U.S.C.G. Merchant Marine Exam

Third Assistant Engineer

Q531 Motor Plants I

(Sample Examination)
Choose the best answer to the following Multiple Choice questions.

1. Which of the terms listed below represents the speed at which the natural period of vibration of a shaft or other machine part is in synchronism with the power impulses?
   o (A) Non-harmonic speed.
   • (B) Critical speed.
   o (C) Maximum speed.
   o (D) Design maximum speed.

   *If choice B is selected set score to 1.

2. The pressure-volume diagrams illustrated are of four internal combustion engine cycles. Which one represents the theoretical diesel cycle? Illustration MO-0102
   o (A) A
   • (B) B
   o (C) C
   o (D) D

   *If choice B is selected set score to 1.

3. Which segment of the two-stroke cycle engine diagram shown in the illustration represents the exhaust event? Illustration MO-0037
   o (A) I
   o (B) II
   o (C) III
   • (D) IV

   *If choice D is selected set score to 1.

4. A four-stroke eight cylinder in-line medium-speed diesel engine has a firing order of 1-5-2-6-8-4-7-3. If No.4 piston is at TDC and firing, how many degrees of crankshaft rotation will occur when No.5 piston reaches TDC and fires?
   o (A) 120 degrees
   o (B) 180 degrees
   o (C) 240 degrees
   • (D) 360 degrees

   *If choice D is selected set score to 1.
5. An eight cylinder, four-stroke cycle, single acting diesel engine has a 650 mm bore and a 1400 mm stroke. What will be the developed indicated metric horsepower if the average mean effective pressure is 30 kg/cm² at a speed of 100 RPM?

- (A) 1,689 kW
- (B) 9,111 kW
- (C) 12,388 kW
- (D) 24,776 kW

*If choice B is selected set score to 1.*

6. Which of the following conditions will cause the engine to operate in area “A” of the diagram shown in the illustration? Illustration MO-0126

- (A) Excessive propeller cavitation
- (B) Fouled hull
- (C) Damaged propeller blades
- (D) Inclement weather

*If choice A is selected set score to 1.*

7. An indicator card or pressure-volume diagram, shows graphically the __________.

- (A) compression ratio of the engine
- (B) volume of the engine
- (C) relationships between pressure and temperature during one stroke of the engine
- (D) relationships between pressure and volume during one cycle of the engine

*If choice D is selected set score to 1.*

8. On the cylinder indicator diagram illustrated, the dotted line indicated as "L" is describing the __________. Illustration MO-0033

- (A) cylinder pressure without injection
- (B) firing pressure at 90 degrees crank angle
- (C) beginning of compression
- (D) power expansion curve

*If choice A is selected set score to 1.*

9. Fuel droplets injected into a diesel engine cylinder must have adequate penetration to __________.

- (A) prolong the ignition delay period
- (B) ensure the beginning of fuel injection
- (C) thoroughly utilize the air charge
- (D) allow controlled fuel combustion

*If choice C is selected set score to 1.*
10. Air/Fuel ratio is defined as __________.

- (A) the ratio of the weight of air present to the weight of fuel injected during each power stroke of an internal combustion engine
- (B) the ratio of the weight of air present to the weight of fuel injected during each compression stroke of an internal combustion engine
- (C) the ratio of the volume of air present to the volume of fuel injected during each compression stroke of an internal combustion engine
- (D) the ratio of the volume of air present to the volume of fuel injected during each power stroke of an internal combustion engine

*If choice A is selected set score to 1.*

11. What event triggers the end of the steady combustion period in a diesel engine?

- (A) piston reaching top dead center
- (B) completion of injection
- (C) intake valve or port closing
- (D) piston reaching bottom dead center

*If choice B is selected set score to 1.*

12. Which of the bearings listed below is most widely used for the main and connecting rod bearings of a modern high-speed diesel engine?

- (A) Steel-lined
- (B) Split roller
- (C) Poured Babbitt, self-aligning
- (D) Precision insert

*If choice D is selected set score to 1.*

13. The small end of the connecting rod is attached to the piston with a __________.

- (A) torque bushing
- (B) wrist pin
- (C) crank pin
- (D) sliding wedge

*If choice B is selected set score to 1.*

14. One end of a cylinder for a medium or high-speed diesel engine is sealed by the piston and rings, the other end is sealed by the __________.

- (A) crankcase
- (B) cylinder head
- (C) valve cover
- (D) engine frame

*If choice B is selected set score to 1.*
15. The piston pin shown in the illustration should be classified as ___________. Illustration MO-0011

- (A) semi-floating
  - (B) fixed
  - (C) full floating
  - (D) anchored

*If choice A is selected set score to 1.*

16. The use of push rods becomes necessary in a diesel engine when __________.

- (A) the camshaft is located some distance below the valve gear
  - (B) the rocker arms are pivoted near their centers
  - (C) two or more valves must be opened and closed at the same time
  - (D) hydraulic valve lash adjusters are used

*If choice A is selected set score to 1.*

17. In a modern two stroke, slow speed, internal combustion diesel engine, what is the part of the engine that houses the crankshaft?

- (A) bedplate
  - (B) sump
  - (C) cylinder block
  - (D) frame

*If choice A is selected set score to 1.*

18. During diesel engine warm-up, which type of valve lash adjuster compensates for the change in length of the exhaust valve stem?

- (A) Mechanical
- (B) Hydraulic
  - (C) Pneumatic
  - (D) Electrical

*If choice B is selected set score to 1.*

19. In the large slow-speed main propulsion diesel engine shown in the illustration, the part labeled "G" is the __________. Illustration MO-0003

- (A) jacket water pump
  - (B) crankcase exhaust fan
  - (C) fuel oil pump
  - (D) lube oil pump

*If choice C is selected set score to 1.*
20. The diesel engine shown in the illustration, the exhaust manifold is indicated by the letter _________. Illustration MO-0003
   o (A) A
   o (B) B
   o (C) P
   • (D) U
   
   If choice D is selected set score to 1.

21. Which of the following represents the diesel engine camshaft shown in the illustration and its relative rotating speed? Illustration MO-0122
   o (A) "B" is the camshaft and it rotates at one-half of the crankshaft speed.
   o (B) "T" is the camshaft and its speed equals crankshaft speed.
   • (C) "B" is the camshaft and its rpm will match that of the flywheel.
   o (D) "Y" is the main camshaft drive and rotates at crankshaft speed.
   
   If choice C is selected set score to 1.

22. Which letter represents the top deck (valve) cover of the engine shown in the illustration? Illustration MO-0122
   • (A) "A"
   o (B) "H"
   o (C) "8"
   o (D) None of the above are correct.
   
   If choice A is selected set score to 1.

23. A diesel engine crankcase ventilation system __________.
   o (A) prevents spark generation
   • (B) removes combustible gases
   o (C) determines the level of combustible gases
   o (D) provides inert gas generation in crankcase
   
   If choice B is selected set score to 1.
24. The thrust bearing shown in the illustration has over eight years of ahead running time. Measurements show \( i_1 \) is 4 mm and \( i_2 \) is 1 mm. Which of the following conditions is indicated and what steps should be taken, if any? Illustration MO-0121

- (A) No appreciable wear has occurred, and the proper maintenance procedures should continue to be followed.
- (B) A wear rate of 1.6 mm per year occurred. Although not excessive, this condition may require more frequent monitoring.
- (C) The stops in which the thrust bearing block rides are worn, and it is necessary to return these to their original specifications.
- (D) A wear rate of 1.6 mm per year is excessive and requires immediate assistance from the manufacturer's field support.

*If choice A is selected set score to 1.*

25. After a long period of operation, a wear ridge, caused by piston ring action, will develop near the top of the cylinder liner. This ridge must be removed during maintenance in order to prevent __________.

- (A) excessive ring wear during the seating period
- (B) excessive lubrication of the top ring
- (C) improper coating of lubrication on the cylinder wall
- (D) breaking of the rings, ring lands, or both during piston removal

*If choice D is selected set score to 1.*

26. Excessive side clearance between a piston ring and its groove will cause the ring to __________.

- (A) expand excessively under operating temperatures
- (B) scuff the cylinder liner excessively
- (C) hammer the piston land above the ring
- (D) hammer the piston land below the ring

*If choice D is selected set score to 1.*

27. The vessel to which you are assigned is fitted with a diesel driven generator engine of the type shown in the illustration. In terms of operating cycle and cylinder configuration, what statement is true? Illustration MO-0006

- (A) This is a four-stroke cycle, 90° V-type engine.
- (B) This is a four-stroke cycle, 45° V-type engine.
- (C) This is a two-stroke cycle, 90° V-type engine.
- (D) This is a two-stroke cycle, 45° V-type engine.

*If choice B is selected set score to 1.*
28. The vessel to which you are assigned is fitted with generator drive engines of the type shown in the illustration. In terms of operating cycle and cylinder configuration, what statement is true? Illustration MO-0163

- (A) This is a two-stroke cycle, 90° V-type engine.
- (B) This is a two-stroke cycle, 60° V-type engine.
- (C) This is a four-stroke cycle, 90° V-type engine.
- (D) This is a four-stroke cycle, 60° V-type engine.

*If choice C is selected set score to 1.*

29. Prior to starting an auxiliary diesel engine on your vessel, the crankcase oil level must be checked. At what checked level would you be required to add make-up oil?

- (A) When the oil level drops below the FULL mark on the dipstick.
- (B) When the oil level drops below the ADD mark on the dipstick.
- (C) When the oil level drops to between the ADD and FULL marks on the dipstick.
- (D) When the oil level drops to where it is no longer visible on the dipstick.

*If choice B is selected set score to 1.*

30. When servicing dry-type air filters as used on the vessel to which you are assigned, which of the following criteria would be the most accurate for determining the need for servicing?

- (A) Estimation of severity of dust conditions at the air intake
- (B) Determination of restriction with suitable gauge
- (C) Determination of engine room fresh air exchange rate
- (D) Determination of operating hours since last servicing

*If choice B is selected set score to 1.*

31. In order to determine the restriction across a dry-type air filter on one of the auxiliary diesel engines on your vessel, the engine should be operating at rated speed and load. What instrument would give the most accurate measurement of air filter element restriction?

- (A) A bourdon tube compound gauge.
- (B) A water manometer.
- (C) A mercury manometer.
- (D) A bourdon tube vacuum gauge.

*If choice B is selected set score to 1.*
32. A diesel engine experiences a sudden loss in speed, accompanied by black exhaust smoke, with the fuel rack at maximum, and the speed remaining below normal. The probable cause is __________.

- (A) engine overload
  - (B) leaky valves
  - (C) stuck or broken piston rings
  - (D) low air injection pressure

*If choice A is selected set score to 1.*

33. One cylinder on an auxiliary diesel engine indicates a low firing pressure and high exhaust temperature. Which of the following operating conditions would most likely have caused this?

- (A) late injection timing
  - (B) air intake clogged
  - (C) early injection timing
  - (D) low back pressure

*If choice A is selected set score to 1.*

34. A two-stroke cycle diesel engine requires less starting air than a four-stroke cycle diesel engine, of equal displacement, because the two-stroke cycle diesel engine __________.

- (A) has little or no internal friction
  - (B) has a lower effective compression ratio
  - (C) operates with scavenge air under a positive pressure
  - (D) operates without energy absorbing intake and exhaust strokes

*If choice D is selected set score to 1.*

35. Starting a large low-speed propulsion diesel engine on diesel fuel during cold weather conditions will be made easier by __________.

- (A) increasing the quantity of starting air
  - (B) increasing the lube oil pressure
  - (C) heating the engine fuel supply
  - (D) heating the engine coolant

*If choice D is selected set score to 1.*

36. In a direct cylinder admission air starting system, once the engine begins to fire, the air starting check valve illustrated, is closed by __________. Illustration MO-0107

- (A) the starting air pressure
  - (B) the spring force and cylinder pressure
  - (C) a valve actuating cam
  - (D) a pneumatic bellows assembly

*If choice B is selected set score to 1.*
37. Air motors used for starting some auxiliary diesel engines are generally the type known as _________.
   - (A) gear motors
   - (B) accumulator motors
   - (C) vane motors
   - (D) plunger motors

   If choice C is selected set score to 1.

38. When starting air is admitted, a diesel engine turns over very slowly without firing. The cause may be _________.
   - (A) an obstruction in an engine cylinder
   - (B) water accumulation in some engine cylinders
   - (C) low starting air pressure
   - (D) low scavenge air pressure

   If choice C is selected set score to 1.

39. If an auxiliary diesel engine equipped with an electric starting system cranks very slowly after repeated attempts to start, the cause could be a/an _________.
   - (A) low lube oil viscosity
   - (B) low compression pressure
   - (C) ring gear with broken teeth
   - (D) overheated motor windings

   If choice D is selected set score to 1.

40. Which of the following viscosity scales measures kinematic viscosity?
   - (A) Society of Automotive Engineers (SAE)
   - (B) Centistokes (cSt)
   - (C) Saybolt Universal Seconds (SSU)
   - (D) Furol Seconds

   If choice B is selected set score to 1.

41. The TBN value of diesel engine lube oil refers to its ability to _________.
   - (A) resist changes in viscosity with changes in temperature
   - (B) resist emulsification
   - (C) neutralize acids
   - (D) resist oxidation at high temperatures

   If choice C is selected set score to 1.
42. The most crucial time for any bearing with regards to diesel engine lubrication is _________.
   - (A) during periods of low load
   - (B) during first warm up
   - (C) during initial starting
   - (D) after load reversals

   *If choice C is selected set score to 1.*

43. The lube oil cooler is located after the lube oil filter in order for _________.
   - (A) the filter to operate more efficiently
   - (B) the lube oil cooler to be bypassed
   - (C) positive lube oil pump suction to be assured
   - (D) galvanic action in the cooler to be minimized

   *If choice A is selected set score to 1.*

44. Mechanical lubricators for diesel engine cylinders are usually small reciprocating pumps which are _________.
   - (A) operated manually once each hour
   - (B) operated until the engine has started
   - (C) placed into operation only at maximum load
   - (D) adjustable to meet lubrication requirements

   *If choice D is selected set score to 1.*

45. The device shown in the illustration is classified as a/an _________. Illustration MO-0008
   - (A) comparator type mist detector
   - (B) exhaust gas vapor condenser
   - (C) Ringelmann exhaust gas analyzer
   - (D) reflective type explosion meter

   *If choice A is selected set score to 1.*

46. If the analysis of used lube oil indicates a high content of iron particles, this could indicate _________.
   - (A) corrosive deterioration of a bearing
   - (B) inadequate air filtration
   - (C) excessive ring and liner wear
   - (D) excessive cooling of lubricating oil

   *If choice C is selected set score to 1.*
47. Which of the following problems could develop due to the accumulation of oil vapors in the crankcase of a diesel engine?

- (A) Reduced lubrication
- (B) Poor fuel economy
- (C) Combustion knock
- (D) Crankcase explosion

*If choice D is selected set score to 1.*

48. Crankcase explosions in propulsion diesel engines can result from which of the following?

- (A) the splashing of lubrication oil by the crankshaft
- (B) the dilution of crankcase oil with particles of combustion
- (C) broken fuel lines spraying oil on the crankcase
- (D) the ignition of vaporized lube oil in the crankcase

*If choice D is selected set score to 1.*

49. Pre-combustion chamber engines inject fuel into an antechamber located in the cylinder wall or cylinder head. What is the antechamber referred to when the injection nozzle is located in the main combustion chamber, outside of the antechamber?

- (A) swirl chamber
- (B) energy cell
- (C) pressure pocket
- (D) charging cell

*If choice B is selected set score to 1.*

50. Which of the following is not an advantage of pre-combustion chamber engines as compared to open combustion chamber engines?

- (A) they have smoother combustion
- (B) they have lower peak cylinder pressures
- (C) they do not require fine atomization of fuel
- (D) they have greater thermal efficiency

*If choice D is selected set score to 1.*

51. The unit of measure expressed as centistokes (cSt) is a measure of what fuel property?

- (A) Viscosity
- (B) Heating value
- (C) Density
- (D) Cetane rating

*If choice A is selected set score to 1.*
52. If a particular liquid has a specific gravity of 0.96 kg/dm³ at 77°F, what will be the specific gravity of the liquid, as determined from the graph shown in the illustration, if the temperature is increased to 167°F? Illustration MO-0113

- (A) 0.910 kg/dm³
- (B) 0.915 kg/dm³
- (C) 0.920 kg/dm³
- (D) 0.925 kg/dm³

*If choice D is selected set score to 1.

53. Which of the listed substances can be satisfactorily removed from diesel fuel by centrifuging?

- (A) Sludge
- (B) Gasoline
- (C) Fuel oil
- (D) Lube oil

*If choice A is selected set score to 1.

54. What is the purpose of water transducers used with the separator shown in the illustration?
Illustration MO-0127

- (A) A transducer is located inside the separator to assist in adjustment of the water and oil interface.
- (B) A transducer is located in the clean oil outlet to sense water content in the oil.
- (C) A transducer is located in the dirty oil inlet to measure the amount of water coming into the separator with the process fluid.
- (D) All of the above are correct.

*If choice B is selected set score to 1.

55. When tightening the lock ring "G" of the device shown in the illustration, two events are simultaneously accomplished. Which of the following statements represents these events?
Illustration MO-0112

- (A) The lock ring ensures proper contact between the bowl top and the sliding bowl bottom, in addition to compressing the disc stack.
- (B) The lock ring forces the disc stack onto the spindle, providing a positive means of rotation and locating the bowl top to seal the separation chamber.
- (C) When tightened, the lock ring allows for movement of the sliding piston and positions the sliding piston within the bowl bottom.
- (D) The lock ring ensures proper positioning of the disc stack and maintains a positive contact of the bowl top and bowl bottom.

*If choice C is selected set score to 1.
56. From the graph shown in the illustration, determine the size of the regulating ring required for the proper operation of the fuel oil centrifuge if the fuel oil specific gravity is 0.9 kg/dm³ at 68°F, and the separating temperature is 158°F. Illustration MO-0113

- (A) 86 mm
- (B) 104 mm
- (C) 110 mm
- (D) 117 mm

If choice C is selected set score to 1.

57. Heavy fuel oil used in the system shown in the illustration will have the lowest viscosity __________. Illustration MO-0058

- (A) in the three-way valve
- (B) at the main engine fuel oil header
- (C) in the settling tank
- (D) at the transfer pump discharge

If choice B is selected set score to 1.

58. Which of the following fuel systems is characterized by a complete absence of high pressure fuel lines?

- (A) In-line multi-plunger type system.
- (B) Unit injector type system.
- (C) Rotary plunger type system.
- (D) Common rail type system.

If choice B is selected set score to 1.

59. When running a large, dual fuel, main propulsion diesel engine on heavy fuel, which of the following precautions should be observed when switching from heavy fuel oil to diesel oil?

- (A) The diesel oil must never be allowed to mix with the heavy fuel.
- (B) The heating steam must be secured before the diesel oil passes through the three-way valve.
- (C) The temperature of the fuel from the preheater should be gradually reduced after switching over the three-way valve.
- (D) The heating steam to the preheater should be increased as soon as the diesel fuel passes through the three-way valve.

If choice C is selected set score to 1.
60. While operating the fuel oil centrifuge shown in the illustration, the bowl fails to open for sludge ejection. The probable cause is that __________. Illustration MO-0012

- (A) one or more of the sludge ports is partially clogged
- (B) the operating water pressure is too high
- (C) the bowl disk set is clogged
- (D) the seal ring on the operating slide is defective

*If choice D is selected set score to 1.*

61. The purpose of the delivery check valve used in a diesel fuel injection jerk pump is to __________.

- (A) assist in a quick cutoff of fuel injection
- (B) allow oil backflow from the injector to the helix
- (C) reduce fuel oil pressure between injection strokes
- (D) meter the quantity of fuel delivered

*If choice A is selected set score to 1.*

62. Fuel injector nozzles are usually of the multi-orifice type with the number and placement of the holes arranged according to the __________.

- (A) type of piston rings
- (B) pressure of the fuel system
- (C) size of the pump plunger spring
- (D) design of the combustion chamber

*If choice D is selected set score to 1.*

63. The amount of fuel delivered by a unit injector is controlled by the __________.

- (A) camshaft
- (B) main spring
- (C) rack position
- (D) engine speed

*If choice C is selected set score to 1.*

64. What is the purpose of the "window" installed in the housing of an individual jerk pump?

- (A) To allow the pump to be timed to the engine.
- (B) To check for sludge on the pump barrel.
- (C) To check that fuel oil return passages are clear.
- (D) To set up the fuel rack calibration in cubic millimeters.

*If choice A is selected set score to 1.*
65. According to the illustration, initial timing of fuel injection into the cylinder is controlled with the component that is identified as the letter _________. Illustration MO-0097

- (A) C
- (B) H
- (C) K
- (D) I

*If choice A is selected set score to 1.*

66. When a nozzle tester is used to check the spray pattern of a diesel fuel injection nozzle, which of the following statements is true?

- (A) The valve should normally begin to open at 1/2 the popping pressure
- (B) The needle valve spring should always be removed first before testing
- (C) A serious hazard of blood poisoning exists if the fuel spray penetrates the skin of the operator
- (D) The needle valve should remain open after the nozzle pops open

*If choice C is selected set score to 1.*

67. An immediate repair is required if a leak occurs in the high-pressure fuel piping between the injection pump and fuel nozzle because of the __________.

- (A) high cost of fuel
- (B) pollution hazard
- (C) serious fire hazard
- (D) poor combustion which will occur in that cylinder

*If choice C is selected set score to 1.*

68. When a fuel injection nozzle overheats, which of the problems listed can be expected?

- (A) The fuel metering will vary.
- (B) The fuel will explode.
- (C) The cylinder head will crack.
- (D) The engine will stop.

*If choice A is selected set score to 1.*

69. What is the minimum nominal pipe size for a fuel oil service tank vent line?

- (A) 1.5 inches
- (B) 2 inches
- (C) 2.5 inches
- (D) 3 inches

*If choice C is selected set score to 1.*
70. When operating the HFO purifiers in "parallel", as shown in the illustration MO-0077

- (A) valve "2" would be closed
- (B) valve "3" would be closed
- (C) valve "6" would be closed
- (D) All of the above

*If choice C is selected set score to 1.*
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Thrust Bearing

<table>
<thead>
<tr>
<th>Nominal dimension</th>
<th>Normal play</th>
<th>Max. play (worn)</th>
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<td>( t = 200 )</td>
<td>( t_f = 1.0 )</td>
<td>2.0</td>
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<tr>
<td>( g = 540 )</td>
<td>( g_f = \text{min.} , 0.10 )</td>
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<tr>
<td>( G = 540 )</td>
<td>( h = +0.46 ) ( +0.30 )</td>
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<td>( k = 20 )</td>
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