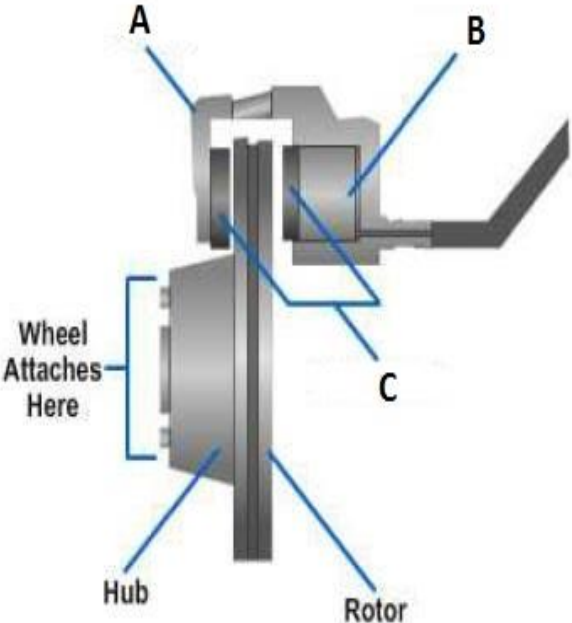


0171 – 38 Level 3 Advanced technical Extended Diploma in Land-based Engineering

0171-016/516 Level 3 Land-based Engineering – Theory Exam 1

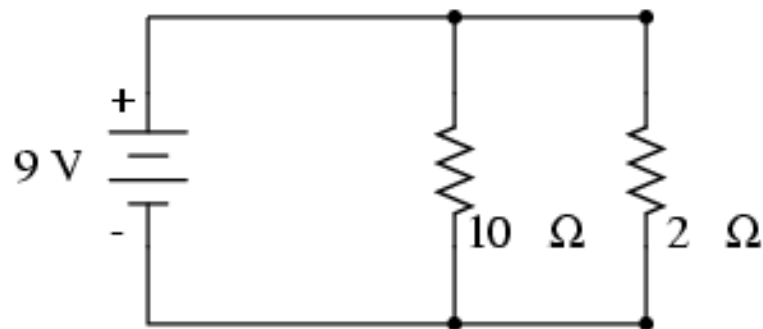
June 2019

1	<p>Identify the components labelled A, B and C in Figure 1. (3 marks)</p>  <p>http://free-ed.net/sweethaven/mechtech/automotive01/</p> <p style="text-align: center;">Figure 1</p>						
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%; text-align: left;">Acceptable answer(s)</th> <th style="width: 25%;">Guidance</th> <th style="width: 15%; text-align: center;">Max mks</th> </tr> </thead> <tbody> <tr> <td> <p>1 mark for each of the following up to 3 marks;</p> <p>A – Calliper</p> <p>B – Piston</p> </td> <td></td> <td style="text-align: center; vertical-align: top;">3</td> </tr> </tbody> </table>	Acceptable answer(s)	Guidance	Max mks	<p>1 mark for each of the following up to 3 marks;</p> <p>A – Calliper</p> <p>B – Piston</p>		3
Acceptable answer(s)	Guidance	Max mks					
<p>1 mark for each of the following up to 3 marks;</p> <p>A – Calliper</p> <p>B – Piston</p>		3					

	C – Brake pads		
2	a) Describe two functions of an ABS braking system. (2 marks) b) Describe two working principles of an ABS braking system. (2 marks)		
	Acceptable answer(s)	Guidance	Max mks
	a) <ul style="list-style-type: none"> • To stop the wheels locking up during braking. (1 mark) • To allow the driver to steer whilst braking heavily. (1 mark) b) <ul style="list-style-type: none"> • Uses an ABS sensor in order to detect skidding. (1 mark) • Brakes rapidly pulse on and off in order to stop the wheels locking. (1 mark) 	Accept any other suitable answer.	4
3	Describe five operating principles of a hydrostatic steering system. (5 marks)		
	Acceptable answer(s)	Guidance	Max mks
	<ul style="list-style-type: none"> • Hydrostatic steering systems have no mechanical linkage to the steered wheels. (1 mark) • Wheels are steered by a cylinder that is hydraulically operated. (1 mark) • A supply pump draws oil from a reservoir and provides flow to a steering orbital. (1 mark) • The metering pump delivers a metered quantity of oil in the steering cylinder relative to the steering wheel movement. (1 mark) • As the steering orbital is rotated by the steering wheel, oil is directed to the relevant side of the cylinder. (1 mark) 	Accept any other suitable answer.	5

4

- a) How much current will be drawn through the 2 Ohm resistor shown in Figure 2? Show all workings. (3 marks)
- b) What is the total resistance value offered by the circuit? (2 marks)



<https://www.allaboutcircuits.com/textbook/direct-current/chpt-5>

Figure 2

Acceptable answer(s)

Guidance

Max
mks

a)

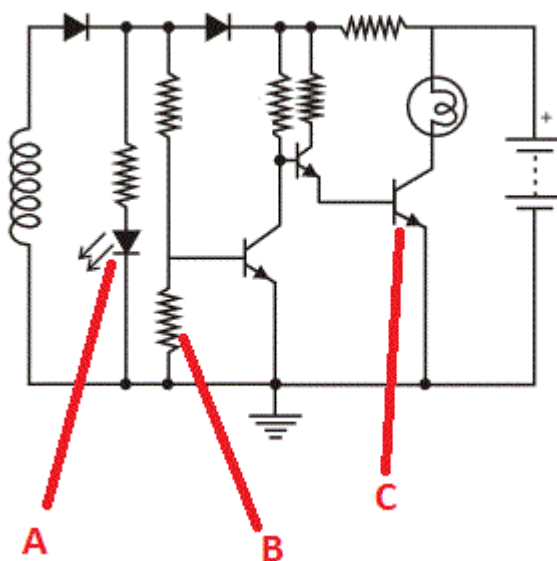
- 1 mark for using the Ohms Law equation ($V=I \times R$)
- 1 mark for transposing the equation to calculate current ($I=V/R$) $I=9/2$
- 1 mark for correctly calculating the current drawn through the resistor (4.5A)

b)

- 1 mark for correctly calculating the total resistance of the circuit ($R_1 \times R_2 / R_1 + R_2 = R_T$)
- 1 mark for the correct answer (1.66 Ohms)

5

5 Identify the components labelled A, B and C in Figure 3. (3 marks)



<https://www.pinterest.co.uk/pin/339107046927087361/>

Figure 3

Acceptable answer(s)

Guidance

Max mks

1 mark for **each** of the following up to 3 marks:

A – Light emitting diode (LED)

B – Resistor

C - Transistor

3

6 Figure 4 lists the specific gravity readings taken by a hydrometer for a 12V lead acid battery.

Cell 1	1.225
Cell 2	1.125
Cell 3	1.280
Cell 4	1.100
Cell 5	1.280
Cell 6	1.270

Figure 4

Referring to Figure 4,

i) Analyse the findings. (2 marks)

ii) Determine the state of charge of the battery. (2 marks)

Acceptable answer(s)

Guidance

**Max
mks**

- i) Any two of the following – 1 mark each
- Cells 3 and 5 are showing as fully charged 1.280
 - Cell 4 is completely discharged 1.100
 - Cell 1 is 75% charge 1.225
 - Cell 2 is discharged 1.125
 - Cell 6 is fully charged 1.270
- ii) Any two of the following – 1 mark each
- The battery needs to be recharged before any further test can be carried out
 - The battery is faulty and needs replacing
 - The battery is low on charge/power
 - Test the battery with a heavy duty tester or electronic battery analyser

Accept any other suitable answer.

4

7

Describe the role of an electronic monitoring and control system on a modern engine fitted to a land based machine. (5 marks)

Acceptable answer(s)

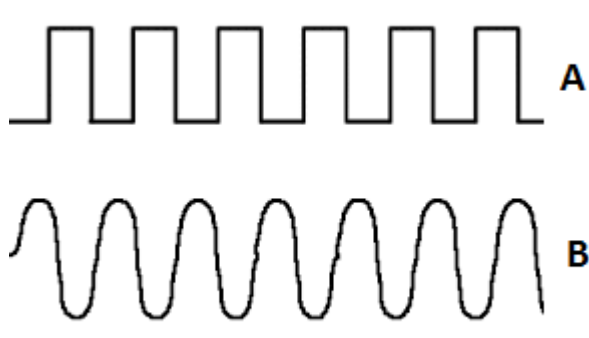
Guidance

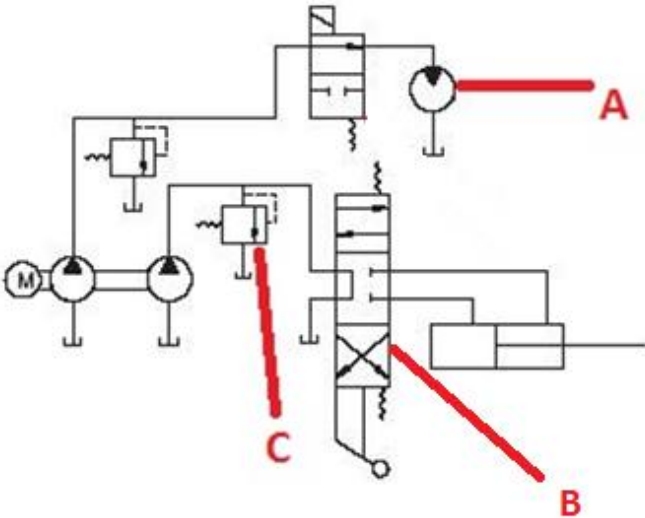
**Max
mks**

- Input signals sent to ECU controller from engine sensors typically- coolant temperature, fuel ratio, air temperature, MAF, MAP DPF, exhaust emissions, crank, throttle and cam position and other fitted input device. (2 marks)
- Output signals to switches and valves (commands) warning lights, HPCR injectors or any other typical output signal (1 mark)
- Monitoring and storage of data relevant to operation and log of fault codes. (1 mark)
- Operator performance screen/monitor detailing information relevant to efficient machine working, fuel consumption, work rate or any typical operation specific reading. (1 mark)

Accept any other suitable answer.

5

8	A tractor with a common rail engine has gone into limp mode. What parameters could be monitored during the fault diagnostic process? (4 marks)		
	Acceptable answer(s)	Guidance	Max mks
	<p>1 marks for each of the following up to 4 marks:</p> <ul style="list-style-type: none"> • Common rail fuel pressure • fuel metering valve • fuel temperature • fuel injection rates • engine speed • fault codes • software updates • mass airflow 	<p>Note to marker: allow fuel pump; fuel pressure; manifold absolute pressure; exhaust gas temperature; diesel particulate filter pre temperature and post temperature.</p> <p>Accept any other suitable answer.</p>	4
9	<p>a) Identify the types of signals labelled A and B in Figure 5. (2 marks)</p> <p>b) What type of waveform is displayed in B in Figure 5? (1 mark)</p> <div style="text-align: center;">  </div> <p style="text-align: center;">http://www.polytechnichub.com</p> <p style="text-align: center;">Figure 5</p>		
	Acceptable answer(s)	Guidance	Max mks

	<p>a) 1 mark each, up to 2 marks A= Digital B= Analogue</p> <p>b) 1 mark for Sinewave (allow alternating)</p>		3
10	<p>Explain the working principles of the components that make up a hydrostatic transmission system. (7 marks)</p>		
<p>Acceptable answer(s)</p>		<p>Guidance</p>	<p>Max mks</p>
<p>1 mark for each of the following up to 7 marks;</p> <ul style="list-style-type: none"> • A variable displacement pump converts mechanical energy into hydraulic energy • The pump delivers flow to a fixed or variable displacement motor • The motor converts hydraulic power into mechanical motion • There are pressure relief valves that regulate maximum pressure in the forward and reverse circuit • A charge pump keeps the closed loop circuit charged with cool, clean oil • The reservoir and filters are responsible for cleaning and cooling the hydraulic oil • A motor loop flush helps to further reduce the operating temperature of the closed loop system 		<p>Accept any other suitable answer.</p>	7
11	<p>a) Identify the components labelled A, B and C in Figure 6. (3 marks)</p> <p>b) Referring to Figure 6, describe what would happen if the cylinder reached the end of its travel and flow continued? (2 marks)</p>		
			

<http://www.hydraulicstatic.com/>

Figure 6

Acceptable answer(s)	Guidance	Max mks
<p>1 mark for stating each of the following up to 3 marks;</p> <ul style="list-style-type: none"> • A – Fixed displacement motor • B –open centre, four way, three position, control valve (spool valve or Directional Control Valve DVC) • C - Pressure relief valve <p>1 mark for each of the following up to 2 marks;</p> <ul style="list-style-type: none"> • Pressure would increase in the circuit • The pressure relief valve would open 	<p>Accept any other suitable answer.</p>	<p>5</p>
<p>12 A tractor has a CAN Bus fault code showing on the display and will not start. The picture on the display indicates an open circuit on the CAN network. Discuss the preparation stages, resources and steps required to carry out a full diagnostic assessment of the CAN system. (12 marks)</p>		
Acceptable answer(s)	Guidance	Max mks
<p>Indicative content:</p> <ul style="list-style-type: none"> • Symptoms of the fault with the operator • Verify the fault code and try to start the tractor • Connect the diagnostic tool and check error codes • Make a note of the error codes and clear them • Turn the ignition on and check error codes again to see if any have returned • Conduct a visual check of electrical connections • Using a multimeter check the resistance across the CAN HI & CAN LO • Total resistance (60 Ohms) • Using a multimeter check the voltage on the CAN HI & CAN LO • Voltage of CAN HI (2.5-3.5 volts) and CAN LO (1.5-2.5 volts) with a total voltage of 5 volts • Check technical documentation and schematic diagrams • Trace the wiring diagram to find each terminating resistor • Check the resistance across each terminating resistor and reconnect • Value of terminating resistance (120 Ohms) 		<p>12</p>

- If these checks highlight an open circuit on the data bus (backbone) then check the continuity of the CAN HI and CAN LO

Band 1 (1-4 marks)

Limited discussion demonstrating **limited** understanding of the diagnostic process with a **limited** range and depth with regards to the preparation, resources and steps required. **Vague** links made in the diagnostic process with **limited** rationale for the proposed preparation, resources and steps required. To access the higher marks in the band, candidates will attempt to order their diagnostic procedure in a logical manner with **limited** success, showing **some** attention to relevant electrical components and may show **limited** attempts to suggest (where applicable) expected outcomes of the proposed diagnostic steps.

Band 2 (5-8 marks)

Detailed discussion demonstrating **clear** understanding of the diagnostic process with **some** range and depth with regards to the preparation, resources and steps required. **Some clear** links made in the diagnostic process with **some** rationale for the proposed preparation resource and steps required. To access the higher marks in the band, candidates will attempt to order their diagnostic procedure in a logical manner with **some** success, showing **clear** attention to relevant electrical components and may have **attempted to suggest** (where applicable) expected outcomes of the proposed diagnostic steps.

Band 3 (9-12 marks)

Comprehensive discussion demonstrating **thorough** understanding of the diagnostic process with **an extensive** range and depth with regards to the preparation, resources and steps required. **Clear and relevant** links made in the diagnostic process with **clear** rationale for the proposed preparation resource and steps required. To access the higher marks in the band, candidates may order the diagnostic procedure in a logical manner **successfully**, showing **focus and comprehensive** attention to relevant electrical components and may **suggest** (where applicable) expected outcomes of the proposed diagnostic steps.