

Qualification title: Level 3 Advanced Technical Extended Diploma in Land-Based Engineering

Test title: 0171-515/015 Level 3 Land-based Engineering – theory exam

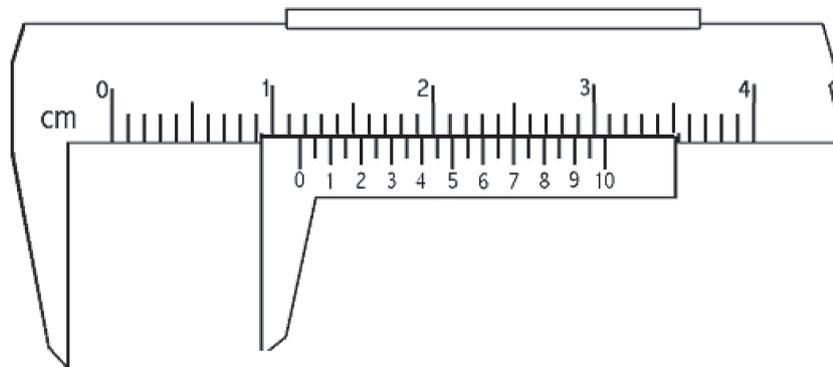
Version: June 2017

Exam date: 22/06/2017

Exam time: 13:30-15:00

Base mark: 60

1.



<http://www.webassign.net>

Figure 1

a) Describe the two scales shown on the measurement tool in Figure 1.

(4 marks)

b) Determine the reading shown on the measurement tool in Figure 1.

(1 mark)

c) Convert the reading found in b) to inches (assuming 1 inch = 25.4 mm), rounded to 1/1000 inch. Show all working.

(3 marks)

Answer:

a) 1 mark for each of the following, up to 4 marks:

- Main scale (1) measured in cm (1)
- Vernier scale (1) measured in mm (1)

b) 1 mark for 11.65 mm (+/- 0.05 mm)

c) 1 mark for each of the following, up to 3 marks:

- Correct working: Reading in mm / mm to inches conversion factor
- Rounding carried out correctly (final answer may still be incorrect)
- Correct answer arrived at: 0.459 inches (based on 0.05 tolerance for part b), other acceptable answers are: 11.60 mm = 0.457 inches; 11.70 mm = 0.461 inches)

Total marks: 8

2. An inlet valve opens 12° before Top Dead Centre (TDC). The crankshaft pulley has a diameter of 125 mm.

Calculate how far around the circumference from TDC the pulley should be marked to indicate the inlet valve opening. Show all working and round your answer to the nearest whole mm.

Assume $\pi = 3.14$

(5 marks)

Answer

- 1 mark for correct formula for determining circumference ($C=2\pi r$ or $C=\pi d$)
- 1 mark for correct circumference (392.5 mm)
- 1 mark for correct working ($(\text{circumference} / 360) \times 12$)
- 1 mark for rounding correctly (final answer may still be incorrect)
- 1 mark for correct answer: 13 mm

Total marks: 5

3. A hydraulic pressure and flow meter shows a pressure readout of 3000 PSI.

a) Convert this pressure value to Bar, rounded to one decimal place. Show all working.

(2 marks)

b) Calculate the pressure value in kilopascals (kPa). Show all working.

(2 marks)

c) Identify **both** the metric and Imperial units of measure for hydraulic flow.

(2 marks)

Answer

a) 1 mark for each of the following, up to 2 marks:

- correct calculation used (3000/14.7 or 3000/14.5)
- correct answer (204.1 Bar or 206.9 Bar, depending on conversion factor used)

b) 1 mark for each of the following, up to 2 marks:

- correct calculation used (answer from part a) multiplied by 100 **or** PSI x kPa conversion factor)
- correct value (20,408 kPa **or** 20,689 kPa **or** 20 684 kPa)

c) 1 mark for each of the following, up to 2 marks:

- l/min
- gal/min

Total marks: 6

4.

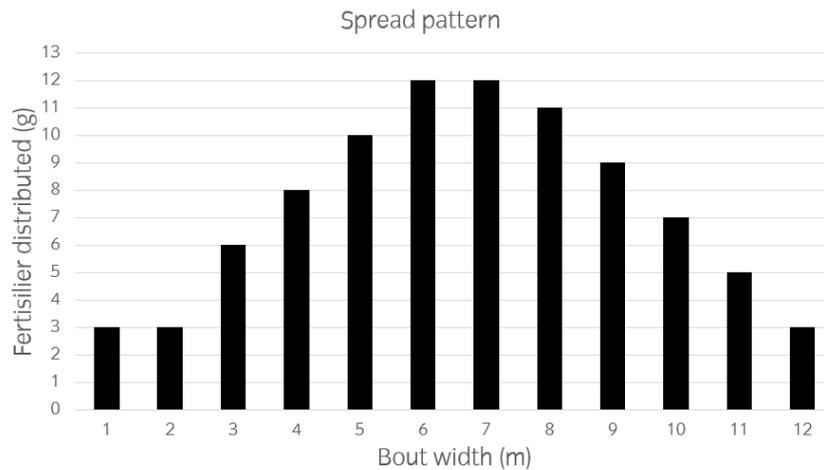


Figure 2

A fertiliser spreader/broadcaster with a 12 m working width has been tray tested in the field. The results are shown in Figure 2.

Using the data in Figure 2, calculate the following:

- a) the total weight of fertiliser distributed (1 mark)
- b) the mean distribution value, rounded to the nearest whole number (1 mark)
- c) the range of distribution values (1 mark)
- d) the mode distribution value (1 mark)
- e) the difference in the weight of fertiliser distributed to the left of the centre line compared to the right of the centre line. (1 mark)

Answer

- a) 1 mark for 89 grams.
- b) 1 mark for 7 grams.
- c) 1 mark for 9 grams.
- d) 1 mark for 3 grams.
- e) 1 mark for 5 grams.

Total marks: 5

5.

Explain the purpose of a lubrication oil in a compression-ignition (CI) diesel engine.

(4 marks)

Answer

1 mark for each of the following, up to 4 marks:

- to neutralise harmful by-products of combustion (e.g. carbon, acids)
- to remove/transport particulates from engine components
- to dissipate heat
- to seal the pistons in the cylinders **or** to create a hydrodynamic film/seal
- to reduce friction and wear **or** to extend component and engine life
- to prevent corrosion/oxidisation of components
- any other suitable answer

Total marks: 4

6.

a) Identify **three** hazardous by-products found in exhaust emissions from a compression-ignition (CI) engine.

(3 marks)

b) Explain how an internal Exhaust Gas Recirculation (EGR) system functions.

(3 marks)

c) Describe the effects on combustion temperatures and emissions when EGR is used.

(2 marks)

Answer

a) 1 mark for each of the following, up to 3 marks:

- Carbon monoxide
- Nitrogen oxides
- Particulate matter/soot
- Hydrocarbons

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

- Extra lobe on camshaft to open an exhaust valve on the inlet stroke
- Allows some spent exhaust gases to be drawn into the cylinder on the inlet stroke
- Reduces the amount of oxygen available for combustion

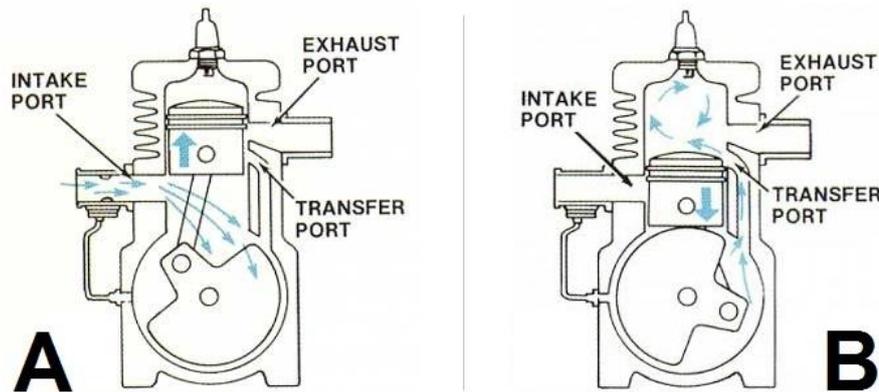
c) 1 mark for each of the following up to 2 marks:

- Temperature lowers
- Lower level of nitrogen oxides
- Increased particulate matter

Accept any other suitable answers

Total marks: 8

7.



<https://www.amsoil.com>

Figure 3

Figure 3 shows the upward and downward strokes of a two-stroke Spark Ignition (SI) petrol engine.

a) Describe what occurs in the two-stroke cycle.

(5 marks)

b) Explain how the induction process is achieved on a naturally aspirated two-stroke engine.

(2 marks)

Answer

a) 1 mark for each of the following, up to 5 marks:

- Inlet port is uncovered to allow for induction of fuel/air mixture
- Piston travelling upwards towards TDC covers the exhaust port to enable compression
- Towards the end of compression, a spark occurs igniting the compressed mixture
- Rapid expansion of burning gases forces the piston downwards towards BDC until the exhaust port is uncovered (i.e. power stroke/exhaust stroke)
- As the piston continues to travel towards BDC, the transfer port is uncovered, allowing pressurised induction gases to push out residual exhaust gases (i.e. scavenging).

b) 1 mark for each of the following, up to 2 marks:

- As the piston travels towards TDC, it creates a depression in the sealed crankcase
- Once the induction/inlet port is opened, the pressure differential pushes the air/fuel mixture into the crankcase.

Accept any other suitable answer

Total marks: 7

8.

a) List **three** types of fuel injector nozzle.

(3 marks)

b) Explain how the nozzle is operated on an electronic fuel injector.

(2 marks)

Answer

a) 1 mark for each of the following, up to 3 marks:

- Single hole
- Multi hole
- Pintle

b) 1 mark for each of the following, up to 2 marks:

- Output from ECU energises solenoid/piezo-electric crystal to lift the nozzle off its seat
- High pressure atomised fuel is delivered into the combustion chamber
- Solenoid/piezo-electric crystal de-energises and spring returns nozzle to its seat

Accept any other suitable answer

Total marks: 5

9.

You are currently working as an engineer in a land-based workshop facility. A tractor with a mechanically fuelled compression ignition engine has been identified as having low compression.

Discuss how compression testing can be carried out to isolate the possible cause(s) of the symptoms.

(12 marks)

Answer

Indicative content

Preparation:

- Appropriate testing equipment
- Obtaining manufacturer's specifications
- Selecting appropriate PPE
- Ensure battery and air cleaner are serviceable

Dry test:

- Prevention of engine start during cranking
- Appropriate testing equipment fitted with effective seals
- Crank engine to achieve maximum pressure on each cylinder
- Compare results to manufacturer's specifications

Wet test:

- Repetition of dry test steps (having first introduced clean oil into each cylinder)
- Compare results to dry test results

Analysis of results:

- Low wet/low dry
- High wet/low dry
- Possible causes

Band 1 (1-4 marks)

The candidate has proposed few - if any - of the preparations required before beginning testing. The candidate has only discussed dry testing in their response, and rarely in a logical sequence. The candidate has not considered that it may be necessary to progress to a wet test. The candidate has suggested few – if any – plausible results for the dry test, and failed to identify any

possible causes of the symptoms. The candidate's response may have strayed from focusing on a mechanically fuelled compression ignition engine.

Band 2 (5-8 marks)

The candidate has proposed some of the preparations required before beginning testing. The candidate has discussed dry and/or wet testing in some detail, although not always in a logical sequence. The candidate is unlikely to have explained why it may be necessary to progress from a dry test to a wet test. The candidate has suggested some possible results for dry and/or wet tests that are relevant to the scenario, and identified some possible causes of the symptoms. The candidate's response remained largely focused on the mechanically fuelled compression ignition engine.

Band 3 (9-12 marks)

The candidate has proposed all of the preparations required before beginning testing. The candidate has provided a detailed discussion of dry and wet tests and in a logical sequence. The candidate has explained why it may be necessary to progress from a dry test to a wet test. The candidate has suggested possible results for both dry and wet tests that are within tolerance and relevant to the scenario, and the candidate has both identified *and* justified possible causes of the symptoms. The candidate remained focused on the mechanically fuelled compression ignition engine throughout their response.

	Total marks: 12
--	------------------------