

**MERCHANT MARINE ACADEMY OF MACEDONIA
SCHOOL OF ENGINEERS**

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Student number:

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FINAL EXAM

A. Fill in the gaps using the words below. There are two extra words. (15 p.)

heavy density pour point energy overheated acid

calories overcooled sulphur liners flash point tank

separators residual carbon thermal temperature

- The _____ content of fuel is stated either in _____ or in British Thermal Units (BTUs) per unit weight.
- The _____ at which fuel oil vapours will ignite when exposed to a flame is the _____ and the minimum acceptable temperature for shipboard _____ fuels has been set to 60 degrees Celsius.
- Corrosion occurs mainly in engines burning _____ fuels, particularly with high _____ content.
- The _____ of a fuel oil determines the requirements for _____ heating and for the arrangement of fuel transfer piping.
- The dew point of sulphuric _____ should be avoided by making sure that fuel injectors, cylinder _____ and exhaust systems are not _____, although this could reduce the _____ efficiency of the engine.
- Information concerning the _____ of fuel is very important for the operation of _____.

B. Complete the sentences with the appropriate form of the words given. (15 p.)

- As heavy fuel oil is more _____ (**viscosity**) than marine diesel oil, it cannot be pressed through the _____ (**inject**) without proper treatment.
- Owners and _____ (**operate**) are taking decisions now on how they will meet the financial and _____ (**comply**) challenges.
- Fuels which are produced on the basis of different crude oils tend to be _____ (**stability**) when mixed.
- Fuel efficiency and _____ (**environment**) friendliness are high on the list of requirements for ship _____ (**propel**) engines from today's shipping and shipbuilding industries.
- Wartsila aims to apply its _____ (**extend**) experience in dual-fuel power to 2-stroke engines.
- The systematic variation in _____ (**alkaline**) may produce uneven _____ (**corrode**) wear on the cylinder wall.

- _____ (residue) fuel oils as bunkered are not fit for use without proper cleaning to remove or reduce _____ (contaminate) that can be present in the fuels, such as water or _____ (catalyst) fines.
- Whatever the advantages of LNG as bunker fuel, _____ (available) of gas is seen as a key issue – if ships cannot bunker LNG where and when it is needed, there will be no incentive to take up this _____ (opt).

C. Fill in the gaps using the words below. There are two extra words. (15 p.)

constituents trim particles wear high deflection crude low
cylinders mechanical crankshaft congeal flow abrasion
viscosity crankpins coolers

- Apart from using the same point on the crankwebs for measuring _____, there are other factors which need to be kept in mind, such as load on the ship, _____, hog, sag, and so on.
- Water mist catchers are installed directly after the air _____ on all MAN B&W MC engines to prevent water droplets from being carried into the _____.
- Over a period of time, as the engine keeps running, the _____ in the bearings may not be uniform across the entire length of the _____.
- Although two fuel oils may have the same _____ figure, the lowest temperature at which they will _____ can be very different because it depends on the _____ of the fuel oils and the types of _____ oils from which they are refined.
- _____ may take place from the products of _____ wear, corrosion and combustion, all of which form hard _____.
- Some fuel oils tend to _____ and wax may appear from the solution when the temperature becomes too _____.

D. Choose the correct option. (5 p.)

- Hard particles which are caught between the upper horizontal ring/groove surfaces can cause ____.
- a. peeling b. punching c. pitting
- Abrasive cylinder wear can be caused by hard ____ which enter the cylinder via the fuel oil and/or air or it may be the result of scuffing.
- a. particles b. parts c. particulates
- The element which causes oxidation to the engine is ____.
- a. carbon b. silicon c. sulphur
- For efficient removal of water by means of a conventional purifier, the correct choice of ____ disc is of paramount importance.
- a. weight b. volume c. gravity

- The ___ the CCAI, the later the ignition takes place.
a. higher b. lower c. clearer

- LNG, as compared to HSFO, emits 99% less harmful ___ and provides a 20% reduction in greenhouse gases from the vessel stack.
a. parts b. particulates c. particles

- In actual practice crankshaft deflection readings should be taken at ___ different positions of the crankshaft.
a. three b. five c. four

- The acronym CFPP stands for :
a. cold filter plugging point
b. carbon filter plugging point
c. cold filter petroleum point

- As gas fuel enters the combustion space and mixes with the combustion air, there is a risk of uncontrolled combustion called ____.
a. blowing b. knocking c. hitting

- The acronym CCAI stands for:
a. calculated calcium aromaticity indication
b. cracked carbon aromaticity index
c. calculated carbon aromaticity index

E. Match the words to their definitions. There is one extra word. (10 p.)

degrade implement gauge congeal dismantle
ease off neutralise catalyst insoluble contaminate tolerance

- a substance which, without itself changing, quickens chemical processes
- solidify/clot
- the permissible variation in some measurements or other characteristics of an object
- make ineffective, with no result
- make impure by mixing in dirty matter
- a measuring instrument
- take apart, disassemble
- come/put into force
- that cannot be dissolved
- become or make less severe

F. Match the terms concerning the marine fuel properties to their definitions/explanations. (15 p.)

lubricity *hydrogen sulphide* *sulphur* *cloud point* *cetane index*

used lubricating oils *heating value* *oxidation stability* *ash*

density *kinematic viscosity* *cat fines* *water* *total sediment aged* *CCAI*

- The inherent ability of the fuel to protect some moving parts of fuel pumps and injectors from wear. _____
- Calcium, zinc and phosphorous are considered “fingerprint” elements of these. _____
- It mainly affects fuel separation. It is used to convert volume to weight. _____
- The temperature at which wax begins to crystallise from a distillate fuel. _____
- The percentage of this in the fuel can be translated into a corresponding energy loss. It may also cause corrosion in the fuel system. _____
- A measure of the tendency of a fuel to form sludge and acid products due to oxidation. _____
- They indicate the presence of tiny particles of aluminium and silicon used in the refining process and carried over into the residual fuel. _____
- The amount of coagulated organic material that can be formed under normal storage conditions. _____
- It is indicative of the ignition delay of a residual fuel oil. _____
- A measure of the fluidity of a fuel at a certain temperature. _____
- An indication of the ignition quality of distillate fuels. _____
- The amount of heat given off on complete combustion of one pound of fuel: _____
- It represents the incombustible metals present in a fuel. _____
- A highly toxic, flammable gas which can be fatal in extreme cases. _____
- Chemical element which can be very injurious to engine parts during combustion because it changes into acid: _____

G. Match the words to their opposites. There is one extra word. (10 p.)

forbid *even* *inflammable* *loose* *slow* *simple*

restricted *longitudinal* *soft* *lose* *inadequate*

- unlimited
- allow
- complicated
- transverse
- sufficient
- rough
- incombustible
- rapid
- irregular
- tight

H. Read the following article and answer the questions that follow. (15 p.)

ExxonMobil has issued fuel-switching tips for vessels entering and leaving ECAs

ExxonMobil has compiled five 'top tips' to help vessel operators switch fuels effectively when entering and leaving emission control areas (ECAs) without introducing maintenance problems.

Typically, inadequate management of the fuel switch-over process can increase the risk of thermal shock to engine components, which can result in fuel pump seizures and engine shut-downs.

ExxonMobil advises marine operators to consider the following key tips:

- Have a clear switch-over procedure. It is important to ensure that the crew is familiar with the process. As an additional safety measure, the procedure should be tested prior to entering crowded and restricted channels where there is a higher risk of grounding or collision.
- Outline the best time to switch over. The optimal switch-over period is different for each vessel and operators must allow sufficient time for the fuel system to be flushed of all non-compliant fuel before arriving at an ECA limit.
- Avoid hazards; know the correct temperature and viscosity. The viscosity of heavy fuel oil (HFO), ECA fuels and marine gas oil (MGO) are very different. The appropriate temperature must be achieved to ensure that the optimum viscosity at the injectors is reached. HFO is injected at ~130°C and MGO needs to be cooled to ~30°C in order to reach the correct viscosity. Major engine manufacturers typically recommend a maximum temperature change of 2°C per minute to help avoid thermal shock.
- Understand compatibility. There is a risk of fuel incompatibility during the switching process where fuels may mix. This may clog filters, causing engine starvation and possible shut-down. In order to understand if fuels are compatible, an industry-standard spot test can be carried out on board or a more thorough compatibility test can be requested from a reputable testing laboratory.
- Choose the correct lubricant. Cylinder oils need to be sufficiently alkaline to neutralise any corrosive acidic sulphur in the fuel. However, when less sulphur is present, less sulphuric acid is produced. Too much alkalinity in the cylinder oil can lead to liner wear, while too little increases the risk of acid corrosion. When burning low sulphur fuels in slow speed engines, it is recommended that a lower base number (BN) lubricant be used.

(Retrieved: 23 June, 2016 from www.mpropulsion.com)

1. What problems can arise if the fuel switch-over process is not carried out adequately?

2. Why should the crew be familiar with the fuel switch-over process in relation to time and area?
3. Why should the crew know the correct temperature and viscosity of the different fuels?
4. What problems can be caused due to fuel incompatibility?
5. How can one check if fuels are compatible?
6. Why is it of paramount importance to choose the correct lubricant?

GOOD LUCK!!!