Qualification: 0171-38-018/518 Level 3 in Land-Based Engineering - Theory exam (2)

June 2018

<table>
<tr><td rowspan="3">1</td><td colspan="3">a) On a tractor, state the two standard speeds for the PTO shaft drive system. (2 marks)
b) State two functions of a universal joint as found in a PTO shaft drive system. (2 marks)</td></tr>
<tr><td>Acceptable answer(s)</td><td>Guidance</td><td>Max mks</td></tr>
<tr><td>a) 1 mark for 540rpm and 1 mark for 1000 rpm

b) 1 mark of each of the following, up to 2 marks:
• To transmit rotary motion
• Allows the rod/shaft to bend in any direction.</td><td>Accept any other suitable answer</td><td>4</td></tr>
<tr><td rowspan="3">2</td><td colspan="3">Describe three disadvantages of using straight spur gears in a transmission system. (6 marks)</td></tr>
<tr><td>Acceptable answer(s)</td><td>Guidance</td><td>Max mks</td></tr>
<tr><td>2 marks for each of the following up to 6 marks:

• Produces a lot of noise when operating at high speeds (1) due to small contact area between mating teeth. (1)
• Cannot be used for high load applications (1) due to small contact area. (1)
• Produce a lot of vibration when operating at high speeds (1) due to increased back lash compared to other types of gear trains. (1)</td><td>Accept any other suitable answer</td><td>6</td></tr>
<tr><td>3</td><td colspan="3">a) Describe two main symptoms and causes of excessive differential backlash. (4 marks)

b) Describe one way to check differential backlash. (1 mark)</td></tr>
</table>

	Acceptable answer(s)	Guidance	Max mks
	a) 2 marks per description of symptom and cause, up to 4 marks • excessive gear noise (1) due to increased clearance and reduced contact face of mating teeth (1) • premature gear wear (1) due to increased loading on tooth profiles (1) b) 1 mark for • Use a dial test indicator to check backlash by rocking the ring gear	Accept any other suitable answer	5

4

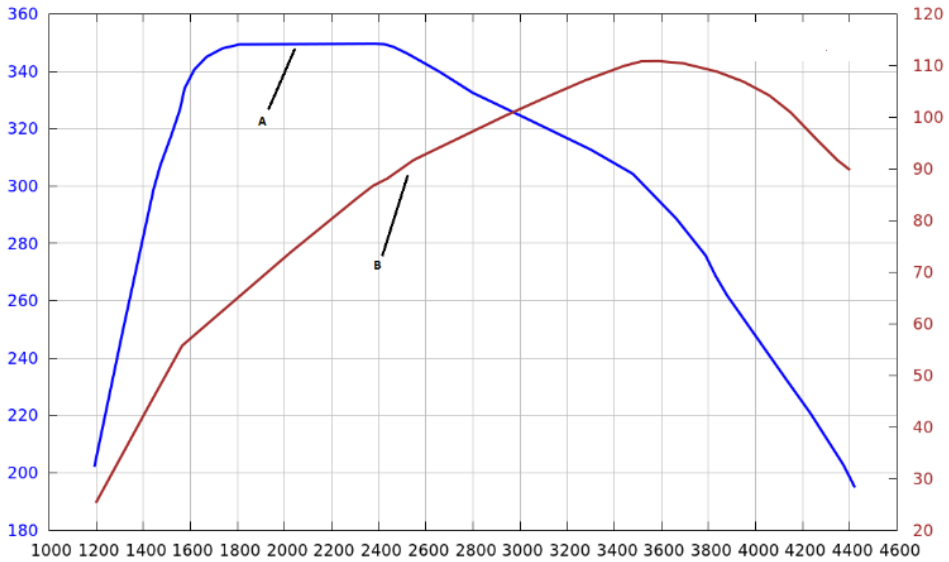


Figure 1

http://community.bugbeargames.com

a) In the graph shown in Figure 1, what does line A represent?

(1 mark)

b) In the graph shown in Figure 1, what does line B represent?

(1 mark)

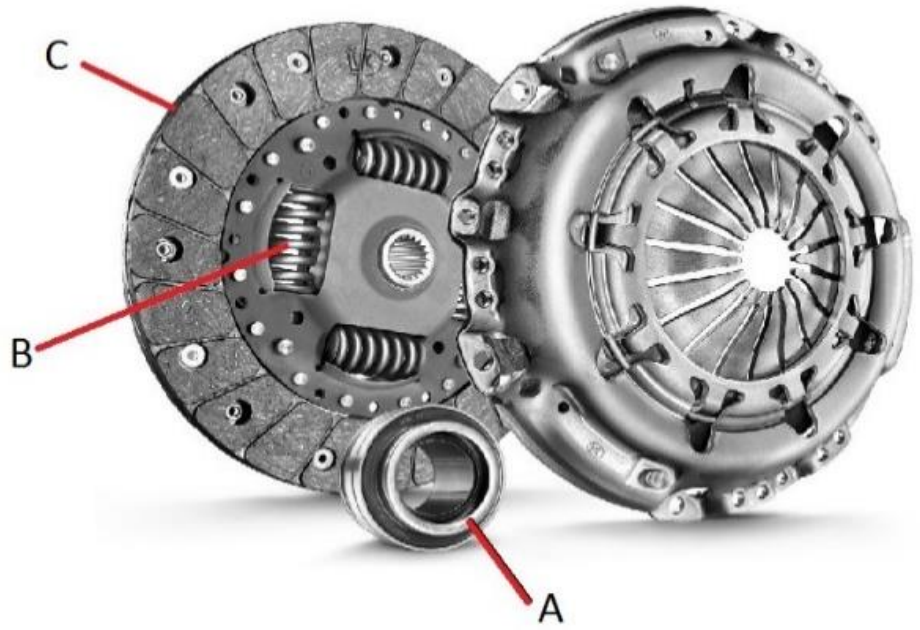
c) What do the numbers on the X axis in Figure 1 represent?

(1 mark)

Acceptable answer(s)	Guidance	Max mks
a) 1 mark for stating torque curve b) 1 mark for stating power curve		3

	c) 1 mark for stating revolutions per minute (rpm)		

5



http://x-engineer.org

Figure 2

a) Identify the type of clutch shown in Figure 2.

(1 mark)

b) Using Figure 2, determine components A, B and C.

(3 marks)

Acceptable answer(s)	**Guidance**	**Max mks**
a) 1 mark for stating single dry plate clutch. b) 1 mark for stating the following up to 3 marks: A – Release bearing B – Torsion spring C – Friction lining / clutch plate/disc		4

6

a) Explain **three** operational symptoms of worn synchronisers in a transmission system.

(6 marks)

b) Describe how to check for synchroniser cone wear.

(2 marks)

	Acceptable answer(s)	Guidance	Max mks
	a) 2 marks each of the following up to 6 marks: • Gears not engaging (1) because the synchroniser cone is not matching speed of the mating gears. (1) • Gears hard to engage (1) because the synchroniser is partially worn and not always fully synchronising (1) • Excessive noise when engaging gears (1) because mating teeth are grating (1) b) 1 mark each for • Check clearance between synchroniser ring and gear against manufacturers specification (1) • Using feeler gauge of appropriate size (1)	Accept any other suitable answer	8

7	Explain **three main** advantages of a full-powershift transmission compared to a semi-powershift transmission. (6 marks)		
	Acceptable answer(s)	**Guidance**	**Max mks**
	2 marks for each of the following up to 6 marks: • No synchronisers (1) meaning less mechanical components in the system and reduced wear (1) • Faster gear changing (1) through electro/hydraulic clutch pack engagement (1) • Smoother gear (1) changing through clutch pack calibration and greater control through solenoid modulation (1).	Accept any other suitable answer	6

8

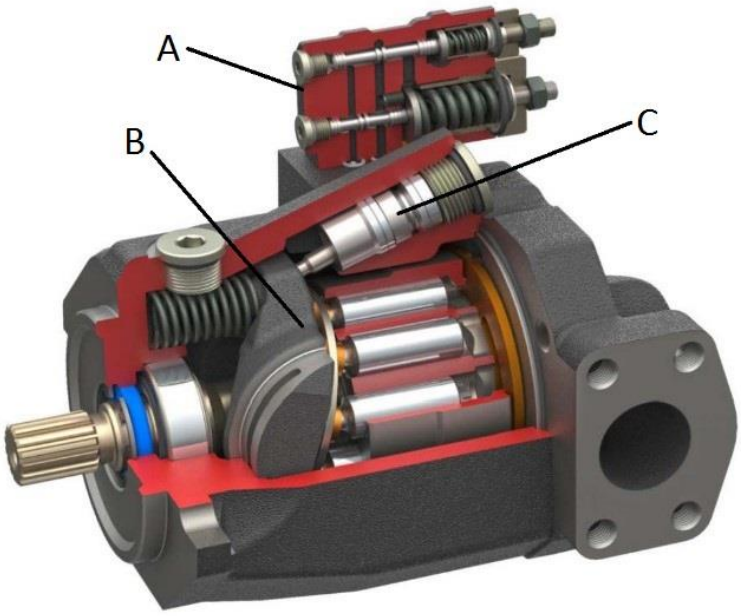


Figure 3

http://www.directindustry.com

a) Identify the type of hydraulic pump shown in Figure 3.

(2 marks)

b) Using Figure 3, identify the components labelled A and B.

(2 marks)

Acceptable answer(s)	**Guidance**	**Max mks**
a) Correct answer is variable displacement axial piston pump 1 mark for stating variable displacement and 1 mark for axial piston pump. b) 1 mark for each of the following up to 2 marks: A – Pressure/flow compensator B – Swash plate		4

9 A hydrostatic transmission circuit is overheating whilst driving. Describe **four** possible causes of the problem. (4 marks)

Acceptable answer(s)	**Guidance**	**Max mks**

	1 mark for each of the following, up to 4 marks: • Damaged motor loop flush • Pressure relief valve set to relieve pressure too early • Low oil level • Partially blocked charge filter • Damaged/restricted oil cooler • Worn charge pump delivering reduced flow • Incorrect oil specification	Accept any other suitable answer	4
10	A typical epicyclic unit consisting of a sun gear, planatary gears, ring gear and planet carrier has a constant input speed on the sun gear. a) What happens to the output speed if the ring gear is rotated in the opposite direction slower than the input? (1 mark) b) What happens to the output speed if the ring gear is rotated in the same direction at the same speed as the input? (1 mark) c) What is the gear ratio if the ring gear is rotated in the same direction at the same speed as the input? (1 mark) d) What happens if the ring gear is rotated in the opposite direction faster than the input? (1 mark)		
	Acceptable answer(s)	**Guidance**	**Max mks**
	1 mark for each of the following up to 4 marks: a) Output speed slows down. b) Output speed matches the input. c) 1:1 d) Output goes in reverse.		4
11	A tractor has a full power-shift transmission with electro-hydraulic control and will not engage into the medium range. Discuss the preparation stages, resources and steps required to carry out a full diagnostic assessment. (12 marks)		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Band 1 (1-4 marks) The candidate has failed to propose many of the appropriate preparation, resources and steps required. The candidate has provided minimal rationale as to why they have proposed any	**Indicative content** • Discuss symptoms of the fault with the operator • Operate the tractor to verify symptoms • Check for error codes	12

	preparation, resources and steps required. The candidate's response may have frequently strayed from focusing on the relevant transmission system and components. The candidate will not have suggested any expected outcomes of their proposed diagnostic steps. **Band 2 (5-8 marks)** The candidate has proposed some appropriate preparation, resources and steps required, in a mostly workable sequence. The candidate has occasionally provided reasons why they have proposed the preparation, resources and steps required. The candidate has largely focused on the relevant transmission systems and components, but may have strayed into discussing irrelevant components. The candidate is unlikely to have suggested expected outcomes of their proposed diagnostic steps. **Band 3 (9-12 marks)** The candidate has proposed a broad range of appropriate preparation, resources and steps required, and in a logical sequence. The candidate has provided clear reasons why they have proposed the preparation, resources and steps required. The candidate has remained focused on the relevant transmission systems and components. The candidate has (where applicable) suggested expected outcomes of their proposed diagnostic steps.	• Select and check relevant technical data/information • Calibrate the transmission • Check electrical solenoids for correct operation • Check for correct adjustment of binocular valve potentiometers • Check binocular valve potentiometer resistance • Check the selector rails are moving and not seized • Conduct a pressure check on the binocular valves • Check diagnostic tools for correct software • Check pressure and flow testing equipment for correct calibration ***For no awardable content, award 0 marks.***	