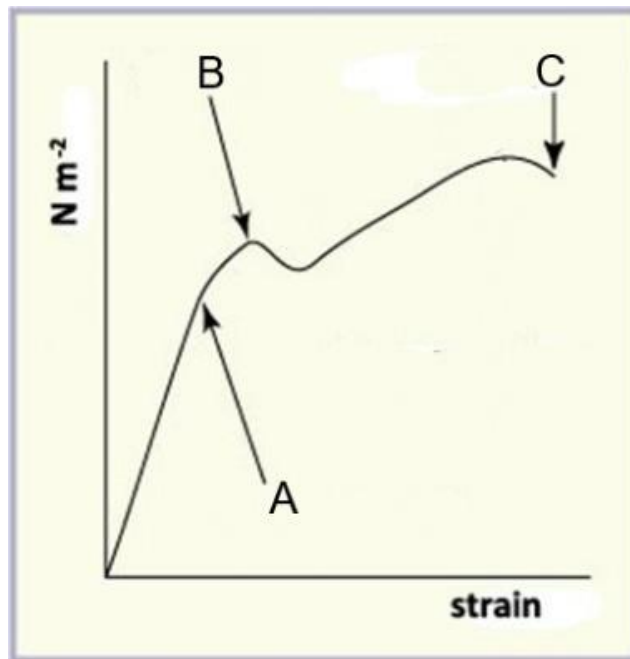


**Qualification: 0171-38-015/515 Level 3 Land-based Engineering - Theory exam  
June 2018**

- 1
- 1a. Define Hooke’s law. (1 mark)
  - 1b. State the formula for Hooke’s law. (1 mark)
  - 1c. Using the graph in Figure 1, explain the points labelled A, B and C, giving an example related to vehicle repairs, for **each**. (6 marks)
  - 1d. Explain the term stress. (1 mark)



**Figure 1**

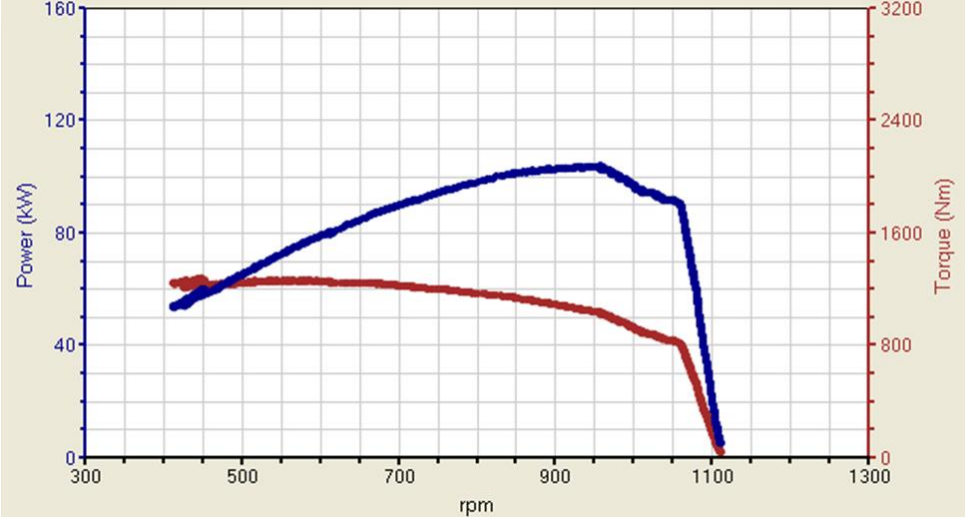
**Acceptable answer(s)**

**Guidance**

**Max  
mks**

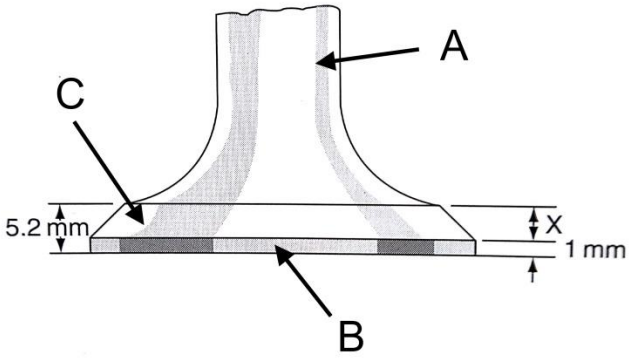
- a. 1 mark for - The extension of an elastic object is directly proportional to the force applied to it. Accept any other suitable wording
- b. 1 mark for -  $F = k \times e$
- c. A- Limit of proportionality material obeys Hooke’s law and will return to original shape or length (1) e.g. tightening a bolt to specific torque. (1)  
B- Yield point is the point where nonlinear (elastic + plastic) deformation begins. (1)E.g. cylinder head stretch bolts (1)

**9**

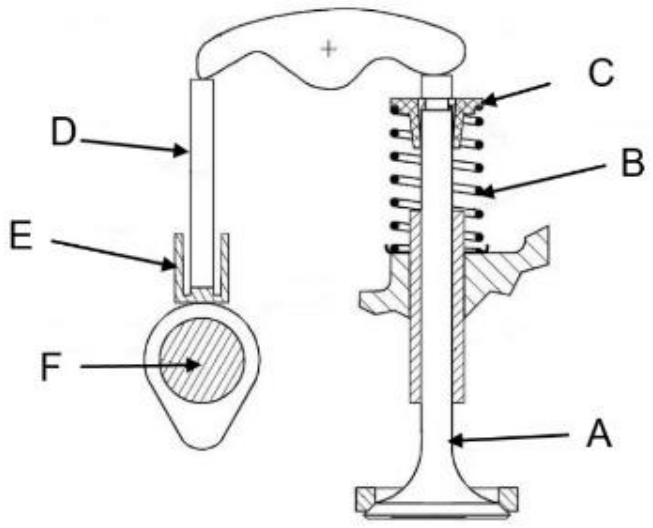
	<p>C- Breaking or fracture point, the stress and load on the material is too great and passes its Ultimate tensile strength therefore it fractures or fails (1). Eeg. over tightening a small nut and bolt.(1)</p> <p>d. Stress is force divided by area. (1)</p>		
2	<p>State a typical modern engine oil pressure reading for a diesel engine, when tested at normal operating temperature. (1 mark)</p>		
<p><b>Acceptable answer(s)</b></p>		<p><b>Guidance</b></p>	<p><b>Max mks</b></p>
<p>1 mark for 50 to 90 psi or 3.4 to 6.2 bar</p>		<p>(do not credit answers without the unit)</p>	<p>1</p>
3	<p>Figure 1 shows the results of a modern diesel engine dynamometer test.</p>  <p style="text-align: center;"><b>Figure 2</b></p> <p>a) Using the graph in Figure 2, state engine power at 950 PTO rpm. (1 mark)</p> <p>b) Using the graph in Figure 2, state the PTO torque at 1000 rpm. (1 mark)</p> <p>c) Convert 90kW to Horse Power. Show all your calculations. (3 marks)</p>		
<p><b>Acceptable answer(s)</b></p>		<p><b>Guidance</b></p>	<p><b>Max mks</b></p>
<p>a) 100-105kW – 1 mark b) 825-875Nm – 1 mark c) 1 HP = 0.746 kW (1); 90 divided by 0.746 = 120.7 HP (1 mark for the correct calculation and 1 mark for the correct answer) total of 3 marks</p>			<p>5</p>

4	Describe <b>four</b> benefits of weighting a tractor when using heavy rear mounted equipment. (4 marks)		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<b>1 mark per description from any of the following, up to 4 marks</b> <ul style="list-style-type: none"> <li>• To achieve conditions of equilibrium/ counter balance weight</li> <li>• To maintain grip / reduce wheel slip (traction)</li> <li>• To maintain steering control</li> <li>• To minimise soil compaction</li> </ul>	Accept any other suitable answer	4
5	a) A two stroke engine requires a fuel mixture of 50:1. What does this ratio mean? (1 mark) b) Describe the effects of an incorrect fuel mixture ratio on engine operation. (4 marks) c) List <b>three</b> special properties of two stroke oil. (3 marks)		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	a) 1 mark for - A mixture of 50 parts petrol to 1 part 2 stroke oil. b) 2 marks per condition, max of 4 marks <ul style="list-style-type: none"> <li>• Too weak results in less oil (1) leading to overheating, seizure, hot running, reduced power output. (1)</li> <li>• Too rich results in more oil (1) leading to poor starting, excessive smoke, reduced power output. (1)</li> </ul> c) 1 mark per answer, up to 3 marks <ul style="list-style-type: none"> <li>• Mixes readily with petrol</li> <li>• Held in suspension enabling lubrication of moving parts</li> <li>• Sticks to internal engine parts</li> <li>• Not diluted by petrol.</li> </ul>	Accept any other suitable answer	7
6	Explain the unit of measurement g/kW/hr. (4 marks)		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>

	<p>The unit of measurement for specific fuel consumption. (1)          The mass of fuel (1) consumed per kW engine power (1) per hour of operation (1)</p>	<p>Accept any other suitable answer</p>	<p>4</p>
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<p>7</p>	<p>Identify the parts of the engine valve, in Figure 3, labelled A, B and C. (3 marks)</p>  <p style="text-align: center;">Figure 3</p> <p>Automotive science and maths Allen Bonnick</p>
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	<p>Acceptable answer(s)</p>	<p>Guidance</p>	<p>Max mks</p>
	<p>1 mark for each answer, up to 3 marks            A - stem            B - margin            C - face</p>		<p>3</p>

<p>8</p>	 <p style="text-align: center;">Figure 4</p>
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	<p>Referring to Figure 4,</p> <p>a) identify the type of valve operation system (1 mark)</p> <p>b) describe the function of the parts labelled B, E and F. (6 marks)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p>a) 1 mark for - O.V.H. or Over Head Valve</p> <p>b) 2 marks per description, up to 6 marks</p> <p>B – to close the valve (1) and hold it closed on the valve seat (1)</p> <p>E – to transmit lift to the push rod (1), stabilise movement of the push rod and evens out wear (1)</p> <p>F – Controls the opening and closing of valve (1) and valve lift (1)</p>	Accept any other suitable answer	7
9	<p>Describe the following engine lubrication terms.</p> <p>a) Multi grade oil (1 mark)</p> <p>b) Oil additives (1 mark)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p>1 mark each</p> <p>i) Multi grade oil – multi viscosity oil</p> <p>ii) Oil additives – additives added to oil to enhance oil</p>	Accept any other suitable answer	2
10	<p>Describe <b>two</b> advantages and <b>three</b> disadvantages of wet cylinder liners. (5 marks)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>

	<p>Advantages – up to 2 marks</p> <ul style="list-style-type: none"> <li>• Replaceable</li> <li>• Thermal cooling conductivity efficiency</li> </ul> <p>Disadvantages – up to 3 marks</p> <ul style="list-style-type: none"> <li>• Can promote cavitation</li> <li>• Can be a challenge to remove</li> <li>• Coolant leakage into engine oil sump</li> </ul>	Accept any other suitable answer	5
11	<p>After winter lay-up, a customer complains that a small four stroke petrol engine machine will not start.</p> <p>Discuss how to diagnose the possible cause(s). (12 marks)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p><b>Band 1 (1-4 marks)</b> The candidate has failed to identify many of the appropriate checks. The candidate has provided minimal rationale for the checks they have proposed. The candidate's responses will not have suggested any expected outcomes of their proposed checks of the systems.</p> <p><b>Band 2 (5-8 marks)</b> The candidate has proposed some appropriate checks, but not in a simple logical sequence. The candidate has provided some reasoning for the checks they have proposed. The candidate's responses have suggested some expected outcomes of their proposed checks of the systems.</p> <p><b>Band 3 (9 -12 marks)</b> The candidate has proposed most of the diagnostic checks in a logical sequence and has provided clear reasoning why they have proposed each check. The candidate has where applicable suggested expected outcomes to their proposed checks.</p>	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• Fuel system- correct type, fresh, carburettor operation/settings, blockages</li> <li>• Air system – blocked air cleaner, contaminated, damaged, restricted air intake (e.g hose collapsed), engine emissions recirculation</li> <li>• Ignition system- spark, plug condition (e.g 0.45mm), wiring, ignition switch/lever</li> <li>• Engine compression testing- wet and dry (eg 10 bar), engine operation</li> </ul> <p><b><i>For no awardable content, award 0 marks.</i></b></p>	12