Questions previously posted in Engine Nautical Queries **Last Modified: 08-14-08**

A vessel has eight B-II CO2 fire extinguishers. How many spare charges must the vessel carry?

A. 0
Correct Answer: Regulation 46 CFR 95.50-15 states that "... spare charges shall be carried for at least 50 percent of each size and variety ... of hand portable fire extinguisher...". Portable CO2 extinguishers are not "readily rechargeable" on board a vessel and "spare charges" as indicated do not need to be carried for this type of extinguisher classification. The regulation continues to state that "... if the unit cannot be "readily recharged" by the vessel's personnel, one spare unit of the same classification is to be carried in lieu of spare charges for all such units of the same size and variety".

B. 1
Incorrect: “A” is the only correct answer.

C. 2
Incorrect: “A” is the only correct answer.

D. 4
Incorrect: “A” is the only correct answer.

Which of the following events shall be conducted during a fire and boat drill?

A. Watertight doors which are in the drill area shall be operated.
Correct Answer: 46 CFR 199.180(f)(2)(v) states checking the operation of watertight doors, fire doors, and fire dampers and main inlets and outlets of ventilation systems in the drill area.

B. All lifeboat equipment shall be examined.
Incorrect: 46 CFR 199.190(e) states that all lifeboat equipment is only required to be checked monthly.

C. Fire pumps shall be started and all exterior outlets open.
Incorrect: 46 CFR 199.180(f)(2)(ii) only requires 2 jets of water be opened to determine that the system is in proper working order.

D. All of the above.
Incorrect: Only "A" above is correct and not "all" of the answers.

Injection lag in a diesel engine may be caused by _____.

A. a higher cetane number of fuel oil
Incorrect: The cetane number of a fuel will not affect the time of fuel injection into the cylinder.

B. the diesel fuel used having a high viscosity
Correct Answer: higher viscosity fuel will contribute to an increased delay of the fuel being forced across the injector tip, resulting in injection lag.

C. mechanical rigidity in the lube pump mechanism
Incorrect: Lube oil pump mechanism has no affect on the fuel system.

D. a decrease in the fuel pump delivery pressure
Incorrect: Decreasing injection pressure will decrease injection lag.

Intercoolers installed on starting air compressors, reduce the possibility of _____.

A. dust entering the high pressure stage
Incorrect: The air filter normally provides this function

B. lube oil carbonization
Correct Answer: By compressing air in stages and cooling it prior to entering the next stage, the temperature of each stage discharge is significantly lowered. Hence, intercooling aids in reducing the carbonization of the lube oil in comparison to compressing air without adding intercoolers.

C. discharge pulsations
Incorrect: Reducing pulsations is a function of the air receiver

D. interstage vapor lock
Incorrect: Vapor lock may be caused by leaky valves

A short circuit in the armature of a DC motor will cause the motor to _____.

A. run fast
Incorrect: A “short circuit" implies that a fewer number of active turns of wire in the armature coils are available for operation. The result of the reduction in available coil conductors would be to produce less torque and thus a reduction in speed

B. hum when energized
Incorrect: During normal operation of an A.C. motor humming is usually associated with AC current creating magnetic field reversals.

C. spark at the brushes
Correct Answer: Brush Problems and Probable Causes-Brush Sparking-short circuit in the armature winding. A short circuit, commonly called a short, is a low resistance current path in the coil of a DC armature and will be indicated by excess current and the smell of burning insulation in addition to the visual indication of sparking at the brushes. Any abrupt change in current flow may cause brush sparking.

D. fail to start
Incorrect: An “open” coil would prevent the flow of current through the coil and result in the DC motor failing to start.

Which of the processes listed occurs during the charging of a lead-acid storage battery?

A. Negative plates change to lead peroxide.
Incorrect: The negative plates containing pure lead, react with the electrolyte and take on the properties of lead sulfate as the battery discharges.

B. Positive plates change to lead peroxide.
Correct Answer: In a fully charged battery, the positive plates contain pure lead peroxide.

C. Both plates change to lead peroxide.
Incorrect: Only the positive plates change to pure lead peroxide

D. Both plates change to lead sulfate
Incorrect: Both positive and negative plates develop lead sulfate, but only during the discharge of the battery.

The most common type of AC service generator found aboard ship is the stationary _____.

A. electromagnetic field, revolving armature
Incorrect: Only found in small simple low power AC generators in which the armature (load carrying conductors) may be rotated in way of a magnetic field.

B. electromagnetic field, oscillatory armature type
Incorrect: This is merely a fictitious description.

C. armature oscillatory electromagnetic field type
Incorrect: This is merely a fictitious description.

D. armature, rotating electromagnetic field type
Correct Answer: When large power units are required, it becomes difficult to sufficiently insulate slip rings, which are a frequent source of trouble. Because of this, most large power producing AC generators are designed with a stationary armature and a rotating magnetic field. In the majority of synchronous machines, and in all of the larger units, magnetic flux is produced in the rotor poles and swept across stationary armature windings. In synchronous alternators, as in all electromagnetic devices, voltage is determined by relative motion between conductors and lines of magnetic flux.

Which type of flux should be used when soldering electrical wire connections and electronic components?

A. Silver flux
Incorrect: This is merely a fictitious description.

B. Rosin flux
Correct Answer: Rosin flux is used to remove oxide films on metals being joined; otherwise the metals will not properly fuse and is widely used for light solder work such as wire connections.

C. Solid flux
Incorrect: This is merely a ficticious description.

D. Alkalide flux
Incorrect: This is merely a ficticious description.

The part of a fuse that melts and opens the circuit is made of _____.

A. copper and antimony
Incorrect: The electrical circuit typically protected by a fuse is composed of copper wiring. As the circuit begins to overheat, the fuse being the “weakest link” will melt and “open” the circuit to prevent the continuation of current flow. Copper and antimony are listed as two individual materials and not as an alloy.

B. steel and babbitt
Incorrect: This answer is incorrect and similar to the discussion in "A" above.

C. aluminum or beryllium alloy
Incorrect: Aluminum is not a suitable fuse material as its melting temperature is relatively high and this may delay it from "opening" quickly to prevent circuit damage, particularly one of aluminum wire.

D. zinc or an alloy of tin and lead
Correct Answer: Generally, fuses are made of zinc or of an alloy of tin and lead. Due to its high resistance and its melting point being lower than that of copper, it will melt before the copper wires become too hot.

The purpose of the water tube boiler furnace refractory is to _____.

I. protect the water drum from direct flame impingement
II. reinforce and strengthen the casing

A. I only
True: The primary purpose of refractory is to retain heat within the furnace, direct flow of heated gases to tubes and to protect the casing and structural members from direct impingement of burner flame. Hence, one result is to protect the water drum from direct flame impingement.

B. II only
False: While refractory will prevent the inner casing from excessive heat and direct flame impingement, anchor bolts welded to the structurally reinforced inner casing prevent refractory walls from falling into the furnace. The refractory itself does not directly lend to the structural reinforcement of the casing.

C. Both I and II
False: Only Choice I is true.

D. Neither I nor II
False: Only Choice II is false.

A three inch overboard discharge line, located six feet below the waterline, has ruptured and separated from the hull. What would be the minimum number of strokes per minute required from a 10" x 8" x 11" duplex double acting reciprocating bilge pump, operating at 93% efficiency, to keep the bilge level from continuing to rise?

A. 46 strokes per minute
Incorrect: Level will rise.

B. 90 strokes per minute
Incorrect: Level will rise.

C. 98 strokes per minute
Correct Answer: (See solution at bottom)

D. 181 strokes per minute
Incorrect Answer: This would be nearly twice the number of working strokes required and unnecessarily overwork the pump

Solution: From the table shown in figure SF-0034, a flow rate of 433 gallons per minute will be discharged from a 3 inch hole with a static head of 6 feet. A pump capacity of at least 433/gpm will be required to prevent the bilge level from rising.

Pump capacity duplex double acting pump: Capacity = Volume of water cylinder x Pumping Stroke Rate x Eff.

Water Cylinder Diameter = 8 inches; Stroke = 11 inches; Pumping Strokes/min = 2 x Strokes/min

$$\text{Capacity (cubic inches)} = \frac{(\text{Pi} \times \text{Diameter}^{(2)})}{4} \times (\text{Length of Stroke}) \times (\text{Pumping Strokes/Min}) \times \text{Eff.}$$

Note: 231 cubic inches equals 1 Gallon

$$C = \frac{(3.1417 \times 8 \times 8) \times (11) \times 2 \times (\text{Strokes/min}) \times \text{Eff}}{4 \times (231 \text{ cubic inches/gal})}$$

$$433 \text{ gal/min} = \frac{1105.84 \times (\text{Strokes/min}) \times .93}{231}$$

$$433 \text{ gal/min} = \frac{1028.43 \times (\text{Strokes/min})}{231}$$

$$\text{Strokes/min} = \frac{433 \times 231}{1028.43}$$

Strokes/min = 97.25

98 Strokes Per Minute Answer

The term "load on top" is used on many crude oil carriers, is to provide a method for _____.

A. calculating the ullage in the cargo
Incorrect: Ullage is the measurement of a liquid's surface in a tank to the top of the tank or sounding tube.

B. loading ballast by gravity
Incorrect: "load on top" is a process only involving the introduction of cargo and is never to incorporate the use of water ballast.

C. the loading of new cargo into the slop tank as a procedure to minimize pollution
Correct Answer: This procedure allows crude oil to be loaded on top of "oily slops" contained in a designated slop oil tank which previously contained contaminated oil from tank cleaning operations and oily bilge water. This tank is heated to permit the water to settle out during the vessel's unloaded ballast passage and decanted through the oily water separator. The procedure minimizes pollution of slop oil being discharged at sea since the "clean" water is carefully monitored during its discharge overboard. Crude oil may then be loaded on top of the remaining water emulsion and slops of which the tank contents will be discharged as cargo at the next discharge port.

D. calculating the ratio of cargo expansion in a cargo tank
Incorrect: Cargo expansion needs to be considered to avoid "overfilling" a tank but has no relationship to "load on top".

Which of the following represents the function of the diffuser used with a mechanical atomizing oil burner?

A. Provide flame stability at the atomizer tip.
Correct Answer: The diffuser limits the amount of primary air by partially shielding the atomizer tip preventing the flame from being blown away from the burner tip.

B. Control the amount of secondary combustion air.
Incorrect Answer: Controlling the amount of secondary combustion air is a function of the forced draft fan speed and damper openings.

C. Complete the vaporization of the fuel for combustion.
Incorrect Answer: There is a difference between the physical process of atomizing into fine particles and the next step of adding heat to the fine particles of fuel to cause vaporization. Through the preheating of the fuel, the use of the correct sprayer plate, and the mixing with heated air provide for vaporization of the fuel.

D. Finely divide the fuel particles into a cone-shaped spray.
Incorrect Answer: The burner sprayer plate develops the cone shaped pattern, dividing the fuel into a fine spray in the process.

In a two stage flash evaporator, operating conditions in the second stage, as compared to the first stage, are _____.

A. higher temperature and higher absolute pressure
Incorrect Answer: In conjunction with the lower absolute pressure in the second stage, the saturation temperature must also be lower.

B. higher temperature and lower absolute pressure
Incorrect Answer: The second stage saturation temperature must also be lower in relation to a lower absolute pressure, than that found in the first stage.

C. lower temperature and higher absolute pressure
Incorrect Answer: The second stage absolute pressure is lower than that of the first stage absolute pressure. As absolute pressure of a heated fluid increases, the saturated temperature of the fluid must also increase.

D. lower temperature and lower absolute pressure
Correct Answer: In order to promote flow from the first stage to the second stage, vacuum in the second stage must be higher. Vacuum is a converse statement of absolute pressure, i.e. as vacuum increases, absolute pressure decreases proportionally and the saturation temperature of the fluid decreases as the absolute pressure decreases.

When renewing sections of pipe in a hydraulic system, the nominal pipe size of the piping always indicates the _____.

A. actual inside diameter
Incorrect Answer: The outside diameter remains constant for a given pipe size while the internal pipe diameter varies according the pipe wall thickness for the service as necessary.

B. actual outside diameter
Incorrect Answer: The actual value of the outside diameter is always greater than the nominal value up to 14 inches, but remains constant regardless of the wall thickness.

C. wall thickness
Incorrect Answer: Pipe wall thickness may be expressed in terms of Standard, Extra Strong, and Double Extra Strong. The external diameter remains constant for each pipe size, where the internal diameter decreases as the wall thickness increases.

D. size for threaded connections
Correct Answer: The nominal pipe size is a relative term indicating a convenient numerical value that is less than the outside diameter, greater than the inside diameter, but is always the same value regardless of wall thickness, and is usefully applied as a convenience in thread sizing.

The function of the loop seal, as typically provided on a flash type evaporator, is to _____.

A. aid in establishing a vacuum in the first stage via the second stage
Incorrect Answer: The air ejectors establish second stage vacuum. The first stage vacuum is established by the use of an external vacuum line or by one or more orifice plates installed in the division wall between the second and first stages.

B. transfer the distillate produced in the first stage to the second stage
Correct Answer: Distillate produced in the first stage is forced to transfer to the second stage condenser section as a result of the pressure differences between the stages and the path provided by the loop seal. Distillate in the loop maintains the pressure differential between the stages.

C. aid in establishing a vacuum in the second stage via the first stage
Incorrect Answer: Second stage vacuum is initially established at a high value by the direct connection to the air ejector equipment. A slightly lower vacuum is developed in the first stage by the second stage.

D. aid in developing a vacuum in the shell of the salt water feed heater.
Incorrect Answer: An external line connected between the first stage of the evaporator shell to the shell of the salt water feed heater is provided to initially develop a lower vacuum in the heater shell than that of the first stage, slightly higher than that of the main steam turbine L.P. bleed.

If you have a simplex single acting reciprocating pump making 190 strokes/minute with a 3” diameter cylinder, a 9” stroke and operating with 90% volumetric efficiency, what is the capacity of the pump?

A. 94 gpm
Incorrect Answer: This would be a correct answer for a duplex double acting style pump.

B. 47 gpm
Incorrect Answer: This would be a correct answer for a simplex double acting or a duplex single acting style pump.

C. 24 gpm
Correct Answer: See solution below.

D. 141 gpm
Incorrect Answer: This would be a correct answer if the cross-sectional area of the water cylinder was presented as a cubed value.

Solution:

Discharge capacity of pumps. The following formula is used to compute the discharge capacity of a water pump in gallons per minute:

G = LANE/231

G = The discharge of the pump, in gallons per minute.
L = the length of the stroke of the piston or plunger, in inches.
A = the cross-sectional area of the pump cylinder, in square inches.
N = the number of working strokes or discharge strokes per minute.
E = the efficiency of the pump. (100% minus the slip in percent)
231 cubic inches equals 1 gal.

Note: As the pump is a simplex (single cylinder) and is single action (one discharge for every two strokes) only half of the strokes completed in this example are "working" strokes.

$$\text{gpm} = \frac{(9) \times (3 \times 3 \times .7854) \times (95) \times (.9)}{231}$$

gpm = 23.54 rounded off to 24 gpm

Which type of screwdriver listed would have a “Keystone” type vertical cross-sectional tip?

A. Torx.
Incorrect Answer: Torx tip has a six point horizontal cross section tip.

B. Phillips.
Incorrect Answer: The head of a Phillips has an "X" shaped horizontal cross section tip.

C. Allen.
Incorrect Answer: Allen tip screwdrivers are made from hexagonal bars of tool steel.

D. Standard.
Correct Answer: Standard screwdrivers have a flat blade but when viewed vertically and from the side, have a “Keystone” shape.

According to the Pollution Prevention Regulations (33 CFR), which of the following conditions would disqualify a nonmetallic hose as being suitable for use in transferring oil?

A. A cut in the cover which makes the reinforcement visible.
Incorrect Answer: 33 CFR 156.120 (i) states that each transfer hose must have no unrepaired loose covers, kinks, bulges, soft spots, or any other defect which would permit the discharge of oil or hazardous material through the hose material and no gouges, cuts, or slashes that penetrate the first layer of hose reinforcement ("reinforcement" means the strength members of the hose, consisting of fabric, cord and/or metal). Since choice A only indicates that the reinforcement is "visible" and does NOT indicate that the reinforcement is damaged or has been penetrated, the hose would still qualify as being suitable.

B. A blown gasket when hydrostatic test pressure is applied.
Incorrect Answer: Deficient gasket connections being indicated during a pressure test of the hose have no bearing on determining the strength of the hose since the gasket is not materially part of the hose.

C. Evidence of internal or external deterioration.
Correct Answer: 33 CFR 156.170 (C)(1)(ii) requires that the hose have no external deterioration and, to the extent internal inspection is possible with both ends of the hose open, no internal deterioration.

D. All of the above statements are true
Incorrect answer: Choice A and Choice B are incorrect.

If your ship burns 3 tons of fuel per hour at 19 knots, how many tons per hour will it burn at 15 knots?

A. 1.5 tons
Correct Answer: A simplified rule of thumb for fuel consumption calculations is that a vessels fuel consumption is proportional to the speed cubed, and represented by the solution below.

B. 1.9 tons
Incorrect Answer: This would be the answer if the formula was solved as a direct proportion to ship speed squared.

C. 2.4 tons
Incorrect Answer: This would be the answer if the formula was solved as a direct proportion to ship speed.

D. 5.3 tons
Incorrect Answer: The fuel consumption must be less than 3 tons per hour since the vessel has decreased speed.

Solution:

$$\frac{\text{Old Fuel Consumption}}{\text{Old Speed}^{(3)}} = \frac{\text{New Fuel Consumption}}{\text{New Speed}^{(3)}}$$

$$\frac{\text{3 Tons per hour}}{19^{(3)}} = \frac{\text{X Tons per hour}}{15^{(3)}}$$

$$\frac{3 \times 15 \times 15 \times 15}{19 \times 19 \times 19} = \text{X Tons per hour}$$

$$\frac{10125}{6859} = \text{X Tons per hour}$$

1.476 Tons per hour = New Fuel Consumption

What is the value of the controlled variable that the automatic controller operates to maintain?

A. Set Point
Incorrect: The set point represents a relative position to which the control-point-setting mechanism is set, and is only obtainable when the value of the controlled variable coincides with the physical setting of the controller and achievable without the condition of "offset."

B. Control Point
Correct Answer: The control point is the value of the controlled variable, which under any fixed set of conditions; the automatic controller operates to maintain the value of the controlled variable.

C. Deviation
Incorrect: Deviation is the instantaneous difference between the actual value of the controlled variable and the value of the controlled variable corresponding with the set point.

D. Offset
Incorrect: Is the steady-state difference between the desired control point and the value of the controlled variable that corresponds to the set point.

Where would a metal-edge, disk type strainer normally be found on a diesel engine lubrication system?

A. Pump discharge line
Correct Answer: This type of strainer is designed for positive pressure applications. It uses a simplified cleaning system and sludge removal feature that can be performed while the system is operating.

B. Gravity tank inlet line
Incorrect. The restricted size of this type of strainer is not practical for large volume/flow applications such as is common in a gravity type lubrication system.

C. Oil sump return line
Incorrect: Oil return lines are not usually fitted with filters, but drain directly and unimpeded to the engine's sump.

D. Pump suction line
Incorrect: The restricted flow through this type of strainer would create an excessive pressure drop and easily cavitate the oil pump.

Which of the operating principles listed would apply to a single-element, thermo-hydraulic feedwater regulator?

NOTE: There are three main sections associated with a single-element feed water regulator. The feed water regulating valve and actuating bellows, which opens in response to applied vapor pressure; an inner tube affixed to the steam drum to reflect the virtual level of water in the drum; and an outer, enclosed tube, pressure generating system or generator. The generator is partially charged with water, and will increase in its percent of vapor in response to and proportional to the drum water level. Hence, the percent of vapor and corresponding vapor pressure will be inversely proportional to the level of water in the steam drum.

A. A failure of the regulator pressure actuating system closes the valve.
Correct Answer: A low water level in the steam drum would result in a large column surface area to be exposed to steam in the inner tube. This relationship results in the transfer of a greater amount of the heat to the fluids in the outer tube resulting in an increase in the percent of vapor and an increase in the vapor pressure. The increase in pressure develops a higher force to act upon the feed water valve actuating bellows atop the feedwater valve stem and in opposition to the countering spring force which attempts to close the feed water valve. A leak of fluid from the outer tube would prevent the pressure buildup required to open the valve against the spring force.

B. The regulator maintains a constant water level throughout the boiler load range.
Incorrect: The single-element or proportional control system is intrinsically subject to the condition of offset as loads vary. The amount of offset increases significantly as the rate of load (steam demand) changes, rendering a steady state or constant water level virtually impossible to maintain unless the control point is continually changed or the addition of process controls, such as reset or rate are added, as associated with the "two" and "three" element regulators.

C. The cooling fins on the generator prevent the formation of steam in the closed system.
Incorrect: The cooling fins applied to the "generator" are simply provided to maintain a continuous transfer of heat to allow and reflect changes in the steam/water relationship within the generator.

D. The pressure in the inner tube acts upon the bellows of the regulator.
Incorrect: The water and steam volumes existing in the inner tube are directly proportional and related to the steam drum contents of water level and steam. The relative volume of water and steam in the inner tube affect the quantity of heat transferred to the water contained in the outer, enclosed tube, pressure generating system or generator, whose vapor pressure changes accordingly and acts directly on the feed water valve actuating bellows.

In a vapor compression type refrigeration cycle, the refrigerant temperature decreases the most in the _____.

A. evaporator
Incorrect Answer: By design, as the cool, mostly liquid refrigerant passes through the evaporator, it absorbs latent heat from the refrigerated space to become fully vaporized. Even though the vaporized refrigerant absorbs additional heat to become superheated, it may only be 10 degrees warmer than it was when it initially entered the coil.

B. condenser
Incorrect Answer: As the refrigerant transfers its latent heat, superheat, and heat of compression as it flows between the inlet and outlet of the condenser, there is a minimal change in temperature and is only due to some minor sub cooling as the high pressure of the condensing gas and liquid remains relatively constant.

C. compressor
Incorrect Answer: The refrigerant vapor will increase in temperature as it is pumped through the compressor.

D. expansion valve
Correct Answer: Significant temperature differences occur in relation to changes in saturation pressure as the refrigerant passes through the restriction within the expansion valve and represent the greatest change at this point. As the high pressure/high temperature liquid refrigerant passes through the restriction into the lower pressure region, a small percentage of the liquid flashes to vapor as the latent heat is absorbed from the remaining liquid reducing its temperature.

To prepare an auxiliary water-tube boiler for a routine hydrostatic test, which of the following procedures should be undertaken prior to filling the boiler with fresh water?

A. The safety valve escape piping should be disconnected from the valve body and a blank inserted.
Incorrect: A safety valve gag is required to be installed "hand tight" on the safety valve stem to prevent it from opening during the actual test. Escape piping need not be dismantled or modified during a routine hydrostatic test.

B. The boiler vent valves should be opened.
Correct Answer: Opening the drum vent and superheater vent valves (if equipped) will allow any trapped air to be expelled from the boiler as it is filled, thereby preventing the compression/expansion of trapped air during the hydrostatic test which could result in pressure fluctuations.

C. All handhole/manhole covers should be tightened up as much as possible to preclude any leaks.
Incorrect: All handhole/manhole covers should only be firmly tightened. As the hydrostatic test is applied, the pressure will tend to firmly seat the covers in place and the nuts holding the dogs should be rechecked for looseness. Only those covers which show signs of leaking during the test should be drawn up with additional force as an initial attempt to stop the leak.

D. All of the above.
Incorrect: As only one of the three answers above is correct, "all of the above" is eliminated as the answer.

When a megohmeter is used to test the insulation of a large motor, the initial dip of the pointer toward ‘zero’ is caused by _____.

A. good insulation
Incorrect: if the insulation is clean and not defective or deteriorated, especially with smaller motors, the megohmeter will register a high value of ohmic resistance and will not indicate any appreciable dip toward "zero" ohms.

B. the capacitance of the winding
Correct Answer: large motors with proper insulation values will show a considerable capacitive effect between the conductors and the frame during the initial operation of the megohmeter. As the meters voltage charge is transferred to the windings, the pointer will dip toward zero due to the flow of charging current.

C. the leakage of the current along the surface of dirty insulation
Incorrect: dirty or defective insulation will be indicated by slight kicks downscale toward zero

D. the dielectric-absorption effect of the insulation
Incorrect: this will not cause the initial dip, but will cause the pointed to slowly increase in value before reaching steady state.

During the compression stroke in a four-stroke/cycle, internal combustion engine, assume that the piston can only travel seven-eighths of the total distance between BDC to the underside of the cylinder head. Which of the following ratios will be the compression ratio for this engine?

A. 6 to 1
Incorrect.

B. 7 to 1
Incorrect.

C. 7.5 to 1
Incorrect.

D. 8 to 1
Correct Answer: The formula to calculate compression ratio is derived as follows. Compression Ratio equals the "Total Volume" in the cylinder at start of compression, divided by the "Remaining Volume" in the cylinder at end of compression. It can also be expressed as: Compression Ratio equals the cylinder piston displacement volume plus the clearance volume, divided by the clearance volume. The question indicates that the total volume in the cylinder is 8 units, the piston displaced volume is 7 units, and the remaining volume is 1 unit, for a compression ratio of 8:1.

Which of the following operating characteristics of the Bendix drive friction clutch is associated with the Bendix drive starter?

A. Helps absorb the shock when the pinion engages the ring gear.
Correct Answer: The clutch helps to cushion the torque force of the pinion as it reaches the end of its axial travel upon engaging with the flywheel.

B. Disengages the pinion from the flywheel ring gear.
Incorrect: After the engine starts, the flywheel rotates the Bendix gear at a higher speed than the rotating shaft of the starter motor. This results in the pinion to be rotated in the opposite direction on the starter motor shaft's helical spiral, causing the pinion to disengage from the flywheel.

C. Engages the pinion with the flywheel ring gear.
Incorrect: The pinion of the Bendix drive is mounted on the starter motor shaft's helical thread. As the starter motor shaft turns, the pinion gear, which floats on the shaft helical thread, moves outward, forcing it to mesh with the flywheel ring gear, to rotate the engine. The friction clutch only helps to absorb the shock of initial engagement.

D. Prevents the pinion starter from overrunning on the starter shaft.
Incorrect: The friction clutch is not designed as an overrunning clutch since that would defeat the purpose of the shaft helical spiral thread in returning the pinion to its initial position after the engine had started.

Refrigerant leaving the metering device in a refrigeration system is a _____.

NOTE: As the liquid passes through the thermal expansion valve (metering device), the high pressure/high temperature liquid experiences an adiabatic process in which the total heat (sensible heat plus latent heat) at the inlet and the total heat at the outlet on the low pressure side are virtually the same. The specific heat of the liquid at the inlet is much higher than the specific heat at the out. Since heat can neither be created nor destroyed, but only transformed, the remaining heat at the low pressure outlet will be transformed as latent heat. As the former high pressure/high temperature liquids passes into the low pressure, the excess specific heat flashes the low pressure liquid and through the flash process reduces the sensible heat of the liquid until it stabilizes at the corresponding saturation temperature to that of the existing low pressure in the evaporator coil.

A. Sub-cooled liquid.
Incorrect: The liquid cannot attain a temperature lower than its saturation condition without having been physically removed from the immediate point of entry.

B. Sub-cooled vapor.
Incorrect: A vapor cannot be sub cooled.

C. Saturated liquid/vapor mixture
Correct Answer: The fluid form leaving the metering device after entering the area of lower pressure and affected by the adiabatic process noted above, now exists as both a saturated vapor and saturated liquid. The mixture continues to pass through the evaporator coils where the remaining liquid continues to absorb additional heat from the space being cooled, completely and ideally vaporizing at a point about 2/3 of the distance into the evaporator coil.

D. Saturated liquid
Incorrect: The only means by which "all" of the liquid could continue to exist as a saturated liquid would be for it to exist at the same temperature/pressure conditions as it did upon entering the metering device.

At what temperature would the reading on the Fahrenheit scale and the Centigrade scale be identical?

A. 16 degrees above zero.
Incorrect.

B. 32 degrees below zero.
Incorrect.

C. 40 degrees below zero.
Correct Answer: See solution below.

D. 64 degrees below zero
Incorrect.

Solution: The question is asking for the numerical value of temperature which is identical on both the Centigrade scale and Fahrenheit scale.

Temperature (Centigrade) = Temperature (Fahrenheit) = Temperature (Answer)

Our standard temperature conversion formula is:

$1.8\ T_{(C)} + 32 = T_{(F)}$

if $T_{(C)} = T_{(F)} = T_{(Ans)}$ then:

$1.8\ T_{(Ans)} + 32 = T_{(Ans)}$

Subtract 32 from both sides of the equation:

$1.8\ T_{(Ans)} + 32 - 32 = T_{(Ans)} - 32$

$1.8\ T_{(Ans)} = T_{(Ans)} - 32$

Subtract $T_{(Ans)}$ from both sides of the equation:

$1.8\ T_{(Ans)} - T_{(Ans)} = T_{(Ans)} - T_{(Ans)} - 32$

$0.8\ T_{(Ans)} = -32$

divide both sides by 0.8

$$\frac{0.8\ T_{(Ans)}}{0.8} = \frac{-32}{0.8}$$

$T_{(Ans)} = -40$

Answer = Minus 40 degrees below zero

The amount of voltage induced in the windings of an AC generator depends mainly on _____.

A. the number of field poles energized
Incorrect: The number of field poles and the speed of rotation of the rotor determines the value of bus frequency, not voltage.

B. the speed at which the stator windings rotate through the magnetic field
Incorrect: The stator windings are attached to the generator stationary housing and do not rotate.

C. the strength of the magnetic field
Correct Answer: DC excitation voltage when applied to the rotating field windings induce an electro-magnetic force in the stator windings, which produces generator output voltage.

D. all of the above
Incorrect: Since choices A and B are incorrect, all of the above cannot be a valid answer.

In the operation of a flash type evaporator equipped with air ejectors, the air and non-condensable gases are evacuated directly from the _____.

A. first stage flash chamber
Incorrect: Evacuating air and non condensable gas directly from the first stage flash chamber would result in maximum vacuum to be developed in the first stage. The two stage process would be reduced to that of a single stage as there would no longer be a sufficient pressure differential to force the fluids into a lower pressure area as normally occurs from the first to the second stage.

B. second stage flash chamber
Incorrect: If the suction line were physically located in the second stage flash chamber, the air ejector would draw large quantities of flashed vapor into the air ejector suction line and "choke-off" the air ejector, impairing its ability to continue to produce the vacuum as required.

C. first stage after condenser
Incorrect: There is no component in a two stage evaporator identified as an "after condenser" as is usually associated with the standard design for the main and auxiliary air ejectors.

D. second stage distilling condenser
Correct Answer: The air ejector normally draws from the lower section of the second stage distilling condenser, which performs, as one of its functions, the separation of air and non condensable gases from the flashed vapor of the second stage. The enhanced method of vapor and non condensable gas separation is similar to the process performed by the air cooler sections of the main and auxiliary condensers.

Which of the following terms represents the form of heat removed from the refrigerant in the condenser of a refrigeration system?

A. Latent heat of vaporization.
Correct: Latent heat of vaporization is absorbed by the condenser cooling water from the vapor while passing across the cool condenser tubes, causing a physical change of state - converting the vapor to a liquid.

B. Heat of compression.
Correct: Heat gained by the vapor during the work of compression is also transferred to the condenser cooling water as the refrigerant is liquefied.

C. Superheat.
Correct: The metered flow of liquid refrigerant passing through the evaporator coil absorbs heat from the space being cooled, causing it to vaporize and become slightly superheated. The superheat vapor protects the compressor suction from liquid slugging.

D. All of the above
Correct Answer: All of the above conditions are correct.

You are attempting to parallel two AC generators and the synchroscope pointer stops at a position other than 0^{o} prior to closing the circuit breaker. This indicates _____.

A. the frequency of the incoming machine is the same as the bus frequency
Correct Answer: The speed and direction at which the synchroscope pointer rotates is a function of the "difference" in frequency between the bus and oncoming generator. The stopping of the pointer indicates that both oncoming generator and bus frequencies are identical but are not necessarily in phase. Since the pointer is at a position other than 0^{o}, this indicates that the on-coming "generator phase relationship" is out of step with the "bus phase relationship" by a fixed number of electrical degrees. The proper procedure for paralleling should be to slightly accelerate the oncoming generator to match the bus phase relationship and close the circuit breaker when the pointer reaches a position slightly before 12 o'clock.

B. the incoming machine is in phase with the bus, but the frequency is not the same
Incorrect Answer: Since the pointer has stopped, the generator and bus frequencies are identical, but the two are out of phase with each other and are not ready to be paralleled.

C. the circuit breaker may be closed after breaker has been reset
Incorrect Answer: The action of "resetting" the breaker is a preparatory requirement to be able to "close" the breaker and is unrelated to synchroscope operation.

D. there is an existing cross current between generators
Incorrect Answer: Cross current conditions can only exist between generators which are operating under parallel conditions. The cross current is the result of having unequal field excitation values between generators and is the interchange of reactive power.

The loop seal connected to the main condenser returns the drains from the _____.

A. vent condenser
Incorrect Answer: The vent condenser is a component of the deaerating feed heater and not part of the main condenser and air ejector condenser installation.

B. intercondenser
Correct Answer: The intercondenser drain is connected to the main condenser through a loop seal line which maintains a continuous drain of condensate collected by the condensation of steam exhausting from the first stage air ejector while maintaining the pressure differential between the main condenser and intercondenser.

C. after condenser
Incorrect Answer: The after condenser is at atmospheric pressure allowing the condensed steam exhausting from the second stage air ejector to gravitate to the to the atmospheric drain tank and then return to the condensate system via the main condenser by the use of a drain regulator.

D. all of the above
Incorrect Answer: As choices A and C are incorrect, all of the above cannot be correct.

Which of the following test indicators should be considered a determining factor as to whether or not a diesel generator's lube oil should be drained and renewed?

Note: The results of several tests must be considered concurrently, i.e. precipitation number, neutralization number, increase in viscosity, etc., when determining whether or not the engine oil should be changed.

A. An extremely "low" neutralization number.
Incorrect Answer: The neutralization number of a lube oil is used to indicate the level of acidity in the oil. Lubricating oil will normally become more acidic over a period of time in a diesel due to its contact with combustion by-products. The neutralization number is established by measuring the number of milligrams of potassium hydroxide (KOH) required to titrate and neutralize the acidity of a one gram sample of the lube oil. A low "neutralization number" represents the fewest number of milligrams needed to neutralize the sample and would have a pH value approaching 7. A high neutralization number indicates a high level of acidity and will result in acidic corrosion of bearing surfaces and other internal parts of the engine.

B. An extremely high precipitation number.
Correct Answer: A high precipitation number indicates that an excessive amount of suspended insoluble particles have accumulated in the oil from a variety of sources such as: combustion by-products, contaminated air charge due to defective air filtration, etc.

C. The oil appears black in color.
Incorrect Answer: A dark color change is usually the result of piston blow-by or from excessive valve guide clearance. This color change is normal due to normal stopping and starting an engine, especially if it is allowed to cool before being restarted.

D. A minor increase in flash point.
Incorrect Answer: An increase in the flash point of a lube oil may be the result of water mixing with the oil and/or an increase in emulsions. A minor increase in flash point should not be a cause for concern or require replacement of the oil.

In a three phase, squirrel-cage type induction motor, the rotating magnetic field is established by the _____.

A. current induced in the rotor windings
Incorrect: The rotor of an induction type motor does not induce a magnetic field in the stator. AC voltages are induced in the rotor circuit as the result of the rotating magnetic field in the stator.

B. application of a three phase voltage supply to the stator windings
Correct Answer: The principle of a rotating magnetic field is the key to the operation of most AC induction motors. The sequential AC phase angle relationships are used to alternately magnetize adjacent stator coils. The sequential shift in magnetization between adjacent stationary stator coils creates the effect and appearance of a rotating magnetic field. The apparent shifting of the magnetic field in the stator induces an internal rotor current creating a second interacting magnetic field in the rotor producing shaft torque.

C. laminated steel core and aluminum conductors in the rotor
Incorrect: A laminated steel core is used in place of a solid iron core for the construction of the rotor to minimize the effect of "eddy" currents. Small stray electrical currents generated within the core material of the rotor by the induced magnetic field results in the buildup of heat. The resultant electrical energy loss or "eddy current loss" and can be reduced by increasing the resistance of the eddy current path by a production process achieved through laminating the core.

D. interaction of the magnetic field caused by the induced current in the squirrel-cage bars with the magnetic field of the stator.
Incorrect: The interaction of the generated magnetic fields between the stator and rotor causes the motor shaft to rotate as a result of applying AC current to the stator windings and the resultant induced magnetic field interaction with the squirrel cage rotor.

When charging a 100 amp-hour lead acid battery, _____.

Note: The practical limitations to the charging rate for batteries are: (1) excessive temperature rise and (2) excessive gassing

A. The temperature of the electrolyte should not be allowed to exceed 90 degrees Fahrenheit.
Incorrect: Care should be taken to keep the electrolyte temperature from exceeding 125ºF, as such, 90ºF is satisfactory.

B. The charging rate should be no greater than 125% of the battery amp-hour rating.
Incorrect: The maximum charging rate (in amperes) should be limited to approximately 30% of the amp-hour rate, or 30 amps for a 100 amp-hour battery.

C. The source of power for charging should be 2.5 volts per cell.
Correct Answer: Applying approximately 2.5 volts charge per cell is recommended and ideal for lead acid batteries. This is slightly higher than the normal no load voltage of 2.1 volts per cell.

D. gassing within the battery decreases when nearing full charge and it will be necessary to reduce the charging current to a low finishing rate.
Incorrect: Gassing will increase and not decrease when more charging current is being fed to the battery than it can use. The excess current produces hydrogen and oxygen gases and contributes to high electrolyte temperatures. Batteries normally begin to release gas at about 80-90% of its full charge. Some battery chargers automatically reduce the current to a trickle charge when the battery reaches this point to limit excess gassing.

The process of reversing any two of the three "rotor" leads of a wound-rotor induction motor will _____.

Note: The stationary "stator" field windings are energized from a three phase power source which produce the effect of a rotating stator field. Reversing the position of any two power leads to the stator will cause the motor to reverse direction of rotation. A "wound rotor" induction motor is constructed with segregated rotor windings which are closed circuited through slip rings with a variable rheostat which provides a means of controlling the induced rotor current. This allows for control of the motors output torque.

A. increase motor performance
Incorrect: Motor performance would not be affected because the rotor windings of a wound rotor induction motor are segregated closed circuits which only provide for a control of induced rotor current through slip rings and a rheostat. In effect, reversing any two leads would be similar to reversing the leads of a resistor in a closed circuit.

B. decrease motor performance
Incorrect: Motor performance would not be affected for the above reason. Only a change in the "resistance value" of the rotor circuit will change the strength of the induced current and resulting rotor magnetic field, which in turn will change output torque.

C. reverse the motor rotation
Incorrect: Reversing the rotor windings on a wound-rotor motor will not change the direction of motor rotation. Changing any two lines of the three voltage sources to the stator coils will reverse the directional sequence of the generated magnetic fields in the stator, thereby reversing the direction of the rotating field and motor rotation.

D. have no effect on the direction of rotation or motor performance.
Correct Answer: The windings or bars on a simple squirrel-cage rotor are short-circuited by end rings. The windings on a "wound-rotor" motor are not short-circuited, but are connected in a delta arrangement to a rheostat. Each winding is brought out via leads to three separate slip rings, which are mounted on the end of the shaft. Stationary brushes ride on each slip ring, forming an external "secondary" circuit into which any desired value of resistance may be inserted, changing the amount of induced current produced in the rotor, changing the motor performance.

Sparking of D.C. motor brushes can be caused by _____.

A. an open commutating winding
Correct: An open winding would cause an alternating interruption of current flow thereby causing sparking of the brushes at the point of brush contact with the open commutator bar.

B. many mechanical, electrical or operating faults
Correct: A variety of mechanical or electrical faults may cause sparking at the brushes including motor vibration, bearing wear, impurities embedded on the brush surface, faulty brush adjustments, unbalanced armature currents, etc.

C. an open interpole
Correct: Interpoles are similar to the main field poles and located on the yoke between the main field poles and have windings in series with the armature winding. Interpoles have the function of reducing the effect of armature reaction which would cause a shift in the magnetic field in the commutating zone. They eliminate the need for shifting the brush assembly with changes in load conditions.

D. all of the above
Correct Answer: Answers A, B, and C could all contribute to sparking of DC motor brushes.

Auxiliary steam at full operating pressure is supplied direct from the boiler to the _____.

A. turbo-generator
Incorrect Answer: A typical turbo-generator on a steam propulsion vessel is supplied steam by superheated, main steam.

B. main air ejectors
Incorrect Answer: The main air ejector is supplied auxiliary steam at a reduced pressure via a reduced pressure regulator set to maintain a pressure no less than 150 psi.

C. distilling plant
Incorrect Answer: The distilling plant feed water heater is usually supplied by low pressure extraction steam at approximately 10 psia.

D. soot blowers
Correct Answer: The soot blowers are directly supplied by full auxiliary steam pressure, which may require a pressure reduction according to its location within the tube bank by use of an orifice plate.

While vacuum is being raised on the main unit and the turbine warmed, condensate is re-circulated to the main condenser to _____.

Note: Condensate is re-circulated back to the main condenser to: 1) prevent the main condensate pump from running dry, which would lead to overheating, and uneven expansion of rotating components and eventual wear of close tolerance components. 2) aid in maintaining a 10 degree Fahrenheit temperature differential of main condensate flowing through air ejector condensers, which assist in maintaining proper steam flow through air ejectors to continue removing non-condensable gases from the main condenser, and 3) assist in developing vacuum as a portion of the re-circulated condensate flashes upon entering the condenser, and as it condenses, the reduction in specific volume of the vapor enhances the developing vacuum.

A. ensure the condensation of the air ejector steam
Correct Answer: When raising vacuum, insufficient steam is exhausted to the main condenser. Hense, the quantity of condensate discharged by the main condensate pump through the air ejector condensers would be insufficient to condense the air ejector steam flow. If it were not for condensate re-circulation, the required steam flow rate through the air ejectors would decrease and deminish the ability of the air ejectors to extract non-condensable gases from the main condenser, and prevent vacuum from developing.

B. cool the main condenser shell for better vacuum
Incorrect Answer: Re-circulating condensate does not cool the main condenser shell as shell temperature is a function of ambient engine temperature and the corresponding saturation temperature to the vacuum maintained.

C. provide a condenser vacuum seal
Incorrect Answer: The gland seal system prevents air from being drawn in along the turbine rotors through the use of low pressure steam supplied to the turbine rotor glands.

D. maintain a proper DC heater water level
Incorrect Answer: The make-up feed and spill (dump) regulators provide the means to control the DC heater level.

In readying an auxiliary water-tube boiler for a routine hydrostatic test, which of the following procedures should be undertaken prior to filling the boiler with fresh water?

A. The safety valve escape piping should be disconnected from the valve body and a blank inserted.
Incorrect: Designated safety valve gags should be used when a boiler is being hydrostatically tested. If a blank is to be used, it should be placed on the inlet side of the safety valve, and not on the outlet.

B. The boiler vent valves should be opened.
Correct Answer: The vent valves should remain open while filling the boiler with water to ensure that all air is expelled. Once water exits the vent valves, the valves must be closed to ensure that the hydrostatic pressure will be maintained if all else is tight.

C. All handhole/manhole covers should be tightened up as much as possible to preclude any leaks.
Incorrect: All handhole/manhole cover gaskets should be sufficiently tightened to ensure a leak proof mating surface. Over-tightening could result in gasket failure and/or handhole damage.

D. All of the above.
Incorrect: Choice "B" is the only correct answer

The primary source of steam to the auxiliary exhaust system is typically supplied directly from _____.

A. the main engine LP bleed
Incorrect Answer: The LP bleed is a low pressure source of steam (approximately 10 psia) extracted off the main propulsion LP turbine primarily used to supply heat for the first stage main feedwater heater and the distiller salt water feed heater.

B. turbine driven and reciprocating steam pumps
Correct Answer: The exhaust from turbine driven and reciprocating steam pumps such as steam driven boiler feedwater, cargo, and ballast water pumps are the main source of steam for the auxiliary exhaust system.

C. the turbine gland exhaust system
Incorrect Answer: The turbine gland exhaust system collects low pressure steam leak-off from the gland sealing system and is evacuated by fan to the gland exhaust condenser.

D. all of the above
Incorrect Answer: Choice “B” is the only correct answer.

When a megohmmeter is being used to test insulation resistance, current leakage along the surface of the insulation is indicated by the megohmmeter pointer _____.

Note: Insulation resistance is a measure of opposition to current leakage presented by the electric machinery insulating material. Insulation resistance measurements are affected by the accumulated presence of moisture and dirt. When the measurement is properly performed, the observed readout of the megohmmeter aids in alerting the operator to impending trouble. The machine being tested should be disconnected from its power source, and the measurements taken immediately after shutdown to avoid errors that may result from condensation of moisture on the windings. One terminal of the megohmmeter should be attached to the machinery electrical lead to be tested, and the other terminal to the machinery frame.

A. fluctuating around a constant resistance reading
Incorrect Answer: Dirty insulation would be indicated by slight kicks downscale from a constant resistance reading and would not fluctuate above and below a constant resistance reading. Note: "Kicking" is a term that describes a megohmmeter pointer movement indicated by intermittent dips downscale from a constant resistance value when measuring resistance.

B. dipping towards zero, then rising slowly
Incorrect Answer: This is the indication of clean and dielectrically proper insulation. The capacitive effect between the windings and the framework of the electric machinery result in the initial dip of the megohmmeter pointer. As the capacitive discharge time is relatively short, the megohmmeter pointer will gradually rise to a high (often infinitive) value of resistance.

C. kicking slightly downscale as voltage is applied
Correct Answer: This is the indication of dirty or deteriorating insulation. The slight kicking downscale is due to the leakage of current conducted along the surface of the insulation via dirt or moisture accumulated in the somewhat porous insulation material. The magnitude of the current leakage is dependent upon the resistance of the leakage path in the insulation and magnitude of the megohmmeter driving voltage.

D. continually rising as the test voltage is applied
Incorrect Answer: The continued slow rising of the megohmmeter pointer is a direct relationship of clean and proper insulation with no current leakage or path of errant current flow. Depending on the size of the machine, it may take hours before the pointer stops rising.

When metal is tempered, it becomes _____.

Note: Tempering, or drawing, is the process of reducing both the degree of hardness and strength of a metal by reducing its brittleness. Hardness is a property of metal that relates its resistance to indentation, and is a function of the percentage of its carbon content. The higher the percentage of carbon content, the harder the metal, and characterized as being more brittle. A brittle metal will break easily and without noticeable deformation (without warning). Soft metal has a conversely lower percentage of carbon, and is used where high strength is not a concern as it becomes more plastic. Softer metals are easier to handle and fabricate.

A. harder
Incorrect Answer: Tempering decreases the hardness of metal.

B. corrosion resistant
Incorrect Answer: Tempering has no effect on corrosion resistance as this is a function of its iron composition and associated alloys.

C. less brittle
Correct Answer: Tempering is the process of controlled heating and cooling of metal to lessen its brittleness.

D. more brittle
Incorrect Answer: Tempering reduces the brittleness of the metal, rendering it less susceptible to fractures.

Which statement is true concerning operational factors affecting the degree of superheat in a single furnace boiler?

Note: Operational factors that affect the degree of superheat in a single furnace boiler include rate of combustion, temperature relationship of the feed water to its design requirements, amount of excess air passing through the furnace, amount of moisture entrained in the steam generated, and the condition of the superheater and water screen tube surfaces.

A. As the rate of combustion increases, the degree of superheat increases throughout the entire firing range.
Incorrect Answer: An increase in steam demand results in an increase in the rate of combustion, that results in an increase in saturated steam generating rate, which in turn results in an increased steam flow through the superheater. The rate of heat absorption by the steam flowing through the superheater increases more rapidly than the increasing rate of steam flow and the superheat temperature while increasing, rises slowly at first until the boiler is operating at near full power. At full power, the rate of steam flow stabilizes resulting in the rate of heat absorption in the superheater to decrease, and the degree of superheat ceases to increase and may decrease slightly even though the rate of combustion had increased.

B. With a constant firing rate and steam consumption equal to generation, a decrease in the incoming feed water temperature results in a superheat temperature decrease.
Incorrect Answer: At a constant firing rate, a decrease in feedwater temperature will result in a superheat temperature increase. If the feedwater temperature decreases, less saturated steam will be generated for the load and the quantity of the fuel being burned. The reduction in steam flow will also result in the corresponding steam pressure, forcing the combustion control to increase the rate of combustion. The resulting increasing combustion airflow results in deeper combustion gas penetration into the generating tube bank. The available heat no longer available to effectively heat the water in the water screen tubes is now increasingly transferred to the superheater, resulting in an increase in the superheater outlet temperature.

C. With large amounts of excess air, superheater outlet temperature will decrease due to lack of sufficient time for heat transfer to take place.
Incorrect Answer: A large amount of excess air repositions the “center” of combustion closer to the superheater tube bank. The available heat no longer available to effectively heat the water in the water screen tubes is now increasingly transferred to the superheater, resulting in an increase in the superheater outlet temperature.

D. Carrying boiler water total dissolved solids higher than normal could result in a decrease in the degree of superheat.
Correct Answer: Carrying the boiler water total dissolved solids higher than normal may result in moisture carryover into the superheater. Consequently, much of the available heat will be given up to transform the entrained moisture to steam before the addition of sensible heat to the saturated steam can occur to increase the temperature in the superheater, thereby resulting in a decrease to the superheat outlet temperature.

When troubleshooting an alkaline storage battery, a weak or dead cell is best located by _____.

A. checking the specific gravity of each cell
Incorrect Answer: The specific gravity of the electrolyte (potassium hydroxide) in an alkaline (nickel-cadmium) battery is 1.200 at 60°F, and essentially remains constant, regardless of charge. Therefore, checking the specific gravity would be ineffective in locating a weak or dead cell.

B. visually inspecting each cell's electrolyte level
Incorrect Answer: The cell's electrolyte level is not an indication of the state of charge. However, maintaining the electrolyte at the "full mark", by the addition of distilled water, would result in less space inside the battery for the accumulation of explosive hydrogen and oxygen gases.

C. load testing each cell with a voltmeter
Correct Answer: Because the specific gravity of the electrolyte is essentially constant, regardless of charge, the battery condition must be determined with a voltmeter such as a digital voltmeter, during charging or discharging. Open circuit voltage of a nickel-cadmium battery is 1.2 volts per cell, and when connected to a load, remains fairly constant up to 90 percent of its rated capacity. Repeated over-discharging below 1.1 volts per cell will damage the battery.

D. measuring the electrolyte temperature with an accurate mercury thermometer
Incorrect Answer: The electrolyte temperature does not provide an indication of the state of charge or discharge of an alkaline battery. However, to limit gassing, the electrolyte temperature should not be allowed to exceed 115°F (46°C) when charging the battery. In addition, a mercury thermometer should never be used to measure electrolyte temperature, as an accidental breakage of the thermometer could result in sparking and an explosion.

Which of the following statements is correct concerning the “flash point of a liquid”?

Note: Flash point is the lowest temperature at which a liquid produces sufficient vapor to form an ignitable mixture that can be ignited by an external source, but is immediately extinguished. This is a result of the rate of vaporization of a liquid at the flash point is usually insufficient to maintain the presence of a continuous quantity of an ignitable mixture.

A. It is lower than the ignition temperature.
Correct Answer: The flash point is the lowest temperature a flammable liquid can form an ignitable mixture and burn when ignited by an external source. The rate of vaporization at the flash point is usually insufficient to maintain continuous burning. If the flammable liquid is heated to a much higher temperature, the vapors produce at the liquid’s surface will continue to ignite without needing the application of an external source of ignition. The temperature at which the vapors self-ignite is referred to as the ignition temperature, and it is higher then the flash point temperature.

B. It is the temperature at which a substance will spontaneously ignite.
Incorrect Answer: Certain substances, such as animal and vegetable oils, create their own heat due to slow oxidation, and if kept in a poorly ventilated area, will self-ignite when the ignition temperature of the oil is reached. This process of slow oxidation and self-ignition is known as spontaneous ignition (combustion).

C. It is the temperature at which a substance, when ignited, will continue to burn.
Incorrect Answer: The fire point is the temperature at which a liquid will produce sufficient vapor and when ignited by an external source, will continue to burn. The fire point lies between the flash point and ignition temperature of a flammable liquid.

D. It is the temperature at which the released vapor will fall within the explosive range.
Incorrect Answer: The flammable vapor of a liquid must mix with the air in a certain proportion to produce an ignitable mixture. The flammable, or explosive range, is the percentage of gas or vapor in the air that forms an ignitable mixture. The explosive range of a gas or vapor lies between the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL). The LEL is the smallest percentage of vapor mixing with air that will form an ignitable mixture. If the percentage of vapor is below the LEL, the mixture is considered too “lean” to support combustion. The UEL is the greatest percentage of vapor in air that will support combustion. If the percentage of vapor in the air exceeds the UEL, the mixture is considered too “rich” to support combustion. The combustible gas indicator is utilized to measure the percentage of flammable vapor in a closed or confined space.

Which of the following statements represents the Coast Guard Regulations (46 CFR) applicable to the equipment required in a fireman's outfit?

A. The flashlight must be of an approved three cell fire proof type.
Incorrect Answer: 46 CFR 96.35-5 (c) states "Flashlights shall be Type II or Type III, constructed and marked in accordance with ASTM F 1014."

B. The assembled lifeline shall have a minimum breaking strength of 1500 pounds (683.8 kg).
Correct Answer: 46CFR 96.35-5 (d) specifically makes the statement that "The assembled lifeline shall have a minimum breaking strength of 1,500 pounds."

C. The combustible gas indicator hose must be 100 feet (30.48m) in length.
Incorrect Answer: The Fireman's Outfit is not required to include the use of a combustible gas indicator. However, in lieu of a flame safety lamp, the vessel may carry an oxygen depletion meter (Refer to 46 CFR 96.35-10 (a)).

D. All protective clothing must be electrically non-conductive.
Incorrect Answer: 46 CFR 96.35-5(f) states that ONLY the boots and gloves are required to be electrically non-conductive. 46 CFR 96.35-5 (h) states that "Protective clothing shall be of material that will protect the skin from the heat of fire and burns from scalding steam. The outer surface shall be water resistant."

When normal operating pressure is applied to the hydraulic oil in a high-pressure system, the oil _____.

Note: Viscosity is a measure of the internal resistance (friction) of a fluid to flow, and is affected by changes in pressure and temperature. A fluid that flows easily is said to have a low viscosity, and a fluid that flows slowly has a high viscosity. Liquids are considered as non-compressible under normal or low pressure conditions. However, when subjected to elevated pressures, the fluid volume decreases approximately one percent per 1000 psi. Hence, extreme hydraulic pressures will decrease volume and the "space" between the liquid molecules, which increases internal resistance, and therefore increases the viscosity.

A. viscosity will increase
Correct Answer: The viscosity of a fluid increases as the pressure on the fluid increases. An increase in pressure decreases the volume of the fluid, and the space between the fluid molecules is reduced. The molecules cannot move as easily, and the viscosity increases.

B. viscosity will decrease
Incorrect Answer: Viscosity of a liquid decreases as its volume, the internal spacing between the molecules increases which reduces its internal resistance.

C. volume will increase
Incorrect Answer: When pressure is applied to the hydraulic oil, the volume will be decreased. At atmospheric pressure, a fluid is considered to be incompressible.

D. floc point will increase
Incorrect Answer: Floc point is the lowering of a temperature at which the waxy material that is ordinarily contained in oils, begins to solidify and separate from a lubricating oil. The floc point is usually a point of consideration for lubricating oils used in systems such as refrigeration units.

Hydraulically servo-operated, automatic, change over valves, utilized in a two ram hydraulic steering gear, serve to _____.

A. allow an alternate main pump to start in the fully loaded condition thus developing immediate full torque
Incorrect Answer: The main pump starts in the unloaded condition. The servo-operated automatic change-over valves held in a spring centered by-pass mode while the pump is stopped. When the main pump starts, an auxiliary pump als building pressure, which overcomes the spring force to close the by-pass and aligns the main pump to the hydraulic s

B. prevent either main pump from being hydraulically motored when idle by cross pressure flow
Correct Answer: The servo-operated automatic change-over valves are held in a by-pass condition by a spring while the pump is stopped, which prevents the pump from being hydraulically motored by cross pressure flow.

C. prevent both units from operating simultaneously which could result in doubling the flow of oil and pressure leading to over pressurization of the system
Incorrect Answer: If quicker system response is actually required, both units may be run simultaneously, which would double the oil flow rate through the system, and correspondingly increase, or double the speed of operation, i.e. swing the rudder at twice the design rate. This is unnecessary as the rate of rudder movement by design is required to move the rudder from 35° on one side of the centerline to 30° on the other side at the rate of 28 seconds. It must also be understood that an action of this nature would exponentially raise the indicated pressure of the system.

D. all of the above
Incorrect Answer: “B” is the only correct answer.

The amount of fuel injected in a particular time, or degree, of crankshaft rotation is termed _____.

Note: The primary function of the fuel- injection system is to deliver fuel to the engine cylinders at the proper time, and in the proper quantity, under various engine loads and speeds. The fuel injection system must also accurately atomize, distribute, and control the rate of injection of the fuel.

A. metering
Incorrect Answer: Metering, or measuring, is the term that refers to the amount of fuel delivered to each engine cylinder just prior to each power stroke. Accurate metering is essential for an even distribution of load between cylinders, and smooth engine operation.
For each setting of the engine fuel control lever, the same quantity of fuel must be admitted to each cylinder each time it fires. The amount of fuel delivered to each cylinder is dictated by load demand, and is achieved by varying the effective stroke of the cylinder injector pump via the engine fuel control lever.

B. timing
Incorrect Answer: Timing refers to the moment when fuel injection begins. It is essential that injection begin at the proper moment to obtain the maximum power from the fuel. If the fuel is injected too early, ignition may be delayed because the final compresson temperature is not high enough. Early fuel injection results in detonation and low exhaust temperatures. If fuel injection occurs too late, the fuel will be burning in the cylinder well past top dead center resulting in high exhaust temperatures. In both cases, fuel consumption will be high, and power output will be low.

C. rate of injection

Correct Answer: Rate of fuel injection of the metered quantity of fuel injected into the combustion chamber in a unit time, or a degree of crank travel, will be reflected in the rotational speed of the crankshaft. The rate of injection determines the degree of combustion, and should proceed at a rate such that the rise in combustion pressure is not excessive. An incorrect rate of injection affects engine performance in the same way as improper timing. If the rate of injection is too high, a given amount of fuel will be injected during a short time, or during a small number of degrees of crank travel, and the results are similar to early injection. Conversely, if the rate of injection is too low, the results will be similar to that of late injection. To lower the injection rate, an injector nozzle tip with smaller holes is utilized to increase the duration of fuel injection. To raise the injection rate, a nozzle tip with larger holes is utilized to decrease the duration of injection.

D. rate of distribution
Incorrect Answer: Distribution is the term that refers to the atomized fuel's ability to penetrate into the combustion chamber. Injection pressure, combustion space design, and compression pressure are the primary factors in determining a fuel's ability to penetrate to all parts of the combustion chamber where oxygen is available. If the fuel is not properly distributed, all of the available oxygen will not be utilized, and incomplete combustion may occur.

Which ring dam arrangement should be used for centrifugal purification?

Note: If the oil discharged from a purifier is to be free of water, dirt, and sludge, and if the water discharged from the bowl is not to be mixed with oil, the proper size discharge ring (ring dam) must be used. The position of the oil and water layer (interface) in the purifier bowl is a function of the specific gravity of the oil, and ring dam size. As a rule, the higher the specific gravity of the oil, the smaller the inside diameter of the ring dam. Hence, an oil with a specific gravity closer to water, will need to have a relatively small inside diameter ring than a lighter oil While the outside diameter of the discharge ring is fixed, the inside diameter may vary. The inside diameter, in millimeters, is stamped on each ring. Nomograms, provided in manufacturers' manuals, specify the proper ring dam size to use with an oil of a given specific gravity at a specified temperature.

A. The largest inside diameter ring without loss of oil.
Correct Answer: The use of the largest inside diameter discharge ring results in the positioning of the oil-water interface towards the outer edge of the purifier bowl. The closer the interface is to the outer edge of the purifier bowl, the smaller the seal water layer depth and the larger the oil layer depth. These factors result in the oil being subjected to centrifugal force for a longer period of time, due to the larger radius of the oil layer. As the increased radius allows for a higher centrifugal force to be applied, this results in a more complete separation.

B. The largest outside diameter ring without loss of oil.
Incorrect Answer: The outside diameter of the ring dam is fixed, and does not change for the specific centrifuge model.

C. The smallest inside diameter ring without loss of oil.
Incorrect Answer: The use of the smallest inside diameter discharge ring results in the positioning of the oil-water interface towards the center of the purifier bowl. The closer the interface is to the center of the purifier bowl, the greater the water layer depth, and the smaller the oil layer depth. This results in the oil being subjected to a lower value of centrifugal force for a shorter period of time, and as the time of separation of water from the oil is reduced, more water entrained with the oil would tend to carry over.

D. The smallest outside diameter ring without loss of oil.
Incorrect Answer: The outside diameter of the ring dam is fixed, and does not change for the specific centrifuge model.

The Total Base Number (TBN) value of diesel engine lube oil refers to its ability to _____.

Note: The TBN of diesel engine lube oil is the measure of the alkaline reserve, or the ability of the oil to neutralize acids from combustion. Depletion of the TBN can lead to acidic corrosion and fouling within the engine.

A. resists changes in viscosity with changes in temperature
Incorrect Answer: The ability of lube oil to resist changes in viscosity with changes in temperature is referred to as Viscosity Index (VI). Oils which are determined as having a narrow or small change in viscosity with a wide change in temperature are assigned a high VI, and oils which undergo a wide or large viscosity change with a narrow change in temperature are assigned a low VI.

B. resists emulsification
Incorrect Answer: An emulsification is a water in oil mixture. The presence of water in lube oil will result in the formation of acid and sludge, which can result in serious damage to engine components if left uncorrected. Additives blended into the lube oil and proper purifier operation both help in resisting emulsification.

C. neutralize acids
Correct Answer: The TBN of a diesel engine lube oil is the measure of the alkaline reserve, or the ability of the oil to neutralize acids formed by the byproducts of combustion.

D. resists oxidation at high temperatures
Incorrect Answer: The ability of lube oil to resist oxidation at high temperatures is defined as Oxidation Stability.

In refrigeration systems with multiple evaporators, the metering of refrigerant to each refrigerated space is accomplished by _____.

A. the king expansion valve
Incorrect Answer: The main liquid line valve, or King valve, as originally used to describe this valve in an ammonia type system, is a stop valve normally installed just after the receiver, and is either fully open or fully closed.

B. individual coil expansion valves
Correct Answer: The metering of refrigerant to each refrigerated space in a multiple evaporator system or multiple refrigerated box system is controlled by each individual coil's thermostatic expansion valve, or TXV. The TXV is designed to proportion the flow rate of refrigerant entering the evaporator coil in proportion to the rate of evaporation of the liquid refrigerant in the coil. The valve opens and closes in response to the change in vapor volume in the sensing bulb clamped to the evaporator coil outlet. To ensure that all of the liquid refrigerant vaporizes by the time it leaves the evaporator coils, the TXV is set to maintain 7-10 degrees of superheat in the refrigerant leaving the coil.

C. a solenoid valve in the liquid line
Incorrect Answer: The solenoid valve is an electro-magnet operated valve installed in the liquid line leading to each TXV employed in a multiple box system. The valve is either fully open or fully closed, and is operated by a thermostatic control switch connected via capillary tubing to a thermal bulb sensing the temperature in the refrigerated space. When the temperature in the refrigerated space drops to the desired set point, the valve closes, and shuts off all liquid refrigerant flow to the thermostatic expansion valve (TXV). When the temperature in the refrigerated space rises above the desired set point, the valve opens, and refrigerant flow is renewed to the TXV.

D. individual back pressure regulating valves on all but the coldest box
Incorrect Answer: The back-pressure regulator is located in the run of evaporator outlet coil used in multiple box systems where different box temperatures in one system are maintained by one compressor. The refrigerated box temperature for a vegetable box may need to be 38°F, yet the freeze box temperature may need to be 0°F. If a refrigerant temperature of -10°F were needed to obtain 0°F, the temperature differential for the vegetable box would be 48°F and the heat release from the vegetables and fruit would be at a rate that would freeze dry and damage them to the point that they would lose their taste and nutrient value. The back pressure valve is adjusted to close and stop the flow of refrigerant through the evaporator should the coil pressure become too low, thus preventing the refrigerated space from becoming too cold.

The primary purpose of a control desuperheater installed in the steam drum of a boiler is to _____.

Note: A desuperheater is a heat exchanger which reduces the temperature of a portion of the superheated steam leaving the boiler for use in the auxiliary steam system. A control desuperheater, or attemperator, is a heat exchanger that controls the superheat outlet temperature at high boiler loads to prevent the main steam piping, turbines, and the superheater from exceeding the designed operating temperature. Both the desuperheater and control desuperheater are installed below the water level in the steam or water drum, and are generally of the "single pipe" or "multi-tube bundle" design.

A. assure a constant volume of steam flow through the entire superheater under all load conditions.
Incorrect Answer: The volume of steam is proportional to boiler load and cannot be "constant" in volume. All of the steam generated by the boiler passes through the superheater, with a portion of the superheated steam redirected through the desuperheater to supply the auxiliary steam system. This arrangement maintains a flow of steam through the superheater at all times.

B. regulate the temperature of superheated steam by adding moisture
Incorrect Answer: The control desuperheater regulates the temperature of a portion of the superheated steam by absorbing a portion of the heat from the superheated steam by the water in the steam drum.

C. regulate the superheater outlet temperature by cooling a portion of the superheated steam
Correct Answer: The control desuperheater regulates the superheat outlet temperature by cooling a portion of the superheated steam. A manual/automatic control valve redirects a portion of the superheated steam through the control desuperheater located in the steam drum. The control desuperheater removes a portion of the sensible heat of the superheated steam, and then returns it to the last group of passes of the superheater where the mixing of the two flows results in a lowering of the superheated steam temperature.

D. regulate saturated steam temperature through the desuperheater
Incorrect Answer: The control desuperheater regulates the superheater outlet temperature.

In which of the listed hydraulic system components could an O- ring seal be satisfactorily used in providing a seal?

Note: The proper sealing in hydraulic systems is important to prevent fluid loss, keep foreign matter out of the system, and maintain differential between high side and low side pressures. Seals are divided into two general classes, static seals and dynamic seals. The O-ring, a molded synthetic rubber seal with a circular cross-sectional shape, is the most common static seal used in hydraulic systems.

A. High pressure pump shaft casing.
Incorrect Answer: An O-ring is impractical for a rotating shaft, as it can be "grabbed" by the shaft during rotation, and may thin the "O" ring in one area, which would permit pressure oil to leak across this area. Pumps and motors operating in high pressure ranges are generally sealed by mechanical seals which are composed of both of a primary dynamic seal, and a secondary static seal.

B. Low pressure pump shaft casing.
Incorrect Answer: An O-ring is impractical for a rotating shaft, as it may allow leakage (see description to "A" above). Pumps and motors operating in low pressure ranges, are generally sealed by lip seals composed of synthetic rubber that are held in place by a retaining spring.

C. Linear actuator without nylon insert.
Incorrect Answer: An O-ring inserted into the annular groove of a linear actuator without a nylon insert (back-up ring), will extrude and be pinched when exposed to high pressure and excessive linear motion.

D. Relief valve spool
Correct Answer: An O-ring provides excellent static sealing capabilities, as long as it does not need to move but a few millimeters, otherwise the resultant drag will cause the flexible O-ring material to slip in between the clearance of the two mating surfaces and damage the ring. O-rings are primarily suited for static sealing or limited motion devices, such as valve spools.

According to Coast Guard Regulations (33 CFR Part 159), which of the listed types of Marine Sanitation Devices (MSD) is designed to hold sewage onboard in special tanks to be pumped out at a shoreside facilities when available?

Note: Marine Sanitation Devices include any equipment installed on board a vessel designed to receive, retain, treat, or discharge sewage. For the purpose of relation to MSD's, sewage is defined as human body wastes and the wastes from toilets and other receptacles intended to retain or contain body waste.

A. Type I
Incorrect Answer: The Type I MSD is a device that produces an effluent having a fecal coliform count not greater than 1000 parts per 100 millimeters and no visible floating solids. The Type I may discharge overboard except where prohibited by the EPA under 40 CFR 140.3 or 140.4 (Also see 33 CFR 159.7 (2)).

B. Type II
Incorrect Answer: The Type II MSD is a device that produces an effluent having a fecal coliform count not greater than 200 parts per 100 millimeters and suspended solids not greater than 150 milligrams per liter. The TYPE II may discharge overboard except where prohibited by the EPA (Also see 33 CFR 159.7 (a) (1)).

C. Type III
Correct Answer: The Type III device does not provide for the treatment of sewage. Sewage is held onboard in a "holding tank" that is to be pumped to a shoreside facility when available. See 33 CFR 159.3 and 33 CFR 159.7 (c).

D. Type IV
Incorrect Answer: The Type IV MSD does not exist.

In order for the hydraulic pump installed in a constant flow system to maintain adequate flow, the pump suction should _____.

A. be taken directly off the reservoir bottom without regard to filters or strainers
Incorrect Answer: If the pump suction were to be taken off the reservoir bottom, contaminants such as water, sludge and other impurities may be drawn into the pump, resulting in damage to the pump internals and system components.

B. be arranged to develop a maximum vacuum of approximately 10 inches of mercury
Correct Answer: Fluid flow velocity in suction piping typically ranges from 2 to 4 feet per second, at a maximum of 10 inches of mercury vacuum. Higher fluid velocities and/or vacuums may result in pump cavitation. Cavitation occurs when the pump suction pressure drops below its vapor pressure causing gas pockets and bubbles to form. The gas pockets become entrained in the fluid entering the pump. As the fluid/vapor mixture moves from an area of low pressure to high pressure, the vapor bubbles compress and collapse. This results in pits or cavities forming on the pump internal surfaces. Turbulent flow develops in the pitted areas resulting in reduced oil flow to the system, higher operating temperatures, and wasted power.

C. be arranged to develop the theoretically maximum attainable vacuum
Incorrect Answer: The higher the vacuum, the greater the tendency for vaporization to occur and the greater the possibility of damaging the pump through cavitation (see explanation for Answer “B”).

D. be provided with three to five half-inch holes in the vertical, suction line to prevent pump starvation should the strainer become fouled
Incorrect Answer: Holes in the suction line would allow solid contaminants to enter the pump, resulting in damage to the pump and other system components. Air may also be drawn into the pump through these exposed holes should the level in the reservoir decrease or surge due to the ships motion in heavy seas.

To properly seat the brushes on slip rings, you should use _____.

Note: Slip rings are commonly found in electrical AC generators and motors to establish an electrical connection to or from the rotating shaft. The slip ring consists of a conductive band mounted on, but insulated from, the rotating shaft. "Brushes", solid segments of carbon, are placed in fixed, spring loaded fixtures to maintain contact with the ring and transfer electric current to the load as the shaft rotates. DC generators and motors have a similar arrangement, but utilize a commutator instead of a slip ring. The seating of all brushes to the exact curvature of the ring is essential to provide for the largest contact surface area possible. Improper seating of brushes will result in an uneven concentration of electrical load between brushes. This will cause some brushes to carry a greater portion of the current load, resulting in damage to the slip ring surface film and brush face.

A. sandpaper
Correct Answer: With the machine de-energized, fine sand paper should be used to seat the brushes. The brush tension should be set for maximum pressure, and the sand paper should be pulled back and forth along the curvature of the slip ring under the brush with the rough side facing the brush. When pulling the sand paper under the brushes, it is important to follow the curvature of the slip ring to avoid rounding the brush edges, which will also reduce the brush contact surface area. Once the seating of the brushes has been completed, the carbon particles (dust) must be removed from the surface using a vacuum cleaner.

B. crocus cloth
Incorrect Answer: Crocus cloth is extremely fine and is primarily used for polishing. The surface of the crocus cloth would rapidly clog, rendering it ineffectual for forming the curvature on the brush face.

C. emery cloth
Incorrect Answer: Emery cloth, while extremely abrasive, is comprised of relatively small particles. The abrasives would easily become imbedded in the "voids" between the carbon structure of the brushes and later score the slip ring surface, whereas sand particles are larger and would not as readily become imbedded in the brush contact surface.

D. all of the above
Incorrect Answer: "A" is the only correct answer

When answering a full astern bell from half ahead, the superheater outlet temperature in a single furnace boiler will _____.

Note: "Answering" a bell is considered the time interval from the moment the order to change speed/direction is rung up on the engine order telegraph, to the moment the required engine speed is achieved.

A. increase sharply with the increased firing rate
Incorrect: The increased firing rate should not result in a sharp increase in the superheat temperature, provided proper combustion conditions are maintained. The superheat temperature should drop initially, and then rise steadily and gradually as the rate of combustion goes up to meet demand.

B. decrease due to the increase steam volume used
Correct Answer: When answering a full astern bell from half ahead, the superheat temperature will drop when steam is first admitted to the astern turbine. The astern turbine requires a greater volume of steam than the ahead turbine, and will result in an increase in the rate of steam flow through the superheater. The increase in the rate of steam flow through the superheater decreases the amount of heat the steam can absorb from the combustion of fuel oil, and the superheat temperature drops. In addition, the increase in rate of steam flow and drop in steam pressure, results in an increase in the firing rate, which results in a rise in the boiler water level (swell). This increases the possibility of moisture carryover into the superheater, and resultant decrease in superheater temperature.

C. decrease momentarily and then increase proportionally with load demand
Incorrect: The superheat temperature drop would not be a momentary decrease, and it would require some time from the initial admittance of steam to the astern element, before the rate of combustion goes up to meet demand, and the superheat temperature gradually begins to rise.

D. remain the same
Incorrect: The boiler superheat temperature will increase or decrease in response to load changes while maneuvering, and will remain the same under steady state conditions only.

Which of the following statements is correct concerning a typical shipboard multi-coil refrigeration system?

A. The liquid receiver functions to collect and remove non-condensable gases.
Incorrect: The receiver serves as a temporary storage and surge space for the sub-cooled liquid refrigerant discharged from the condenser. The receiver also serves as a vapor seal to prevent the entrance of vapor into the liquid line to the thermostatic expansion valve (TXV).

B. A thermostatic expansion valve is used to control refrigerated space temperature.
Incorrect: A thermostatically controlled solenoid valve normally controls box temperature. Back-pressure valves are also used in multi-coil refrigeration systems to raise coil temperatures in higher temperature refrigerated spaces. The back pressure valve is located at each evaporator outlet, except on the evaporator in which the lowest temperature is to be maintained. The back-pressure valve is normally set to prevent the pressure in the coil from falling below the pressure corresponding to the lowest temperature required in the space.

C. Refrigerant temperature in an evaporator is directly related to refrigerant pressure.
Correct Answer: The thermostatic expansion valve (TXV) is used to maintain a constant degree of superheat in the refrigerant leaving the evaporator coil by adjusting the flow of liquid refrigerant entering the evaporator. An increase in the degree of superheat will result in the TXV opening to allow more refrigerant to the coil, and a decrease in superheat will tend to close the TXV, reducing the refrigerant flow to the coil.

D. Dehydrators must be used continuously in a refrigeration system.
Incorrect: A dehydrator is installed in the liquid refrigerant line to remove moisture from the system. It should be in use when charging the system, or when moisture is suspected to be present in the refrigerant.

Which of the listed conditions describes the effect on intrinsic semiconductor operation as a result of a temperature increase?

Note: A semiconductor is a material that has a resistance in between that of a conductor and an insulator. Through a process called doping, impurities are added to the semiconductor to increase conductivity. A pure semiconductor without any doping is called an intrinsic semiconductor. Semiconductors are generally silicon in material, and are used to make diodes, transistors, and integrated circuits.

A. Capacitive reactance will decrease.
Incorrect Answer: An increase or decrease of capacitive reactance (X_C) in a circuit is dependent on a change in frequency or capacitance, not a change in temperature.

B. Conductivity will increase.
Correct Answer: Conductivity is a measure of a material's ability to conduct an electric current, and is temperature dependent. Semiconductors have a negative temperature coefficient which means the resistance of the semiconductor decreases with an increase in temperature resulting in an increase of conductivity.

C. Inductive reactance will decrease.
Incorrect Answer: An increase or decrease of inductive reactance (X_L) in a circuit is dependent on a change in frequency or inductance, not a change in temperature.

D. Resistivity will increase.
Incorrect Answer: The resistivity of a material is the resistance of a specified length and cross sectional area. The electrical resistivity of metals increase with temperature, while the resistivity of semiconducters decrease with increasing temperature.

Which of the following statements best describes an oil lubricated stern tube bearing installation?

Notes: Oil lubricated stern tube bearings are cast from babbitt metal, an alloy of tin, antimony, and lead. The bearing shells have large wall thicknesses, and are pressed directly into the stern tube. The bearing is totally submerged in oil, and through the use of seals forward and aft of the tube, the entrance of seawater and leakage of oil is prevented. A circulating pump is generally installed to force the oil through the tube, and a head tank maintains the proper pressure differential between the oil in the stern tube and seawater at the seal.

A. It receives its oil supply from a branch line of the main lube oil system.
Incorrect Answer: An oil lubricated stern tube bearing system is a closed system and is independent of the main engine lube oil system.

B. No shaft liner is needed in the area of the babbitted bearing surface.
Correct Answer: No shaft liner is required as in a water lubricated system since the corrosive contact with seawater does not occur.

C. The system pressure must be lowered when maneuvering in port to prevent blowing the outer oil seal.
Incorrect Answer: The height of the oil head tank in the system maintains a fairly constant system pressure eliminating sharp spikes in pressure that would “blow out” any of the seals.

D. “For precise regulation of the bearing temperature, the system is required to have its own oil cooler.”
Incorrect Answer: Coolers are rarely used in oil lubricated stern tube bearing systems as the temperature leaving most stern tubes does not exceed 120°F.

Which of the following statements is/are true regarding hydraulic pumps in general?

Note: The gear type hydraulic pump consists of two "spur" gears that mesh together within a casing. The driven gear, which is rotated by the prime mover, simultaneously rotates the idler gear, but in the opposite direction. As the gears rotate, the teeth separate from each other on the intake side of the pump, creating a void and suction readily filled by fluid. The fluid is carried by the gears to the discharge side of the pump, where the meshing of the gears displaces the fluid from the area between adjoining teeth to the outlet.

A. Variable volumes can be obtained with gear pumps only by variation of the pump drive speed.
Correct Answer: Gear pumps are fixed displacement, meaning they pump a constant amount of fluid for each revolution, thus increasing or decreasing the volume of fluid discharged is achieved through variation of the pump drive speed.

B. A radial piston pump houses sliding pistons in a stationary cylinder block through which passes a rotating pintle or ported shaft.
Incorrect Answer: A radial piston pump houses the sliding pistons in a cylinder block which revolves around a **stationary** pintle or ported shaft.

C. The amount of liquid displaced per revolution of an axial piston rotary pump is maximum when the angle of the tilting box is at right angles to the shaft.
Incorrect Answer: The maximum amount of liquid displaced per revolution of an axial piston rotary pump occurs when the angle of the tilting box is at maximum angle to the shaft.

D. All of the above.
Incorrect Answer: Choice "A" is the only correct answer.

Kingsbury thrust bearings are lubricated by _____.

Note: Kingsbury or segmental pivoted-shoe thrust bearings are designed to maintain the correct axial position of the main propulsion crankshaft, or turbine rotor, by absorbing the thrust transmitted from the vessel's propeller. The bearing consists of a thrust collar, which is fixed to the shaft, stationary thrust shoes, which bear against both sides of the collar, leveling plates, and a base ring. These bearings operate on the principle that a wedge-shaped film of oil can carry a heavier load than a flat film. The thrust shoes, which are free to tilt (pivot), permits the formation of the wedge-shaped oil film. Any forward or astern thrust of the shaft is restrained by the action of the thrust shoes against the thrust collar. The leveling plates distribute the load equally among the shoes, and the base ring transmits the thrust on the leveling plates to the ships structure.

A. flooding the thrust bearing assembly with oil
Correct Answer: The Kingsbury thrust bearing is generally pressure lubricated, and runs in a bath of oil to maintain the wedge-shaped oil film between the shoes and thrust collar.

B. submerging oil wiper rings in an oil bath
Incorrect Answer: Line shaft bearings, or spring bearings, support the propulsion shafting, and utilize oil wiper rings submerged in an oil bath.

C. pressure lubricating through internal passages
Incorrect Answer: Pressure lubrication through internal passages is commonly utilized in diesel engine crankshaft and connecting rod assemblies.

D. spraying oil directly on the thrust collar and shoes
Incorrect Answer: Spraying oil directly on the thrust collars and shoes would not provide a sufficient amount of oil to maintain the wedge-shaped oil film required for proper operation.

The movement of heat within a fluid, caused by the application of thermal energy, is called _____.

A. radiation
Incorrect Answer: Radiation is the transfer of heat in the form of waves similar to light and radio waves, and occurs without physical contact between the emitting and the receiving regions.

B. conduction
Incorrect Answer: Conduction is the transfer of heat by actual contact between substances, or from molecule to molecule within a substance.

C. convection
Correct Answer: Convection is the transfer of heat by the circulation of a liquid or gas such as air. Convection may be forced by use of a pump or fan, or it may occur naturally due to heated air or liquid rising and forcing the colder air or liquid downward.

D. condo-radiation
Incorrect Answer: Condo-radiation as a form of heat transfer does not exist.

The high air velocity leaving the air impeller of an exhaust gas turbocharger is converted to pressure in the _____.

Note: A diesel engine turbocharger is a gas driven turbine coupled to a centrifugal type air compressor. The turbine inlet receives exhaust gases from the engine exhaust manifold causing the turbine wheel to rotate and drive the compressor. The compressor compresses the ambient air and delivers it to the air intake of the engine for combustion. Forcing compressed air into the combustion chambers allows more fuel to be burned in the engine then in a naturally aspirated type of the same size and speed, resulting in a greater power output. In addition, converting some of the energy from the exhaust gas into useful work to drive the turbine increases engine efficiency.

A. inlet nozzle ring
Incorrect Answer: The inlet nozzle ring is on the gas side of the turbocharger. The exhaust gas expands as it passes through the ring which results in the conversion of pressure energy into kinetic energy (velocity).

B. turbine wheel blading
Incorrect Answer: The turbine wheel blading is on the gas side of the turbocharger. The high velocity gases exiting the nozzle ring are directed onto the turbine blading which drive the turbine wheel.

C. diffuser passages
Correct Answer: The high velocity air exits the air side impeller and passes through the diffuser where the air is converted into pressure energy.

D. inlet volute
Incorrect Answer: The inlet volute directs filtered air from the engine room or other outside source to the air compressor section of the turbocharger.

Decreasing the frequency in a capacitive circuit while maintaining a constant circuit voltage will result in a/an _____.

Note: Capacitors are energy storage devices, and when inserted in an electrical circuit, act to oppose any change of voltage in the circuit. A capacitor will conduct current in proportion to the rate of voltage change, and will pass more current for faster changing voltages, and less current for slower changing voltages. Capacitors are utilized in circuits for motor starting, power factor improvement, and as electronic filters.

A. increase in apparent power
Incorrect Answer: Apparent power is the product of the circuit's voltage and current (S=IE). Decreasing the frequency in a capacitive circuit while maintaining a constant circuit voltage will result in a decrease in circuit current, and **decrease** in apparent power.

B. decrease in circuit current
Correct Answer: Alternating current (I) in a simple capacitive circuit is equal to the circuit voltage (E) divided by the capacitive reactance (X_C). Capacitive reactance is inversely proportional to the frequency of the circuit, and a decrease in frequency will result in an increase in capacitive reactance. An increase in capacitive reactance while maintaining a constant circuit voltage will result in a decrease in circuit current ($I=E/X_C$).

C. decrease in capacitive reactance
Incorrect Answer: Capacitive reactance is inversely proportional to the frequency of the circuit ($X_C = 1/6.28(f)(C)$). A decrease in frequency will result in an **increase** in capacitive reactance.

D. decrease in total impedance
Incorrect Answer: Impedance (Z) in a capacitive circuit is directly proportional to the circuit voltage (E), and inversely proportional to the circuit current (I). Decreasing the frequency in a capacitive circuit while maintaining a constant circuit voltage will result in a decrease in circuit current, thus an **increase** in total impedance (Z=E/I).

Electrical wire in general, when used aboard vessels must meet minimum requirements. Which of the following statements is/are correct?

A. Each wire must be 14 AWG or larger, regardless of locations and use.
Incorrect Answer: 46 CFR 111.60-4 states “Each cable conductor must be # 18 AWG (0.82MM^2) or larger except- (a) Each power and lighting cable conductor must be #14 AWG (2.10mm^2) or larger; and (b) Each thermocouple, pyrometer, or instrumentation cable conductor must be #22 AWG (0.33mm^2) or larger.”

B. Wire must be copper stranded.
Correct Answer: 46 CFR 111.60-11(e) states “Wire must be of the copper stranded type.”

C. The only wire that does not have to be in a suitable enclosure or cover is the ground wire used with portable tools and lights.
Incorrect Answer: 46 CFR 111.60-11(a) states “Wire must be in an enclosure.”

D. All of the above.
Incorrect Answer: Choice “B” is the only correct answer.

In an AC circuit, the inductive reactance of a coil varies with the _____.

Note: When an AC current is passed through a coil of wire, or "inductor", a counter-electromotive force (cemf) is generated that delays the increase or decrease in flow of current. The opposition the inductor presents to the change in flow of alternating current is referred to as inductive reactance (X_L), and is measured in ohms. Inductors are used as current-limiting devices on large AC machines, and as "chokes" in filter circuits.

A. resistance of the circuit
Incorrect Answer: The circuit current will vary in inverse proportion to a change in resistance, but the inductive reactance will not change.

B. frequency of the circuit
Correct Answer: Inductive reactance varies in direct proportion to the frequency (f) of the circuit, and inductance (L) of the coil ($X_L = 6.18(f)(L)$). An increase in frequency and/or inductance results in an increase in inductive reactance, and a decrease in frequency and/or inductance will result in a decrease in inductive reactance.

C. voltage of the circuit
Incorrect Answer: The circuit current will vary in direct proportion to a change in voltage, but the inductive reactance will not change.

D. current of the circuit
Incorrect Answer: Varying the current has no affect on the inductive reactance. See explanation in *Note.*

Reset control is also referred to as _____.

Note: Proportional control is one type of feedback process control, which continuously adjusts the controller output based on the difference between the process variable (temperature, level, pressure, etc) and the set point. The greater the difference between the process variable and the set point, the greater the controller output. Derivative(rate) and/or integral control(reset) are added to proportional control to improve the response. When the three are used together, the acronym PID is used to describe the controller.

A. derivative control
Incorrect Answer: Derivative control is also referred to as rate control. A proportional plus derivative control will produce the effect of increasing the stability of the system, reducing the tendency to overshoot the set point, and improve the transient response.

B. integral control
Correct Answer: Integral control is also referred to as reset control. A proportional plus integral control will have the effect of eliminating steady-state errors (offset) inherent in proportional only control, but will also result in the process overshooting the set point.

C. rate control
Incorrect Answer: Rate control is another term for derivative control.

D. proportional control
Incorrect Answer: Proportional control is considered to be a linear feedback control. See explanation in *Note*.

Boiler water hardness in modern high pressure boilers should be kept as close to ‘zero’ as possibly by chemically treating with _____.

Note: Hardness is a measure of the mineral content of water generally expressed in parts per million (ppm). Calcium and magnesium are the primary minerals found in “hard water”, and will separate out of solution to form scale that adheres to the boiler tube surfaces. The scale deposits act as insulators and reduce the heat transfer rate across the tube surface at the point of deposition, which results in the increase of the tube metal temperature until overheating, softening, blistering, or tube failure may occur.

A. trisodium phosphate
Correct Answer: Chemically treating the boiler water with trisodium phosphate maintains the hardness of the water at close to zero. Trisodium phosphate reacts with water to form sodium hydroxide and disodium phosphate. The sodium hydroxide increases the alkalinity to minimize boiler tube corrosion, while the disodium phosphate reacts with the scale forming sulfates of calcium and magnesium to form a sludge that is removed by the process of blow down.

B. soda ash
Incorrect Answer: Soda ash, or sodium carbonate, is an alkaline compound that neutralizes corrosive acid salts and increases the alkalinity of boiler water. In addition, soda ash reacts with the scale forming sulfates of calcium and magnesium to form sludge. However, soda ash decomposes to caustic soda at elevated temperatures and pressures, which could lead to caustic embrittlement of metal surfaces, thus it is not normally used in high-pressure boilers.

C. caustic soda
Incorrect Answer: Caustic soda, or sodium hydroxide, is an alkali that neutralizes corrosive acid salts and increases the alkalinity of boiler water. Caustic soda is rarely used as the primary treatment chemical for high-pressure boilers due to the fact that excess quantities of it can lead to caustic embrittlement.

D. all of the above
Incorrect Answer: Choice “A” is the only correct answer.

A six cylinder, single acting, four-stroke/cycle diesel engine has a bore of 10 ½ inches, and a stroke of one foot, producing 75 HP per cylinder at 720 RPM. What is the mean effective pressure in the engine cylinders for the stated conditions?

Note: Mean effective pressure is the average pressure exerted on a piston during each power stroke, and is determined by formula or by means of a planimeter.

A. 39.7 psig
Incorrect Answer: "A" is incorrect as power occurs only once in two revolutions and "360" should have been used as "N" rather than "720".

B. 79.4 psig

Correct Answer:

$$HP = \frac{PLAN}{33000}$$

HP = shaft, or brake horsepower = 75 HP

P = mean effective pressure

L = piston stroke in feet = 1 foot

A = effective area of the piston, $in^2 = \prod r^2 = 3.14(5.25)^2 = 86.5$ (r = 0.5 bore)

N = number of power strokes per minute = 720 RPM ÷ 2 = 360

33,000 = unit of power (1 hp), or foot-pounds per minute

Solving HP equation for P results in:

$$P = \frac{HP}{LAN}(33000) = \frac{75}{(1)(86.5)(360)}(33000) = 79.4 \text{ psig}$$

C. 476.4 psig
Incorrect Answer: "C" is incorrect as mean effective pressure is calculated per cylinder, and remains the same regardless of the number of engine cylinders (P ≠ 479.4 psig = 6 x 79.4 psig).

D. 952.7 psig
Incorrect Answer: "D" is approximately double the value of "C", and is incorrect.

Which of the listed motors will operate at the highest RPM, assuming that each operates at the same frequency?

Note: A synchronous motor is a constant speed machine in which the rotor normally rotates at the same speed as the revolving stator field (synchronous speed). An induction motor is a variable speed machine in which the rotor always rotates slower than the revolving stator field. The induction motor is the most commonly used AC motor in industry because of its simplicity and low cost. Large low-speed synchronous motors operate more efficiently than an induction motor, and are typically used as marine propulsion motors.

A. A four-pole synchronous motor under normal load.
Correct Answer: The speed of a synchronous motor rotor is equal to the rotating stator flux speed, which is directly proportional to the frequency of the applied voltage, and inversely proportional to the number of stator poles. The fewer the number of stator poles, the greater the speed. Expressed mathematically:

$$n_r = n_s = \frac{120\, f_s}{P} = \frac{120\, f_s}{4} = 30\, f_s$$

where, n_r = rotor speed (RPM), n_s = synchronous speed, f_s = frequency of applied voltage, and P = number of poles.

B. A four-pole induction motor under no load.

Incorrect Answer: At a constant frequency, a four-pole induction motor will run faster than a six-pole induction motor or six-pole synchronous motor, but slower than a four-pole synchronous motor due to slip. Expressed mathematically,

$$s = (n_s - n_a)/n_s$$

where, s = slip, n_s = synchronous speed, and n_a = actual speed.

Full-load slip varies from less than 1 % in high hp motors to more than 6 % with small hp motors.

C. A six-pole synchronous motor under normal load.
Incorrect Answer: See explanation for choice A. The greater the number of stator poles, the slower the speed. Expressed mathematically:

$$n_r = n_s = \frac{120\, f_s}{P} = \frac{120\, f_s}{6} = 20 f_s$$

thus, a six-pole synchronous motor will run slower then a four-pole synchronous motor or four-pole induction motor under normal load, but faster then a six-pole induction motor.

D. A six-pole induction motor under full load.
Incorrect Answer: A six-pole induction motor will run slower then a four-pole induction motor or four-pole synchronous motor or six-pole synchronous motor under full load conditions.

The most common instrument used to measure diesel engine exhaust pressure is the _____.

A. pyrometer
Incorrect Answer: A pyrometer is a high temperature measuring device, and is used to monitor cylinder and/or engine exhaust temperatures.

B. bourdon gauge
Incorrect Answer: The accuracy of a bourdon-tube pressure gauge diminishes below pressures of 15 psig and vacuum pressures slightly less than 14.7 psia rendering it unsuitable for measuring the low exhaust pressures typical of diesel engines.

C. pneumercator
Incorrect Answer: A pneumercator measures liquid tank levels proportional to the height of a liquid producing static pressure.

D. manometer
Correct Answer: A manometer is a liquid column instrument that measures very accurately low pressures nearly atmospheric and is ideal for measuring comparitively low engine exhaust pressure. In its simplest form, a manometer consists of either a straight or U- shaped tube filled with a liquid. One end of the tube is open to the atmosphere, and the other end connected to the pressure source to be measured. The liquid reacts to the amount of pressure exerted on it and moves up or down within the tube. The pressure in a U-tube is determined by matching the difference in liquid level against a graduated scale (such as inches or millimeters of water) within the manometer.

An example of a combustible liquid is _____.

Note: A combustible liquid is any liquid which gives off flammable vapors above 80° F, and within this class of liquids are two grades, Grade D and E, which are based on flash point. A flammable liquid is any liquid which gives off flammable vapors at or below 80° F, and within this class of liquids are three grades, Grade A, B, and C, which are based on Reid Vapor Pressure and flashpoint. There is a misconception that flammable and combustible liquids burn or explode. Specifically, the vapors produced from these liquids either burn or explode in the proper amount of air.

A. lube oil
Correct Answer: Lube oil is a Grade D **combustible** liquid. Grade D combustible liquids are those having a flash point above 80° F, but below 150° F. Grade E combustible liquids are those liquids that have a flashpoint above 150° F.

B. gasoline
Incorrect Answer: Gasoline is a Grade B **flammable** liquid. A Grade B flammable liquid has a Reid Vapor Pressure (RVP) between 8.5 and 14 psi, and a flash point of 80° F or lower.

C. butane
Incorrect Answer: Butane is a Grade A **flammable** liquid. A Grade A flammable liquid has a RVP of 14 psi or greater, and a flash point of 80° F or lower.

D. benzene
Incorrect Answer: Benzene is a Grade C **flammable** liquid. A Grade C flammable liquid has a RVP of 8.5 psi or less, and a flash point of 80° F or lower.

An additive used to improve the ability of a lube oil to reduce friction is known as a/an _____.

A. suppressant additive
Incorrect Answer: Suppressants are antifoam agents added to lubricating oil.

B. dispersant additive
Incorrect Answer: Dispersant additives prevent oxidized particles from attaching to each other or the engine metal surfaces by keeping the particles suspended in the oil.

C. extreme pressure additive
Correct Answer: An extreme pressure (EP) additive is an agent utilized in lubricating oil that reacts with metal under high pressure to prevent metal to metal contact and thus reduces friction.

D. ph alkaline additive
Incorrect Answer: ph alkaline additives are added to lube oil to prevent the corrosion of metal as a result of acids formed by oxidized oil substances.

The amount of fuel injected in a particular time, or degree, of crankshaft rotation is termed _____.

Note: The primary function of the fuel- injection system is to deliver fuel to the engine cylinders at the proper time, and in the proper quantity, under various engine loads and speeds. The fuel injection system must also accurately atomize, distribute, and control the rate of injection of the fuel.

A. metering
Incorrect Answer: Metering, or measuring, is the term that refers to the amount of fuel delivered to each engine cylinder just prior to each power stroke. Accurate metering is essential for an even distribution of load between cylinders, and smooth engine operation.
For each setting of the engine fuel control lever, the same quantity of fuel must be admitted to each cylinder each time it fires. The amount of fuel delivered to each cylinder is dictated by load demand, and is achieved by varying the effective stroke of the cylinder injector pump via the engine fuel control lever.

B. timing
Incorrect Answer: Timing refers to the moment when fuel injection begins. It is essential that injection begin at the proper moment to obtain the maximum power from the fuel. If the fuel is injected too early, ignition may be delayed because the final compresson temperature is not high enough. Early fuel injection results in detonation and low exhaust temperatures. If fuel injection occurs too late, the fuel will be burning in the cylinder well past top dead center resulting in high exhaust temperatures. In both cases, fuel consumption will be high, and power output will be low.

C. rate of injection
Correct Answer: Rate of fuel injection of the metered quantity of fuel injected into the combustion chamber in a unit time, or a degree of crank travel, will be reflected in the rotational speed of the crankshaft. The rate of injection determines the degree of combustion, and should proceed at a rate such that the rise in combustion pressure is not excessive. An incorrect rate of injection affects engine performance in the same way as improper timing. If the rate of injection is too high, a given amount of fuel will be injected during a short time, or during a small number of degrees of crank travel, and the results are similar to early injection. Conversely, if the rate of injection is too low, the results will be similar to that of late injection. To lower the injection rate, an injector nozzle tip with smaller holes is utilized to increase the duration of fuel injection. To raise the injection rate, a nozzle tip with larger holes is utilized to decrease the duration of injection.

D. rate of distribution
Incorrect Answer: Distribution is the term that refers to the atomized fuel's ability to penetrate into the combustion chamber. Injection pressure, combustion space design, and compression pressure are the primary factors in determining a fuel's ability to penetrate to all parts of the combustion chamber where oxygen is available. If the fuel is not properly distributed, all of the available oxygen will not be utilized, and incomplete combustion may occur.

Which ring dam arrangement should be used for centrifugal purification?

Note: If the oil discharged from a purifier is to be free of water, dirt, and sludge, and if the water discharged from the bowl is not to be mixed with oil, the proper size discharge ring (ring dam) must be used. The position of the oil and water layer (interface) in the purifier bowl is a function of the specific gravity of the oil, and ring dam size. As a rule, the higher the specific gravity of the oil, the smaller the inside diameter of the ring dam. Hence, an oil with a specific gravity closer to water, will need to have a relatively small inside diameter ring than a lighter oil While the outside diameter of the discharge ring is fixed, the inside diameter may vary. The inside diameter, in millimeters, is stamped on each ring. Nomograms, provided in manufacturers' manuals, specify the proper ring dam size to use with an oil of a given specific gravity at a specified temperature.

A. The largest inside diameter ring without loss of oil.
Correct Answer: The use of the largest inside diameter discharge ring results in the positioning of the oil-water interface towards the outer edge of the purifier bowl. The closer the interface is to the outer edge of the purifier bowl, the smaller the seal water layer depth and the larger the oil layer depth. These factors result in the oil being subjected to centrifugal force for a longer period of time, due to the larger radius of the oil layer. As the increased radius allows for a higher centrifugal force to be applied, this results in a more complete separation.

B. The largest outside diameter ring without loss of oil.
Incorrect Answer: The outside diameter of the ring dam is fixed, and does not change for the specific centrifuge model.

C. The smallest inside diameter ring without loss of oil.
Incorrect Answer: The use of the smallest inside diameter discharge ring results in the positioning of the oil-water interface towards the center of the purifier bowl. The closer the interface is to the center of the purifier bowl, the greater the water layer depth, and the smaller the oil layer depth. This results in the oil being subjected to a lower value of centrifugal force for a shorter period of time, and as the time of separation of water from the oil is reduced, more water entrained with the oil would tend to carry over.

D. The smallest outside diameter ring without loss of oil.
Incorrect Answer: The outside diameter of the ring dam is fixed, and does not change for the specific centrifuge model.

The Total Base Number (TBN) value of diesel engine lube oil refers to its ability to _____.

Note: The TBN of diesel engine lube oil is the measure of the alkaline reserve, or the ability of the oil to neutralize acids from combustion. Depletion of the TBN can lead to acidic corrosion and fouling within the engine.

A. resists changes in viscosity with changes in temperature
Incorrect Answer: The ability of lube oil to resist changes in viscosity with changes in temperature is referred to as Viscosity Index (VI). Oils which are determined as having a narrow or small change in viscosity with a wide change in temperature are assigned a high VI, and oils which undergo a wide or large viscosity change with a narrow change in temperature are assigned a low VI.

B. resists emulsification
Incorrect Answer: An emulsification is a water in oil mixture. The presence of water in lube oil will result in the formation of acid and sludge, which can result in serious damage to engine components if left uncorrected. Additives blended into the lube oil and proper purifier operation both help in resisting emulsification.

C. neutralize acids
Correct Answer: The TBN of a diesel engine lube oil is the measure of the alkaline reserve, or the ability of the oil to neutralize acids formed by the byproducts of combustion.

D. resists oxidation at high temperatures
Incorrect Answer: The ability of lube oil to resist oxidation at high temperatures is defined as Oxidation Stability.