U.S.C.G. Merchant Marine Exam

Third Assistant Engineer

Q537 Steam Plants I

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

1. Which of the following statements describes the effects that dissolved oxygen has on boiler internal surfaces with changes in temperature and pressure?

   (A) It increases the corrosive effect with lowered pressure and increases its corrosive effect with increased temperature.
   (B) It decreases the corrosive effect when both pressure and temperature are increased.
   (C) It increases the corrosive effect with increased pressure and decreases its corrosive effect with increased temperature.
   (D) Temperature and pressure have no effect on the corrosive effect of dissolved oxygen.

If choice C is selected set score to 1.

2. Assume that steam has formed in a boiler in which all of the steam stop valves are closed, and the water level is held constant. When there is an increase in the temperature of the steam and water in the boiler, which of the following effects will occur on the pressure and the specific volume of the steam?

   (A) The steam pressure and volume will remain constant.
   (B) The pressure will increase and the volume will remain constant.
   (C) The pressure will increase and the specific volume will decrease.
   (D) The pressure will remain constant and the volume will increase.

If choice C is selected set score to 1.

3. Reaching which "end point" will result in the most severe damage to the boiler?

   (A) Carryover
   (B) Atomization
   (C) Circulation
   (D) Combustion

If choice C is selected set score to 1.

4. Circulation of water and the steam/water mixture within a natural circulation boiler is retarded by __________.

   (A) back pressure in the steam drum acting on the user tubes
   (B) fluid friction in the downcomers, drums, generating tubes, and headers
   (C) large changes in steam density
   (D) high feedwater pressure

If choice B is selected set score to 1.
5. Proper bracing and support of the boiler safety valve escape piping is necessary to __________.
   • (A) prevent scale from lodging on the valve seat
   • (B) prevent stressing of the safety valves
   • (C) allow for back pressure formation in the line
   • (D) prevent condensate from accumulating in lines

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

6. A boiler safety valve must be capable of __________.
   • (A) closing with a chattering motion to free scale deposits from the seats
   • (B) remaining open until a preset pressure drop occurs
   • (C) opening gradually above a designated pressure
   • (D) remaining open until all pressure in the steam drum is relieved

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

7. Which of the listed refractory materials is capable of providing structural stability?
   • (A) Insulating block
   • (B) Firebrick
   • (C) Chrome castable
   • (D) Insulating brick

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

8. A corbel is used in a boiler furnace to __________.
   • (A) protect the expansion joints
   • (B) reduce gas turbulence
   • (C) contain the furnace heat
   • (D) direct the flow of gases

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

9. In most marine boilers, the primary reason the first few rows of generating tubes, called screen or furnace row tubes, are made larger in diameter than the rest of the generating tubes is because __________.
   • (A) they require more water flow since they are exposed to the greatest heat
   • (B) they must act as downcomers to ensure proper circulation
   • (C) their main function is to retard combustion gas flow for maximum heat transfer rates
   • (D) they must screen the superheater from the direct radiant heat of the burners

   *If choice A is selected set score to 1.*
10. The advantage of installing waterwall tubes in a boiler furnace is to __________.
   - (A) increase heat transfer to the mud drum
   - (B) decrease the flow of gases through the furnace
   - (C) increase the flow of gases through the furnace
   - (D) permit higher combustion rates

   If choice D is selected set score to 1.

11. Desuperheated steam can be found at the __________.
   - (A) main steam stop
   - (B) spray attemperator outlet
   - (C) generator steam stop
   - (D) high-pressure turbine steam chest

   If choice B is selected set score to 1.

12. Which of the following statements concerning boiler steam drum surface blow piping is correct?
   - (A) The centerline of the pipe is normally situated at a distance from the bottom of the steam drum equal to approximately one fourth the diameter of the drum.
   - (B) Usually the surface blow pipe is perforated with holes along its top surface; however, when a scum pan is also employed, the holes are located along the bottom of the pipe surface.
   - (C) To ensure adequate blowdown, the aggregate cross-sectional area of these perforated holes must be equal to approximately twice the cross-sectional area of the pipe.
   - (D) All of the above.

   If choice B is selected set score to 1.

13. A boiler internal feed pipe is perforated to __________.
   - (A) provide positive flow to the downcomers
   - (B) reduce the weight of the steam drum internals
   - (C) create a slight turbulence in the steam drum
   - (D) distribute water evenly throughout the steam drum

   If choice D is selected set score to 1.

14. A check valve is located between the economizer and the steam drum to __________.
   - (A) prevent the feed pump from becoming vapor bound
   - (B) assure a positive feedwater flow through the economizer
   - (C) assure a positive feedwater flow to the steam drum
   - (D) prevent steam and water flow reversal from the drum should an economizer casualty occur

   If choice D is selected set score to 1.
15. Which of the conditions listed could cause steam formation in the economizer?

- (A) Excessive water flow rates.
- (B) Soot buildup on the gill rings.
- (C) Sudden large increase in the firing rate.
- (D) An open main feed pump recirculating line.

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

16. The main steam stop bypass valve is used to __________.

- (A) supply auxiliary steam when the main steam stop is closed
- (B) cross-connect two steaming boilers
- (C) isolate the main steam stop for repairs while steaming
- (D) gradually increase the pressure and temperature of the main steam piping when warming up

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

17. Scavenging air is supplied to steam sootblower elements to __________.

- (A) prevent back up of combustion gases into sootblower heads
- (B) prevent overheating of adjacent tubing
- (C) provide cooling air when sootblower elements are rotating through blowing arcs
- (D) prevent buildup of soot on the element

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

18. The boiler superheater shown in the illustration is a/an __________. Illustration SG-0007

- (A) overdeck integral-type
- (B) horizontal U-type
- (C) vertical U-type
- (D) overdeck convection-type

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

19. Where is the superheater located in the boiler shown in the illustration? Illustration SG-0008

- (A) G
- (B) H
- (C) I
- (D) J

*If choice A is selected set score to 1.*
20. Which of the following precautions should be taken prior to lighting off a boiler?

- (A) Bottom blow the mud drum.
- (B) Secure the main steam line drains.
- (C) Purge the furnace of combustible gases.
- (D) Close the air register.

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

21. Many steam plants are designed so that diesel oil can be provided to the burners when __________.

- (A) overload capacity is required
- (B) a heavy fuel must be blended
- (C) heavy smoking persists
- (D) lighting off a cold ship

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

22. When raising steam on a cold boiler under normal conditions, you should always __________.

- (A) raise steam within one hour or less
- (B) use a small orifice burner sprayer plate to start
- (C) take 24 hours to raise steam
- (D) use a large orifice burner sprayer plate to start

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

23. When raising steam on a boiler, the superheater drains should __________.

- (A) be closed until just before line pressure is reached, and then given a short blow period
- (B) be closed until after the air cock is closed, and then opened until the boiler is placed on line
- (C) be opened to remove condensate, and then closed when the first burner is lit
- (D) remain open or partially open until steam blows through the lines, and then the valves should be closed

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

24. When a boiler has been secured and is being initially cooled, the water level showing in the steam drum gage glass should be __________.

- (A) maintained at the normal level
- (B) maintained at a full glass
- (C) allowed to go out of sight
- (D) allowed to drop naturally

*If choice A is selected set score to 1.*
25. Which of the actions listed should be carried out immediately after securing the fires in one boiler of a two boiler ship?

- (A) Relieve all fuel oil service pressure to that boiler.
- (B) Secure the main feed pump.
- (C) Drain and refill the boiler with cold water.
- (D) Open the air registers wide to cool the furnace.

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

26. Before using a boiler compressed air sootblower system, you should ________.

- (A) drain the sootblower pneumatic operating lines
- (B) reduce the boiler pressure
- (C) decrease the forced draft fan speed
- (D) lower the water level

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

27. Which of the following items should be checked each time the firing rate or forced draft pressure is adjusted?

- (A) Fuel oil suction pressure
- (B) Atomizing steam pressure
- (C) Fuel oil heater inlet temperature
- (D) Smoke periscope

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

28. If there is a sudden drop in the outlet temperature of an uncontrolled superheater, you should ________.

- (A) check for high water level in the drum
- (B) bypass the air heater
- (C) reduce the forced draft fan speed
- (D) increase the firing rate

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

29. To assure a long service life for boiler refractory materials after installation, the most effective method is to ________.

- (A) properly secure refractory with anchor bolts
- (B) avoid rapid temperature changes and follow recommended operating procedures
- (C) maintain a high furnace temperature at all times
- (D) patch refractory with plastic chrome ore

*If choice B is selected set score to 1.*
30. The boiler water gage glasses should be blown down __________.
   o (A) when the boiler water level changes in a steaming boiler
   o (B) twice each day on the midnight and afternoon watches
   o (C) every 12 hours of steady boiler steaming operation
   • (D) when you are in doubt about the water level

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

31. Radial cracks have developed in the castable refractory of the burner cones after the first firing since the installation of new furnace front refractory. This is an indication of __________.
   o (A) a need for plastic firebrick patchwork
   • (B) relieved stresses
   o (C) a need for castable refractory patchwork
   o (D) inadequate cone angle

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

32. When a propulsion boiler is removed from service for an extended period, why should the firesides be thoroughly dried after water washing?
   o (A) Prevent flarebacks on lighting off.
   o (B) Reduce the possibility of thermal spalling.
   • (C) Reduce the probability of corrosion.
   o (D) Prevent cracking of the brickwork.

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

33. When installing new safety valve escape piping, precautions should include assuring that __________.
   o (A) the piping leads directly to the bilge
   • (B) no stress is transmitted to the valve
   o (C) the quick-closing valve operates freely
   o (D) bends or elbows in the line do not exist

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

34. If the engineer on watch has reason to doubt the accuracy of the water level showing in the boiler gage glass, he should FIRST __________.
   o (A) start the standby feed pump
   • (B) blowdown the gage glass
   o (C) replace the gage glass
   o (D) open the auxiliary feed line

*If choice B is selected set score to 1.*
35. Lower boiler efficiency results from carrying too much excess air because __________.

- (A) it varies the degree of deposits on heat absorbing surfaces
- (B) it decreases the volatility of the fuel
- (C) the flame temperatures are lower
- (D) it increases the volume and temperature of the furnace gas leaving the stack

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

36. Before an explosion can occur in a boiler furnace, there must be an accumulation of unburned fuel, sufficient air to form an explosive mixture, and a __________.

- (A) ground in the burner ignition electrode
- (B) space large enough for the explosion to occur
- (C) high steam demand on the boiler
- (D) source of ignition for the explosive mixture

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

37. The MOST common cause of heat blisters developing on boiler generating tubes is due to __________.

- (A) flame impingement
- (B) gas laning
- (C) insufficient water circulation
- (D) waterside deposits

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

38. Oil or scale deposits on boiler tube walls will cause __________.

- (A) increased boiler steam pressure
- (B) an explosion in the boiler
- (C) decreased boiler steam pressure
- (D) those tubes to overheat

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

39. The boiler feedwater control valve varies the unity relationship between steam and water flow during periods of __________.

- (A) overload operation
- (B) steady boiler load
- (C) minimum boiler load
- (D) load change

*If choice D is selected set score to 1.*
40. During cold ship start-up, you should open the feedwater outlet and condensate valves to a DC heater in order to __________.

- (A) expel non-condensable vapors from the vent
- (B) prevent excessive pressure
- (C) thoroughly atomize incoming condensate
- (D) avoid running the feed pump "dry"

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

41. If it is necessary to operate a turbine driven main feed pump at shut off head, or at less than 20% of its rated capacity, what will prevent the pump from overheating?

- (A) A bypass or recirculating line led back to the pump impeller eye or suction.
- (B) Throttling of the steam supply valve.
- (C) A bypass or recirculating line led back to the source of suction supply.
- (D) Throttling of the liquid discharge valve.

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

42. Which of the following statements is correct regarding the start-up operation of a non-condensing turbine-driven feed pump?

- (A) Keep the pump casing vent valve closed until flow is established through the pump.
- (B) Keep the steam exhaust valve closed until steam is applied to ensure that the auxiliary exhaust line pressure does not drop.
- (C) Secure all drains prior to admitting any steam to avoid damage to traps.
- (D) Open the pump suction valve prior to admitting steam to the turbine.

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

43. With the steam control valve wide open during normal operation, the rate of steam flow from the auxiliary exhaust steam line to the DC heater is actually a function of __________.

- (A) rate of condensation in the DC heater
- (B) rate of evaporation in the DC heater
- (C) spring pressure of the spray valves
- (D) water level in the DC heater reservoir

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

44. The two-element feedwater regulator functions similarly to the three-element feedwater regulator, but does not utilize __________.

- (A) water level
- (B) steam flow measurement
- (C) drum pressure
- (D) feedwater flow measurement

*If choice D is selected set score to 1.*
45. While underway on watch in the engine room of a steam vessel, the proper valve positions for controlling feedwater to the boiler using the auxiliary feed system should be __________.

- (A) the stop and stop-check valves fully open and the feed pump speed used to regulate the amount of flow
- (B) the stop valve fully open and the auxiliary stop-check valve used to regulate the amount of flow
- (C) the check valve fully open and the stop-check valve regulated by the feedwater regulator
- (D) the auxiliary check valve fully open and the stop-check valve used to regulate the amount of flow

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

46. Which of the conditions listed may be indicated by the lifting of the DC heater relief valve?

- (A) A malfunctioning auxiliary exhaust make-up steam regulating valve.
- (B) Low water level continually maintained in the DC heater.
- (C) Excessive deaeration of the feedwater.
- (D) Low back pressure in the auxiliary exhaust line.

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

47. According to the illustrated diagram, what is the correct sequential order of heat exchangers that the main condensate pump pumps condensate through? Illustration SG-0010

- (A) Main air ejector condenser, deaerating feed tank, gland exhaust condenser, first stage feed heater.
- (B) Main air ejector condenser, gland exhaust condenser, first stage feed heater, deaerating feed tank.
- (C) Main air ejector condenser, first stage feed heater, gland exhaust condenser, deaerating feed tank.
- (D) Main air ejector condenser, deaerating feed tank, first stage feed heater, gland exhaust condenser.

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

48. While vacuum is being raised on the main unit and the turbine is being warmed, condensate is recirculated to the main condenser to __________.

- (A) maintain a proper DC heater water level
- (B) ensure the condensation of air ejector steam
- (C) cool the main condenser shell for better vacuum
- (D) provide a condenser vacuum seal

*If choice B is selected set score to 1.*
49. The automatic recirculating valve in the main condensate recirculating line is controlled by a temperature sensor which is located at the __________.

- (A) condensate inlet to the main air ejectors
- (B) main condensate pump suction
- (C) main condensate pump discharge
- (D) air ejector condensate discharge

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

50. Serious tube leaks in the air ejector condenser assembly will cause __________.

- (A) clogged steam strainers
- (B) faulty steam pressure
- (C) fouled nozzles
- (D) loss of vacuum

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

51. Which of the conditions listed could prevent a centrifugal condensate pump from developing its rated capacity?

- (A) Operating the pump with a positive suction head.
- (B) Closing the water seal line to the packing gland.
- (C) Flooding of the main condenser hotwell.
- (D) Venting the pump to the vacuum side of the condenser.

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

52. A basic comparison can be made between a low-pressure evaporator operation and a main condenser with regards to the removal of non-condensable gases. The vacuum drag line for the main condenser is specifically connected in which area?

- (A) main tube bank
- (B) steam lane
- (C) hotwell
- (D) air cooler section

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

53. The most harmful slag forming compounds found in fuel oils are __________.

- (A) vanadium and sodium
- (B) iron and sulfur
- (C) calcium and silica
- (D) potassium and nickel

*If choice A is selected set score to 1.*
54. In accordance with 46 CFR Subchapter D (Tank Vessels), what is the minimum flash point of oil to be used as fuel for the boilers?

- (A) 80°F (26.7°C)
- (B) 110°F (43.3°C)
- (C) 140°F (60.0°C)
- (D) 150°F (65.6°C)

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

55. Which combustible element in fuel oil is considered a significant and major source of air pollution?

- (A) Sulfur
- (B) Nitrogen
- (C) Hydrogen
- (D) Vanadium

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

56. When testing boiler flue gas with a chemical absorption apparatus, to obtain accurate results __________.

- (A) prevent any air from contaminating the gas sample
- (B) run each analysis for at least 3 minutes
- (C) analyze for nitrogen content before oxygen content
- (D) purge the apparatus with air before use

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

57. When burning fuel oil in a boiler, a high CO₂ content is desired in the stack gas because __________.

- (A) more heat is liberated by the production of CO₂ than CO
- (B) efficient combustion is indicated and the heat liberated is equal to the heat produced by the formation of CO
- (C) less excess air is required to produce CO₂ than CO
- (D) efficient combustion is indicated even though the heat liberated is less than the heat produced by burning to CO

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

58. If the stack temperature is higher than normal, this could indicate __________.

- (A) too much excess air
- (B) high feedwater pressure
- (C) low fuel oil back pressure
- (D) external boiler casing leakage

*If choice A is selected set score to 1.*
59. Which characteristic of fuel oil is the most significant when determining the temperature to which the fuel oil must be heated for proper atomization?

- (A) Pour point
- (B) Flash point
- (C) Viscosity
- (D) Specific gravity

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

60. Fuel oil is transferred to the settling tanks for __________.

- (A) purging of any large air bubbles that have formed
- (B) the purpose of removing any volatile gases present in the fuel
- (C) heating to the correct temperature for proper burner atomization
- (D) heating to allow water and sediment to settle out

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

61. The last two digits stamped on a fuel oil atomizer sprayer plate represents the cross-sectional area ratios of the tangential slots and orifice. This ratio determines the __________.

- (A) degree of atomization
- (B) capacity of the atomizer
- (C) angle of the cone
- (D) density of the oil spray

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

62. Valve "H" shown in the illustration, functions to __________. Illustration SG-0009

- (A) regulate the amount of fuel burned
- (B) provide a quick shut off of fuel to the boiler
- (C) recirculate fuel oil during start-up
- (D) prevent a backflow from the manifold

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

63. According to the illustration, what part number identifies the "air door handle"? Illustration SG-0016

- (A) 4
- (B) 6
- (C) 7
- (D) 12

*If choice D is selected set score to 1.*
64. While trying to light off a burner on a semi-automated boiler, you note that the fuel oil solenoid valve at the burner will not stay open. Which of the following conditions could cause this problem?

- (A) The flame scanner is adjusted for excessive time delay in the ignition trial circuit.
- (B) The solenoid coil is energized causing the valve to remain closed.
- (C) The fuel oil pressure at that burner is too high.
- (D) The forced draft air supply has failed.

If choice D is selected set score to 1.

65. In the majority of marine power plants, the fuel oil heater installations are divided into several units because __________.

- (A) more heating is required for lower loads
- (B) auxiliary steam is better utilized in this system
- (C) plant operation can be continued while repairs are being made to a defective unit
- (D) oil leakage into the condensate system is less likely with multiple systems

If choice C is selected set score to 1.

66. Which of the following procedures represents the proper care of unused burners during low load conditions?

- (A) They may be left in place, with fuel and steam secured as long as they are not fouled.
- (B) They may be left in place, but only if they are clean and if fuel oil is recirculated to provide cooling.
- (C) They should be removed, cleaned and stored in the rack on the burner bench.
- (D) They should be removed, cleaned, refitted with smaller tips and reinstalled to be ready for immediate use.

If choice C is selected set score to 1.

67. To obtain the best mixing of air and fuel with a fuel oil atomizer, you need to adjust the __________.

- (A) atomizer position using the distance piece
- (B) diffuser to the desired flow
- (C) primary and secondary air cones for desired air flow
- (D) total air volume admitted to the boiler furnace

If choice A is selected set score to 1.

68. Insufficient combustion air supply will cause an atomizer flame to appear as a __________.

- (A) ragged flame
- (B) dull red flame with black streaks
- (C) pointed flame
- (D) light yellow flame with white streaks

If choice B is selected set score to 1.
69. If a boiler is smoking black and increasing the boiler front air box pressure does not reduce the smoke, the cause can be __________.

- (A) heavy soot on tubes  
- (B) high ambient air temperature  
- (C) dirty atomizers  
- (D) forced draft fan failure

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

70. Which of the conditions listed can cause the flame of a mechanically atomized burner to be blown away from the burner tip when you are attempting to light off?

- (A) The diffuser is burned out.  
- (B) Fuel oil viscosity is too low.  
- (C) Insufficient excess air is being supplied to the furnace.  
- (D) The secondary air cone is improperly adjusted.

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