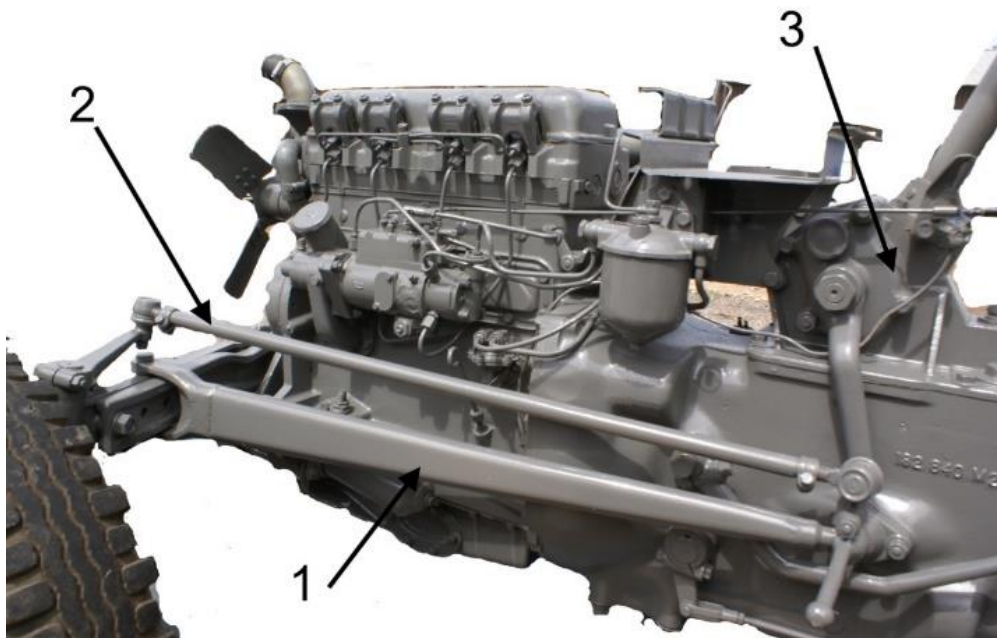


**Qualification: 0171-038-016/516 Level 3 Land-based Engineering - Theory exam**

**June 2018**

1 Name the steering parts labelled 1 to 3 in Figure 1. (3 marks)



**Figure 1**

**Acceptable answer(s)**

**Guidance**

**Max mks**

1 mark each:  
 1 = Radius rod  
 2 = Drag link  
 3 = Steering box

**3**

2	Describe the procedure to adjust the front wheel bearing on a manual steering two wheel drive tractor. (9 marks)		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	1 mark per description up to 9 marks <ul style="list-style-type: none"> <li>• Ensure the vehicle is on a flat level ground</li> <li>• safe jacking /axle stands/ chock axle frame</li> <li>• Remove caps and discard split pin</li> <li>• torque as per manufacturers specification</li> <li>• or tighten nut till free play removed (pre load)</li> <li>• slacken nut until free play is evident (unload)</li> <li>• tighten nut until no free play (bearing nip)</li> <li>• fit new split pin, replace cap and grease</li> <li>• Wheel nuts torqued at end of procedure</li> </ul>	Accept any other suitable answer	9
3	a) Calculate the current flowing, in amperes, in the following 12 volt vehicle light circuits: <p>i. 4 side lights each with 5 watt bulbs and 2 head lamps on dip beam, each with a 55 watt bulb. (4 marks)</p> <p>ii. 4 side lights each with 10 watt bulbs and 2 head lamps on a main beam, each with a 60 watt bulb. (3 marks)</p> <p>b) What size fuse should be fitted to protect each of the circuits in i) and ii). (2 marks)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	a) <p>i) <math>4 \times 5 = 20 \text{ w}</math> (1 mark)  <math>2 \times 55 = 110 \text{ w}</math> total = 130 w (1 mark)  Formula <math>W = A \times V</math> transpose <math>A = W/V</math> (1 mark)  Therefore <math>130/12 = 10.8</math> amps flowing in a) (1 mark)</p> <p>ii) <math>4 \times 10 = 40 \text{ w}</math> (1 mark)  <math>2 \times 60 = 120 \text{ w}</math> total = 180 w (1 mark)  Therefore <math>180/12 = 15</math> amps flowing in b) (1 mark)</p> <p>b) A = Accept 12 or 15 amp fuse (1 mark)  B = 20 amp fuse. (1 mark)</p>		9
4	State the meaning of the following electrical terms: <p>a) Volts (1 mark)</p> <p>b) Resistance (1 mark)</p> <p>c) Watt (1 mark)</p>		

	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p>1 mark for each:</p> <p>a) Volt - unit of electrical potential or motive force  b) Resistance- measure of the difficulty to pass an electric current through a conductor  c) Watt - unit of electrical energy or power</p>	Accept any other suitable answer	3
5	<p>a) Explain the role of the electronic control unit (ECU) in engine management systems. (6 marks)</p> <p>b) Describe the two inputs required to generate a signal by the following sensors:</p> <p>i) Camshaft sensor (1 mark)</p> <p>ii) Coolant sensor (1 mark)</p> <p>iii) Intake air temperature. (1 mark)</p>		
	<p><b>Acceptable answer(s)</b></p> <p>a) 1 mark per point, up to 6 marks:</p> <p>ECU receives information from the sensors (1) and in its processing unit and mapping (1) then determines what actions to take to operate the actuators (1) (injectors and supply pump pressure). Closed loops system enables actions and reactions to occur continuously (1) to adjust fuelling timing/duration/frequency (1) and maintain constant pressure (1).</p> <p>b) 1 mark each, up to 3 marks:</p> <p>i) Engine speed and voltage signal  ii) Voltage and coolant temperature(resistance)  iii) Voltage and air temperature (resistance hot wire)</p>	Accept any other suitable answer	9
6	<p>In relation to yield mapping, state the meaning of the following terms.</p> <p>a) RTK (1 mark)</p> <p>b) GALILEO (1 mark)</p>		

c) DGPS. (1 mark)

Acceptable answer(s)

Guidance

Max mks

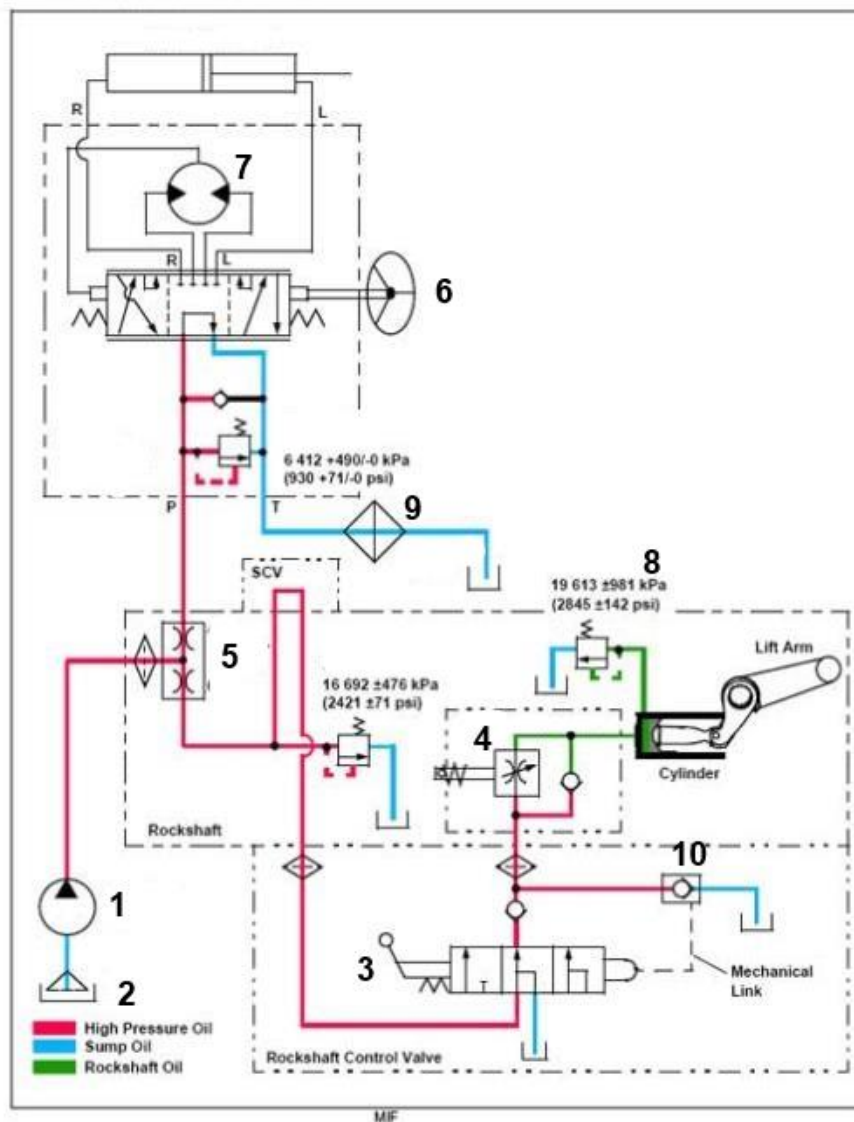
1 mark each, up to 3 marks:

- a) Real Time Kinematics
- b) Europe's own global navigation satellite system
- c) Differential Global Positioning System

3

7 A hydraulic circuit using ISO standard hydraulic symbols is shown in Figure 2.

- a) Name the parts labelled 1, 4 and 9 in Figure 2. (3 marks)
- b) State the type of hydraulic system shown in Figure 2. (1 mark)
- c) Describe the operation of the parts labelled 6, 8 and 10, in Figure 2. (6 marks)



<b>Figure 2</b>			
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p>a) 1 mark each:</p> <p>1- Pump fixed displacement. 4- Variable flow control valve. 9-Oil cooler</p> <p>b) 1 mark for: Open centre.</p> <p>c) 2 marks per description, up to 6 marks:</p> <p>6- To control the steering cylinder (1) using an open centre 3 position DCV sprung loaded to neutral position. (1)</p> <p>8- PRV to limit local circuit pressure (1) to 19613 +- 981 kPA pressure (1)</p> <p>10- Check or one way valve to control oil direction (1) to sump (1).</p>	Accept any other suitable answer	10
8	Explain the difference between positive and non-positive displacement hydraulic pumps. (2 marks)		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>
	<p>1 mark per difference, up to 2 marks:</p> <p>Positive displacement hydraulic pumps have a fixed output at a constant pump speed. (1)</p> <p>Non-positive displacement hydraulic pumps have a variable output at a pump speed. (1)</p>	Accept any other suitable answer	2
9	<p>A customer complains that a 3 cylinder indirect injection engine is a poor starter from cold and misfires when starting. The workshop has assessed that the engine is mechanically good.</p> <p>Discuss the diagnostic procedures to identify the possible cause(s) for this problem. (12 marks)</p>		
	<b>Acceptable answer(s)</b>	<b>Guidance</b>	<b>Max mks</b>

	<p><b>Band 1 (1-4 marks)</b> Basic diagnostic procedures discussed with some understanding of component layout and operation. Little or no specialist terms used and discussion lacks structure.</p> <p><b>Band 2 (5-8 marks)</b> Some diagnostic procedures discussed in a logical sequence and reasonable understanding of systems layout and component names and functions. Some specialist terms used. The information is mostly presented in a structured format.</p> <p><b>Band 3 (9-12 marks)</b> Diagnostic procedures discussed in a clear, logical sequence. Broad understanding of component layout, names and functions. Specialist terms will be used correctly and appropriately. The information is presented in a structured format.</p>	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• Discuss with operator correct starting procedure</li> <li>• Verification of fault.</li> <li>• Access technical information</li> <li>• Visual check for poor connections, broken wires, corrosion</li> <li>• Test battery record results</li> <li>• Measure alternator output</li> <li>• Measure starter volt drop</li> <li>• Check cold starting aid (glow plugs) relay operation</li> <li>• Feed to glow plugs</li> <li>• Test individual plugs for continuity/substitution.</li> <li>• Report fault(s)</li> <li>• Diagnostic tools</li> </ul> <p><i>For no awardable content, award 0 marks.</i></p>	12
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