0171-515 JUNE 2019
Level 3 Advanced Technical Extended Diploma in Land-Based Engineering (1080)
Level 3 Land-Based Engineering – Theory exam (1)

If provided, stick your candidate barcode label here.

Candidate name (first, last)
First
Last
Candidate enrolment number Date of birth (DDMMYYYY) Gender (M/F)
Assessment date (DDMMYYYY) Centre number Candidate signature and declaration*

* I declare that I had no prior knowledge of the questions in this examination and that I will not divulge to any person any information about the questions.

You should have the following for this examination
• a pen with blue or black ink
• a non-programmable calculator

General instructions
• Use black or blue ball-point pen.
• The marks for questions are shown in brackets.
• This examination contains 10 questions. Answer all questions.
• Answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
• Cross through any work you do not want to be marked.
1. Figure 1 shows a resistor which is supplied with a range of voltages. The voltage and current flowing through it is recorded using an ammeter.

![Figure 1](image)

The readings taken are shown in Table 1.

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>0</th>
<th>1.00</th>
<th>2.00</th>
<th>3.00</th>
<th>4.00</th>
<th>5.00</th>
<th>6.00</th>
<th>7.00</th>
<th>8.00</th>
<th>9.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage drop</td>
<td>0</td>
<td>0.3</td>
<td>1.1</td>
<td>2.2</td>
<td>3.1</td>
<td>4.2</td>
<td>5.0</td>
<td>6.0</td>
<td>6.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Current</td>
<td>0</td>
<td>0.06</td>
<td>0.21</td>
<td>0.42</td>
<td>0.6</td>
<td>0.75</td>
<td>0.9</td>
<td>1.1</td>
<td>1.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Table 1**

a) Using the results in Table 1, calculate the value of the resistor. Show all your workings with the correct units. 

(3 marks)

b) State the electrical theory which relates to 1a). 

(1 mark)

c) Explain the relationship between the **three** units used in the calculation in 1a). 

(3 marks)
2  a) State the unit used to measure the fuel consumption of an agricultural tractor. (1 mark)

b) Explain why the unit given in 2a) is not realistic when comparing differing tractor fuel consumptions. (2 marks)

c) Explain the importance of g/kWh in relation to fuel consumption measurement in an agricultural tractor. (2 marks)
3 a) Name the **two** types of bar chart in Figures 2 and 3. (2 marks)
b) Using the information in Table 2, calculate the mean of the lead acid battery cell readings correct to two decimal places. Show all your workings. (2 marks)

<table>
<thead>
<tr>
<th>Cell 1</th>
<th>Cell 2</th>
<th>Cell 3</th>
<th>Cell 4</th>
<th>Cell 5</th>
<th>Cell 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.265</td>
<td>1.273</td>
<td>1.256</td>
<td>1.260</td>
<td>1.269</td>
<td>1.274</td>
</tr>
</tbody>
</table>

Table 2

4 The following engine components have a range of settings. Calculate the minimum and maximum ranges for each.

a) Nut securing compressor gear: 125 ± 19 Nm (2 marks)

b) Bolts securing timing gear: 36 ± 4 Nm (2 marks)

c) Unions securing piston lubrication nozzles: 15 ± 3 Nm (2 marks)

5 State the formula for torque and state the metric units used. (2 marks)
6   a) State what each of the following abbreviations stands for.
   i)   EGR   (1 mark)

   ii)  DEF   (1 mark)

   iii) DPF   (1 mark)

b) Explain the principle of operation for each system in 6a), in relation to engine emissions.

   EGR   (3 marks)

   DEF   (3 marks)

   DPF   (3 marks)
7  a)  Explain the main function of each of the following components in a 4-stroke petrol engine.
   i)  Top piston ring.  
   ii) Crankshaft.  
   iii) Rocker arm.  

   b)  Give three consequences of not applying a torque tightening sequence of the cylinder head.

8  What is the function of an internal combustion engine?

9  One of the main functions of a lubrication system in a typical land-based engine is to reduce friction. State two other functions of this system.
A warning light on the dashboard of a common rail diesel engine is indicating that there is water in the fuel system and the engine is running erratically.

Propose a diagnostic, repair and testing procedure, including the prevention of reoccurrence and any typical readings to be taken. (12 marks)