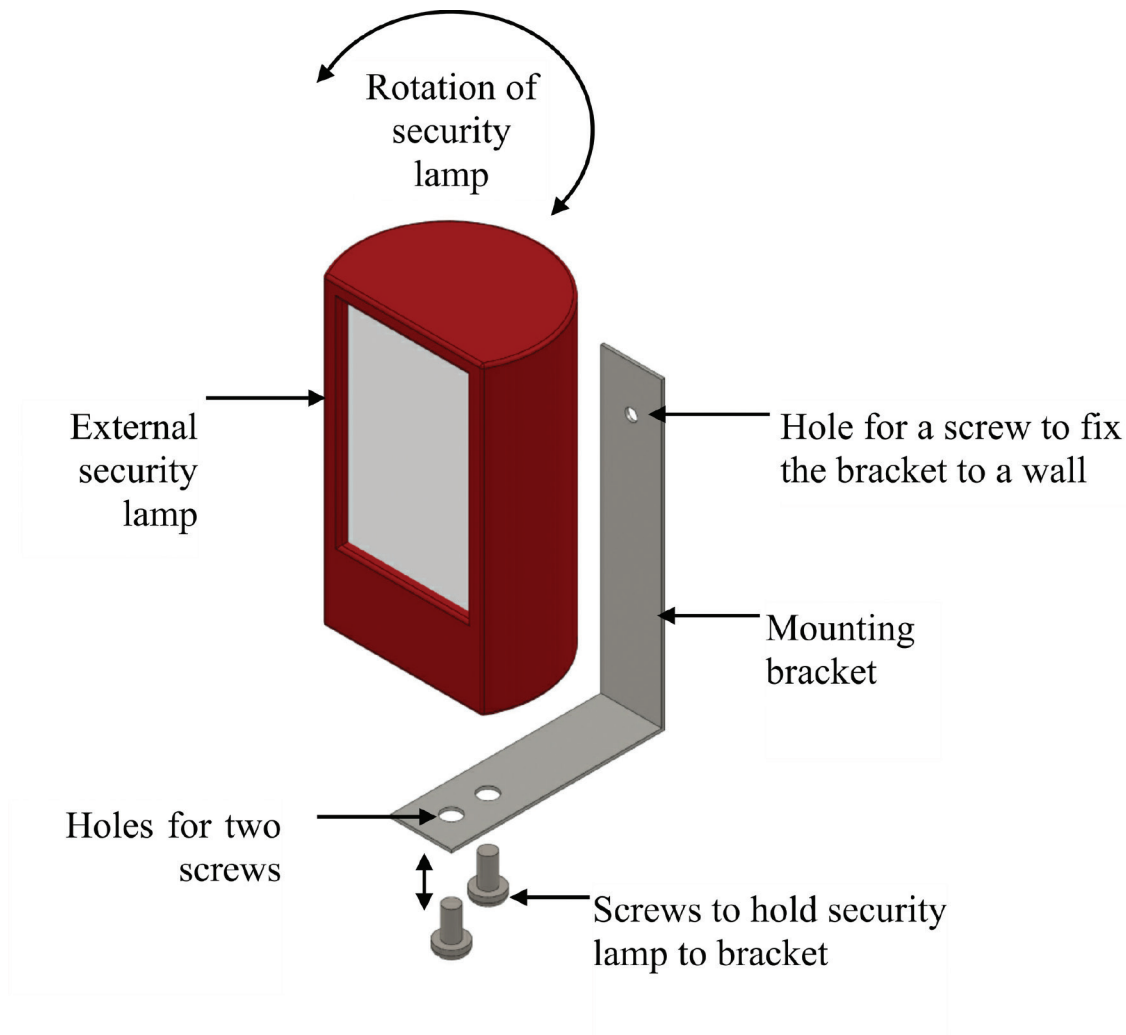
Set task information

Engineering brief

A customer wants to redesign a mounting bracket for an external security lamp. The mounting bracket is currently made from mild steel and attached to the base of the security lamp using two screws.

The design of the security lamp must not change.

The customer wants the new mounting bracket to allow the user to be able to rotate the external security lamp. The requirement is to allow a 90° rotation and the redesigned bracket must be suitable for manufacture in batches of 100.



To make the mounting bracket, a technician currently:

- uses a hacksaw to cut to length a strip of mild steel 20 mm wide and 3 mm thick
- marks the position of the three holes
- drills the three holes
- uses an engineer's vice to bend the mounting bracket to shape.



You must complete ALL activities in Part 2.

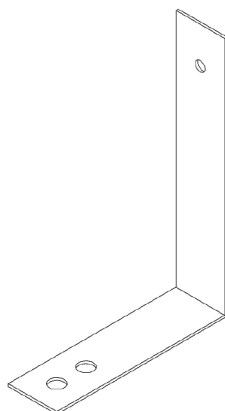
Activity 2a: Evaluation

Explain the issues with the design of the mounting bracket.

Think about how the mounting bracket is made and how it will be used. You should consider dimensions and tolerances, physical form, attributes, materials and processes.

Write your answer in the line space provided on the next page.

You may annotate the diagram to identify the issues with the design of the mounting bracket.



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You should spend 20 minutes completing Activity 2a.

(Total for Activity 2a = 8 marks)



Activity 2b: Redesign

You have been asked to consider different ways to manufacture this mounting bracket. You should consider different designs and processes to make it.

Sketch a design idea for the mounting bracket that is an improvement on the existing design. You may annotate the diagram to indicate design improvements.



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Justify why your design idea is an improvement on the existing mounting bracket and explain which processes you would use to make your design idea.

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You should spend 30 minutes completing Activity 2b.

(Total for Activity 2b = 10 marks)



Set task information

Engineering brief

Your engineering organisation is interested in the quality of its manufactured components. The quality control inspector has asked you to review a drawing, manufacturing process and production data to try to understand why issues have occurred during the production of a polymer assembly.

The components will be manufactured in batches of 5000 using an automated process. Component parts are injection moulded and then glued together.

Once joined the two parts should require a force of 150 Newtons to separate them.

The drawing for the component parts is shown below.

4				3				2				1			
F										F					
E										E					
D										D					
C										C					
B										B					
A										A					
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS				DO NOT SCALE DRAWING		REVISION 3.2									
NAME		SIGNATURE		DATE		TITLE									
DRAWN P. SHELLEY		P. Shelley		3/10/19		COMPONENT PARTS									
CHK'D S. DIGGLE		S. Diggle		4/10/19											
APPV'D H. DEVOTO		H. Devoto		5/10/19											
		MATERIAL:		DWG. NO.		BTEC-DRG-68A		A4							
		ABS													
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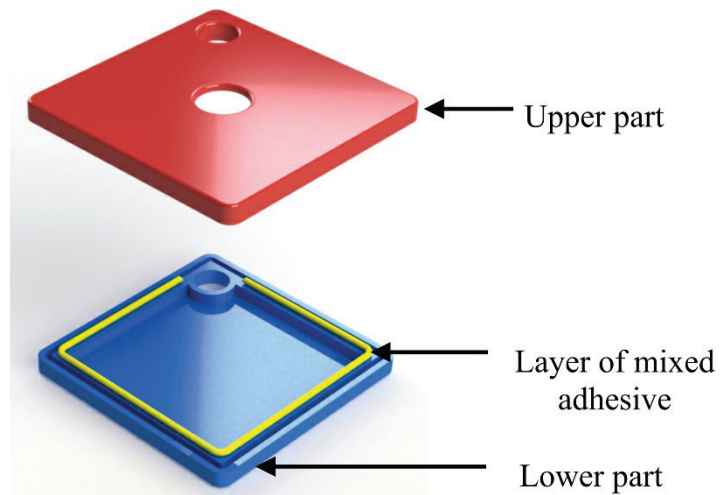


Manufacturing process

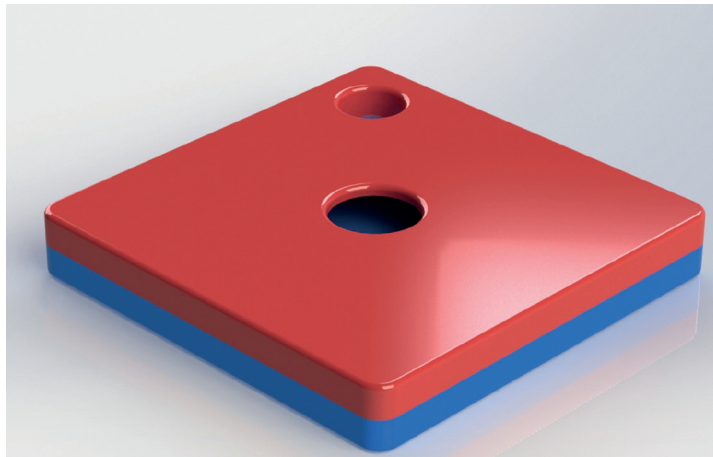
To test the joining process, the first batch of components has been assembled by an engineer.

To assemble the component parts the engineer:

- mixes an adhesive with a catalyst
- applies a layer of the mixed adhesive to the lower part (as shown below)



- lines up the edges of the upper and lower parts
- pushes them together (as shown below).



Testing of the assembled components indicates that the amount of catalyst used and the temperature of the room affect the strength of the glued joint.

The table below gives this data.

Room temperature (°Celsius)	18	18	18	20	20	20	22	22	22
% catalyst used	8	10	12	8	10	12	8	10	12
Strength of joint (Newtons)	94	130	166	110	150	190	126	170	214



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Handwriting practice area with 30 horizontal dotted lines.

You should spend 40 minutes completing Activity 3.

(Total for Activity 3 = 12 marks)

TOTAL FOR PAPER = 60 MARKS





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