BTEC

Pearson Higher Nationals in

Engineering

EXAMPLE ASSESSMENT BRIEF

Unit 1: **Engineering Design**

For use with the following qualifications:

Higher National Certificate and Higher National Diploma in Engineering

Higher National Certificate and Higher National Diploma in Nuclear Engineering

Higher National Certificate and Higher National Diploma in Aeronautical Engineering

Brief Number: 1

First teaching from September 2017

Issue 2

Pearson

Edexcel, BTEC and LCCI qualifications

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Higher National Certificate/Diploma in Engineering/Nuclear Engineering/Aeronautical Engineering

Example Assessment Brief

Student Name/ID Number	
Unit Number and Title	**1: Engineering Design**
Academic Year	
Unit Tutor	
Assignment Title	**The design of a Printed Circuit Board (PCB) inspection jig**
Issue Date	
Submission Date	
IV Name & Date	

Submission Format
You should present For Part 1: A formal report of around 1000 words with appropriate use of structure and referencing. This should incorporate a design specification and project plan, which can be included as an annex to the report. For Part 2: A written evaluation of around 600 words, to include three potential design solutions with evidence of the use of software in simulation/modelling/prototyping and a justification of a proposed final design solution. For Part 3: An industry standard design report of around 1200 words with appropriate use of structure and referencing.

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For Part 4:

A formal presentation, using no more than 8 presentation slides, and a formal feedback e-mail to your manager of around 200 words.

Unit Learning Outcomes

LO1 Plan a design solution and prepare an engineering design specification in response to a stakeholder's design brief and requirements

LO2 Formulate possible technical solutions to address the student-prepared design specification

LO3 Prepare an industry-standard engineering technical design report

LO4 Present to an audience a design solution based on the design report and evaluate the solution/presentation

Assignment Brief and Guidance

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Scenario:

You work as a design engineer for a small manufacturing company and have been asked to meet with a potential customer. The company mass-produces Printed Circuit Boards (PCBs) for laptop computers, in factories across Asia, the Far East and South America. Currently PCBs are being inspected by hand, but errors and damage have occurred on some production lines.

They require an adjustable jig that can be used in all the manufacturing facilities, on each of the production lines, and can hold a variety of different PCBs. The jig is to be attached to a workbench and it should rotate and swivel to allow inspection of the PCB from any angle and both sides.

Task:

Part 1: Preparing a design specification

With reference to the customer brief above you should produce a design specification, using a standard template, which meets all the customer requirements. In addition, you should present a project schedule for the design of the product. You should consider the importance, sequence and timing of each activity within your plan and provide illustrations of these.

To determine whether your brief is appropriate you should compare and contrast it with the supplied industry standard specification.

To complete this part, the following elements should also be undertaken:

- Research the characteristics of PCBs used in laptop computers and existing inspection jigs/fixtures/techniques
- Study the customers/stakeholder's requirements, explaining how these influence the preparation of the design brief
- Explain the use of Critical Path Analysis (CPA) in managing a project
- Evaluate the potential planning techniques available and justify the preferred method.

Part 2: Formulating possible technical solutions

Having completed your design specification, you have been asked to present a suggested design solution, based upon your design specification from Part 1. Your presentation should include an evaluation of at least three different solutions and make the case for your proposed final choice.

To complete this part, the following elements should also be undertaken:

- The use of software to model/simulate/prototype different solutions, based on annotated sketches/CAD models/drawings.
- The use of industry standard evaluation techniques, such as cause and effect diagrams, forced decision making or a Pugh matrix.

Part 3: Preparing an industry standard engineering technical design report

Your manager likes your design proposal and would like you to formally report on this technical solution. You should produce an industry standard design report, and part of this report should incorporate an evaluation of the effectiveness of this report in terms of whether it will allow the production of a finished product that meets the manufacturer's and customer's requirements.

To complete this part, the following elements should be incorporated/considered within your design report:

- An explanation of the role of design specifications and standards
- An assessment of your design solution including an identification of the limitations, compliance, standards, safety and risk management issues.
- Appropriate referencing and citation should be used.

Part 4: Present to an audience a design solution based on the design report and evaluate the solution/presentation

Your manager has reviewed your design report and would now like you to prepare and deliver a presentation to a wider audience of production managers and design engineers. It is likely that the audience may suggest changes/improvements to the given design solution and you should be prepared for this. Your manager wants a de-brief afterwards and will expect a justification of any further potential improvements following feedback and/or review of the presented design solution.

Your manager will also expect you to explain the possible communication strategies and presentation methods you might have used and reflect on the effectiveness of the communication strategy chosen.

To complete this part, you should also consider/produce:

- The audience identified (see above)
- Opportunities for feedback/Q&A should be considered as part of the presentation
- An e-mail debrief for your manager.

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Notes to Assessors – Please delete this section prior to circulating it to students.

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1. *The design solution could either be for a product or a process/service. For example, students could individually select from a given range of scenarios or design problems, such as the PCB inspection jig, linked to their engineering pathway/industry.*
2. *Centres should provide (or ask student to research) a relevant industry standard specification (this means either a product/service design specification or technical/industry standard e.g. British Standard 7373-3:2005) for comparison purposes.*
3. *The presentation element of this EAB lends itself to an invited audience of local engineering companies with students/assessors giving the opportunity to ask informed questions regarding a student's design solution. Student audiences can also be used but the assessor may need to be more proactive in this case.*
4. *The debrief used in LO4 could be a viva-voce, written report, interview etc.*
5. *Centres are encouraged to adapt/develop their own scenarios based around the needs of local and/or national industry as well as available resources.*
6. *This EAB is presented as a whole unit assignment however centres are free to deliver these as separate assignments provided that Learning Outcomes are not split. In this situation modification to the scenario and evidence requirements may be required.*
7. *Centres are encouraged to provide an exemplar formal report template. This could be typically contained within the student handbook, on a VLE, available within the library or accessible electronically.*
8. *Students should be encouraged to use appropriate referencing/citation where appropriate e.g. where critical reflection is required referencing/citation would be anticipated to evidence this.*
9. *Students should be encouraged to reference the published assessment criteria when completing an assignment, to ensure all elements of each criterion are addressed.*
10. *Where criteria specify 'and/or' assessors should be aware that this reflects a choice which can be incorporated into the assignment.*

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<table>
<tr><th colspan="3">Learning Outcomes and Assessment Criteria</th></tr>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Plan a design solution and prepare an engineering design specification in response to a stakeholder's design brief and requirements</td><td rowspan="2">D1 Compare and contrast the completed design specification against the relevant industry standard specification</td></tr>
<tr><td>P1 Produce a design specification from a given design brief

P2 Explain the influence of the stakeholder's design brief and requirements in the preparation of the design specification

P3 Produce a design project schedule with a graphical illustration of the planned activities</td><td>M1 Evaluate potential planning techniques, presenting a case for the method chosen

M2 Demonstrate critical path analysis techniques in design project scheduling/planning and explain its use</td></tr>
<tr><td colspan="2">LO2 Formulate possible technical solutions to address the student-prepared design specification</td><td rowspan="2">D2 Evaluate potential technical solutions, presenting a case for the final choice of solution</td></tr>
<tr><td>P4 Explore industry standard evaluation and analytical tools in formulating possible technical solutions

P5 Use appropriate design techniques to produce possible design solutions</td><td>M3 Apply the principles of modelling/simulation/prototyping, using appropriate software, to develop appropriate design solutions</td></tr>
</table>

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<table>
<tr><td colspan="2">LO3 Prepare an industry-standard engineering technical design report</td><td rowspan="2">D3 Evaluate the effectiveness of the presented industry-standard engineering technical design report for producing a fully compliant finished product</td></tr>
<tr><td>P6 Prepare an industry standard engineering technical design report

P7 Assess the presented technical design and identify any potential limitations it may have</td><td>M4 Explain the role of design specifications and standards in producing a finished product

M5 Identify any compliance, safety and risk management issues present in the chosen solution</td></tr>
<tr><td colspan="2">LO4 Present to an audience a design solution based on the design report and evaluate the solution/presentation</td><td rowspan="2">D4 Justify potential improvements to the presented design solution, based on reflection and/or feedback obtained from the presentation</td></tr>
<tr><td>P8 Present the recommended design solution to the identified audience

P9 Explain possible communication strategies and presentation methods that could be used to inform the stakeholders of the recommended solution</td><td>M6 Reflect on effectiveness of communication strategy in presenting the solution</td></tr>
</table>

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Engineering

EXAMPLE ASSESSMENT BRIEF

Unit 2: **Engineering Maths**

For use with:

Higher National Certificate and Higher National Diploma in Engineering

Higher National Certificate and Higher National Diploma in Aeronautical Engineering

Higher National Certificate and Higher National Diploma in Nuclear Engineering

Brief Number: 1

First teaching from September 2017

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Higher National Certificate/Diploma in Engineering/Nuclear Engineering/Aeronautical Engineering

Example Assessment Brief

Student Name/ID Number	
Unit Number and Title	**2: Engineering Maths**
Academic Year	
Unit Tutor	
Assignment Title	**Analyse engineering data and solve engineering problems**
Issue Date	
Submission Date	
IV Name & Date	

Submission Format
You should present For Part 1, Part 2 and Part 3: A series of hand written or word processed responses. For Part 4: A report featuring graphical data generated using computer software that could be understood by a non-technical audience.

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Unit Learning Outcomes

LO1 Identify the relevance of mathematical methods to a variety of conceptualised engineering examples

LO2 Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages

Assignment Brief and Guidance

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Scenario:

You work as a production engineer for a company that manufactures engine parts. You have been investigating a number of issues in the production area and have been given access to a range of manufacturing data. Your manager has asked you to analyse the data in order to present this to non-technical colleagues within the organisation.

Activity:

Part 1:

Data has been gathered from a lifting system used to transport engine parts. The system consists of a drum and cable. The following data was obtained when the drum lowers the load (assume constant acceleration).

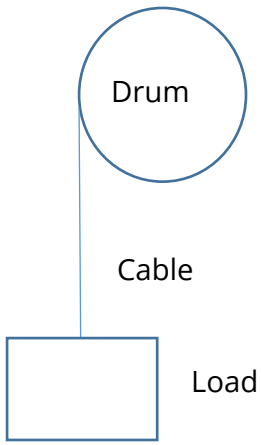
Drum diameter = 0.8m

Mass of load = 3kg

Initial velocity = 0 m/s

Time to descend = **A** secs

Distance travelled = 0.25m



You have been asked to use this information to determine:

a) The final linear velocity of the load
b) The linear acceleration of the load
c) The final angular velocity of the drum
d) The angular acceleration of the drum
e) The tension force in the cable

f) The torque applied to the drum

In determining the above quantities, you should clearly state the formulae used and apply dimensional analysis techniques to show that all values/units used are homogeneous.

From the formulae used (above) you should apply dimensional analysis techniques to develop two equations for power (in terms of linear velocity and angular velocity).

Part 2:

a) You are investigating the electrical testing circuits and find that, in an inductive circuit, the relationship between instantaneous current *i* (amps) and the time *t* (secs) is given by:

$$i = 2.1(1-e^{-9t})$$

You have been asked to determine the time taken for the current to rise from 1 to **B** amps.

b) The drive system of a conveyor used to transport the engine parts is made up of an open belt which passes over two pulleys. The pulleys have diameters of 200mm and 320mm respectively and the distance between centres is **T** mm.

You have been asked to determine the length of the belt, using trigonometric techniques, assuming the belt is in tension.

c) An electrical cable is to be suspended across two machines. The machines are a distance **L** metres apart. The cable forms the shape of a catenary of the form y = c cosh (x/c) where x = L/2. You have been asked to determine the fixing point height (y) if the minimum clearance (c) is to be 3m at the centre of the catenary.

Part 3:

A drill used in the manufacture of the engine parts is designed to have seven speeds. The range of hole sizes anticipated is from 6mm to 25mm.

You have been asked to determine the six spindle speeds (rev/min) given that the cutting speed is 20m/min. These spindle speeds are to be arranged in:

a) arithmetic progression
b) geometric progression

Note: $N=\frac{1000s}{\pi D}$

Where, N = spindle speed (rev/min), s = cutting speed (m/min) and D = hole diameter (mm).

Part 4:

The company considers itself to have quality processes in line with 6σ principles

Measurement of inspection time, from a large sample of a specific engine part, gave the following distribution:

Time (sec)	50-79	80-109	110-139	140-169	170-199	200-229
Number	1	5	11	10	4	1

You have been asked to determine the mean inspection time and the standard deviation (in seconds). You should also present a graphical illustration of the distribution using appropriate computer software.

From the data gathered and processed you have asked to determine:

a) the maximum and minimum limits that inspection time might take (assuming the distribution to be normal and 6σ compliant (all times within mean ±3σ)
b) the probability that a randomly chosen inspection time will be greater than 180 seconds
c) the probability that a randomly chosen inspection time will be shorter than 60 seconds

One of the machines is causing quality problems as **P**% of the engine parts produced on this machine have been found to be defective. Find the probability of finding 0, 1, 2, 3, and 4 defective parts in a sample of 50 parts (assuming a binomial distribution). You should also present a graphical illustration of the probabilities using appropriate computer software.

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Measurement of inspection time, from a large sample of outsourced components, gave the following distribution:

Time (sec)	20	22	24	25	27	28	29	31
Number	1	3	2	3	4	3	3	4

Your manager thinks that the inspection time should be the same for all outsourced components. Using the data provided test this hypothesis and indicate whether there is a correlation or not.

Your manager has asked you to summarise, using appropriate software, the statistical data you have been investigating in a method that can be understood by non-technical colleagues.

Student	A	L	B	T	P
1	1.96	3.46	1.56	760	9.6
2	1.97	3.47	1.57	770	9.7
3	1.98	3.48	1.58	780	9.8
4	1.99	3.49	1.59	790	9.9
5	2.00	3.50	1.60	800	10
6	2.01	3.51	1.61	810	10.1
7	2.02	3.52	1.62	820	10.2
8	2.03	3.53	1.63	830	10.3
9	2.04	3.54	1.64	840	10.4

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1. *Individual values are provided for students to encourage authenticity. Assessors should modify this table to suit the number of students and/or the statistical data to be considered. This approach is recommended for all analytical subjects except where time controlled assessment/exams are used.*
2. *In Part 1: centres should give students some of the formulae, but ensure that scope is given for deriving further equations from this.*
3. *In Part 3: the data used by students for statistical analysis should, where possible, be from practical experiments such as timing of objects/activities, or a series of electrical/mechanical measurements.*
4. *Centres are encouraged to adapt/develop their own scenarios based around the needs of local and/or national industry as well as available resources.*
5. *This EAB is presented as an assignment covering two Learning Outcomes however, centres **cannot** deliver LO1/LO2 as separate assignments as this will not allow Distinction opportunities in all assignments, thus restricting achievement for students. Additionally centres are reminded that Learning Outcomes cannot be split.*
6. *Students should be encouraged to use appropriate referencing/citation where appropriate e.g. where critical reflection is required referencing/citation would be anticipated to evidence this.*
7. *Students should be encouraged to reference the published assessment criteria when completing an assignment, to ensure all elements of each criterion are addressed.*
8. *Where criteria specify 'and/or' assessors should be aware that this reflects a choice which can be incorporated into the assignment task.*

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<tr><td colspan="2">LO1 Identify the relevance of mathematical methods to a variety of conceptualised engineering examples</td><td rowspan="5">LO1 & 2

D1 Present statistical data in a method that can be understood by a non-technical audience</td></tr>
<tr><td>P1 Apply dimensional analysis techniques to solve complex problems

P2 Generate answers from contextualised arithmetic and geometric progressions

P3 Determine solutions of equations using exponential, trigonometric and hyperbolic functions</td><td>M1 Use dimensional analysis to derive equations</td></tr>
<tr><td colspan="2">LO2 Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages</td></tr>
<tr><td>P4 Summarise data by calculating mean and standard deviation, and simplify data into graphical form

P5 Calculate probabilities within both binomially distributed and normally distributed random variables</td><td>M2 Interpret the results of a statistical hypothesis test conducted from a given scenario</td></tr>
</table>

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Engineering

EXAMPLE ASSESSMENT BRIEF

Unit: **3 Engineering Science**

For use with the following qualifications:

Higher National Certificate and Higher National Diploma in Engineering

Higher National Certificate and Higher National Diploma in Nuclear Engineering

Higher National Certificate and Higher National Diploma in Aeronautical Engineering

Brief Number: 1

First teaching from September 2017

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Higher National Certificate/Diploma in Engineering/Nuclear Engineering/Aeronautical Engineering

Example Assessment Brief

Student Name/ID Number	
Unit Number and Title	**3: Engineering Science**
Academic Year	
Unit Tutor	
Assignment Title	**Testing materials using scientific method**
Issue Date	
Submission Date	
IV Name & Date	

Submission Format
You should present For Part 1: A formal laboratory report of around 1000 words with appropriate use of structure and referencing. For Part 2: A formal report of around 1000 words with appropriate use of structure and referencing.

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Unit Learning Outcomes

LO1 Examine scientific data using both quantitative and computational methods

LO3 Explore the characteristics and properties of engineering materials

Assignment Brief and Guidance

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Scenario

You work as a materials engineer and have been tasked with investigating issues with products manufactured by your company. These products are made from polymer, composite and metal components.

Materials are failing in service, but your manager is not sure of the reason for this and has hypothesised that this could be due to degradation caused by fatigue, creep or other means. It has been suggested that types of hysteresis should be considered and/or that there are issues with the specification of materials being used.

Task

Part 1:

You have been given samples of metals, composite and polymer materials. You have access to tensile testing equipment (destructive) and dye penetrant testing equipment (non-destructive).

You are required to carry out tests on these materials and present a formal laboratory report.

By comparing and contrasting results obtained in your testing with theoretical material properties you should be able to draw appropriate conclusions. To do this the laboratory report must be structured to follow a formal scientific method thus ensuring your analysis can be relied upon to be scientifically sound.

You should ensure that your report includes the following elements:

- Graphical representations of the quantitative data gathered, using appropriate software
- The SI units used including prefix notation, symbols and derived units
- Full citation/references using an acceptable referencing system.

Part 2:

Your manager wants you to write a formal report on the potential in service conditions that may have caused material failure and the structural properties of the given metals, polymer and composite that you have been investigating (from Part 1).

You should consider the effect of degradation on the appearance of the given materials and gather qualitative feedback from colleagues on the potential causes of failure. This feedback/data will be presented, using appropriate graphical software within your report.

Your report should reflect on the application of the scientific method (demonstrated in your laboratory report) for the testing you carried out. There should also be an analysis of all the graphical data presented (qualitative and quantitative information from Part 1 and Part 2).

You should ensure that your report includes the following elements:

- An explanation and comparison of the types of degradation including elastic, electrical and magnetic hysteresis
- A description of the structural properties linked to their respective material properties
- The SI units used including prefix notation, symbols and derived units
- Full citation/references using an acceptable referencing system.

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1. *The different tests carried out by students need not be tensile and dye penetrant. Opportunities for destructive and non-destructive testing are provided in the different parts of the task and can be edited accordingly.*
2. *To allow qualitative data to be examined and analysed students should have the opportunity to share information/observations with assessors, other students, local employers, guest speakers etc. By collecting information on the modes of potential degradation appropriate qualitative analysis can take place.*
3. *The values obtained through destructive and non-destructive test methods should allow a comparison with theoretical values from typical accredited data sources.*
4. *The description of structural properties of materials can be undertaken as a visual inspection of prepared samples and/or a research activity.*
5. *Centres are encouraged to adapt/develop their own scenarios based around the needs of local and/or national industry as well as available resources.*
6. *This EAB is presented as an assignment covering two Learning Outcomes. This is a holistic activity that requires both the laboratory report and the formal report to be assessed together. This EAB cannot be split into separate assignments for Part 1 and Part 2 as individual criteria are spread across both parts of the assignment.*
7. *Centres are free to deliver individual Learning Outcomes as separate assignments, provided that Learning Outcomes are not split. In this situation modification to the scenario and evidence requirements may be required.*
8. *Centres are encouraged to provide an exemplar formal report template and a laboratory report template. This could be typically contained within the student handbook, on a VLE, available within the library or accessible electronically.*
9. *Students should be encouraged to use appropriate referencing/citation where appropriate e.g. where critical reflection is required referencing/citation would be anticipated to evidence this.*
10. *Students should be encouraged to reference the published assessment criteria when completing an assignment, to ensure all elements of each criterion are addressed.*
11. *Where criteria specify 'and/or' assessors should be aware that this reflects a choice which can be incorporated into the assignment task.*

*Please access HN Global for additional resources support and reading for this unit. For further guidance and support on report writing please refer to the Study Skills Unit on HN Global www.highernationals.com

Please note that this Example Assessment Brief is NOT an authorised assignment brief. It is provided as a reference only.

Centres must develop assignments and assessment materials that meet the needs of their students and align with their curriculum planning. This Example Assessment Brief may be used as a starting point for the development of an assignment, however Centres are expected to modify and revise the Example Assessment Brief to meet the specific needs of their students and curriculum. All assessment briefs must be Internally Verified.

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<table>
<tr><th colspan="3">Learning Outcomes and Assessment Criteria</th></tr>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine scientific data using both quantitative and computational methods.</td><td rowspan="2">D1 Present an analysis of scientific data using both computational and qualitative methods.</td></tr>
<tr><td>P1 Describe SI units and prefix notation.

P2 Examine quantitative and qualitative data with appropriate graphical representations.</td><td>M1 Explain how the application of scientific method impacts upon different test procedures.</td></tr>
<tr><td colspan="2">LO3 Explore the characteristics and properties of engineering materials.</td><td rowspan="2">D3 Compare and contrast theoretical material properties of metal and non-metallic materials compared with values obtained through destructive and non-destructive test methods.</td></tr>
<tr><td>P6 Describe the structural properties of metals and non-metals with reference to their material properties.

P7 Explain the types of degradation found in metals and non-metals.</td><td>M3 Review elastic, electrical and magnetic hysteresis in different materials</td></tr>
</table>