BTEC Level 3 Nationals in Engineering:
Unit 1

Your free sample of the student book: preparation for assessment

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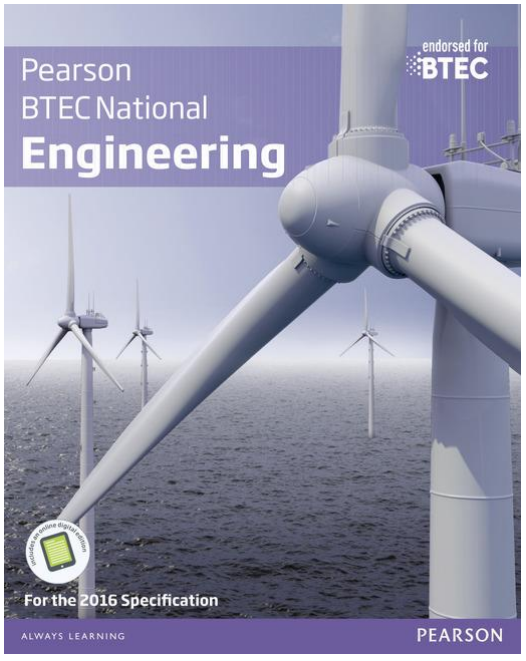

Getting ready for assessment

This section has been written to help you to do your best when you take the external examination. Read through it carefully and ask your tutor if there is anything you are not sure about.

About the test

This unit is externally assessed using an unseen paper-based examination. Pearson sets and marks the examination. The assessment must be taken under examination conditions.

As the guidelines for assessment can change, you should refer to the official assessment guidance on the Pearson Qualifications website for the latest definitive guidance.

Make sure you are familiar with the command words and know how to apply them within the context of the examination. The table below shows the command words for each Assessment outcome.

Assessment outcome	Command words
AO1	calculate, describe, explain
AO2	calculate, find, solve
AO3	find, calculate, describe, draw, explain
AO4	calculate, draw
AO5	calculate, draw, explain

Remember that all the questions are compulsory and you should attempt to answer each one.

Organise your time based on the marks available for each question. Set yourself a timetable for working through the test and then stick to it – do not spend ages on a short 1–2 mark question and then find you only have a few minutes for a longer 6–7 mark question.

Try answering all the simpler questions first, then come back to the harder questions. This should give you more time for the harder questions.

Sitting the test

Listen to and read carefully any instructions you are given. Lots of marks are often lost through not reading questions properly and misunderstanding what the question is asking.
Most questions contain command words. Understanding what these words mean will help you to understand what the question is asking you to do.

Command word	Definition – what it is asking you to do
Calculate	Learners judge the number or amount of something by using the information they already have, and add, subtract, multiply or divide numbers. For example, 'Calculate the reaction forces…'
Describe	Learners give a clear, objective account in their own words showing recall, and in some cases application, of the relevant features and information about a subject. For example, 'Describe the process of heat transfer…'
Draw	Learners make a graphical representation of data by hand (as in a diagram). For example, 'Draw a diagram to represent…'
Explain	Learners make something clear or easy to understand by describing or giving information about it. For example, 'Explain one factor affecting…'
Find	Learners discover the facts or truth about something. For example, 'Find the coordinates where…'
Identify	Learners recognise or establish as being a particular person or thing; verify the identity of. For example, 'Identify the energy loss…'
Label	Learners affix a label to; mark with a label. For example, 'Label the diagram to show…'
Solve	Learners find the answer or explanation to a problem. For example, 'Solve the equation to…'
State	Learners declare definitely or specifically. For example, 'State all three conditions for…'

Sample answers

For some of the questions you will be given background information on which the questions are based.

Look at the sample questions that follow and our tips on how to answer these well.

Answering applied mathematics calculation questions

- Identify the method required to solve the type of problem set.
- Explain each step and show all your workings.
- Express your answer in appropriate units.
- Check your answer.

Worked example

The velocity of a model rocket fired vertically upwards is given by the equation $v = 2t^2 + 5t - 11$.

Find, by use of the quadratic formula, the time when the rocket reached its highest point. (2 marks)

Answer

At its highest point the velocity of the rocket will have fallen to 0, so

$$2t^2 + 5t - 11 = 0$$

The quadratic formula takes the form

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

In this problem:

$$a = 2, b = 5, c = -11$$

$$\text{so } t = \frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times (-11)}}{2 \times 2} = \frac{-5 \pm 10.63}{4} = 1.41 \text{ or } -3.91$$

The negative value is not valid in the context of the question, so check the answer by substituting $t = 1.41$ into $v = 2t^2 + 5t - 11$:

$v = 3.96\ldots + 7.03\ldots - 11 = 0$ (remember to use unrounded values)

The highest point will be reached after 1.41 s.

Where calculations are involved, marks are awarded for 'knowing a method and attempting to apply it' at each stage. It is essential, therefore, to show your working and make clear which principle or formula is being applied. Further marks are awarded for accuracy, that is, for reaching the correct numerical answer, only if the relevant method marks have already been awarded.

Answering engineering principles calculation questions

- Identify the variables from the information given in the question.
- Write down the formula you need.
- Substitute numbers into the formula.
- Explain each step and show all your workings.
- Express your answer in appropriate units.
- Check your answer.

Worked example

An engineer is testing an inductor with an inductance of 0.5 H and a resistance of 8 Ω. It is connected to a 120 V 50 Hz a.c. supply.

Calculate the current drawn from the power supply. (3 marks)

Answer

The solution will require the calculation of I_{rms}.

The values given in the question are:

$L = 0.5\,\text{H}$, $R = 8\,\Omega$, $V_{rms} = 120\,\text{V}$, $f = 50\,\text{Hz}$

The inductive reactance is $X_L = 2\pi fL = 2\pi \times 50 \times 0.5 = 157.08\,\Omega$.

The total impedance is given by $Z = \sqrt{X_L{}^2 + R^2} = \sqrt{157.08^2 + 8^2} = 157.28\,\Omega$.

So the a.c. current is $I_{rms} = \dfrac{V_{rms}}{Z} = \dfrac{120}{157.28} = 0.763\,\text{A}$ or 763 mA.

Answering engineering principles short-answer questions – state

- Read the question carefully.
- Make sure that you make the same number of points as there are marks available in the question.

Worked example

State two sources of energy loss that affect the efficiency of electrical transformers. (2 marks)

Answer

Eddy currents. Hysteresis losses.

This answer provides two accurate points and full marks would be awarded. Command words such as 'give', 'state' or 'identify' can be answered in single words or brief statements. There is no need to write in full sentences because the examiner is only testing your ability to recall information.

Answering engineering principles short-answer questions – describe, explain

Worked example

Describe the process of heat transfer through conduction. (4 marks)

Answer

Heat transfer by direct contact between adjacent atoms:

Heat energy is a measure of the vibrational kinetic energy possessed by atoms. These vibrations are passed between atoms that are in direct contact with each other.

Heat transfer by the movement of electrons:

Heat energy can also be distributed through a material by the transfer of vibrational kinetic energy possessed by free-moving electrons as they move around within a material. This helps to explain why metals are in general good thermal (as well as electrical) conductors.

The mechanism of energy transfer through direct contact between atoms and the secondary mechanism involving energy transfer by free-moving electrons have been correctly identified. Each mechanism is then explained and expanded upon sufficiently for the award of the additional marks available.

Answering synoptic questions

Worked example

A heat engine driving a combined heat and power system outputs mechanical energy to drive a generator.

The energy is provided by a combustion process that uses air and a fuel with an energy content of 40 MJ kg^{-1}, which is supplied at a rate of 0.003 kg s^{-1}. The generator has a rotor that turns at 1500 rpm and has a torque of 255 N m. The output of the generator is 6.5 A at 400 V.

a) Explain how energy loss processes in both mechanical and electrical equipment affect the efficiency of the system. (4 marks)

b) Calculate the efficiency with which the heat engine provides mechanical work to the generator. (7 marks)

c) Calculate the overall system efficiency. (3 marks)

Synoptic questions, such as the example given above, are basically a combination of interrelated short-answer and calculation questions based around a common complex system or theme. As such they can be broken down into individual elements that should be approached in a similar way to the worked examples already discussed.

Synoptic questions will require you to make links between engineering principles from the full range of disciplines covered in the unit.