

U.S.C.G. Merchant Marine Exam

Chief Engineer-MODU

Q740 Engineering Safety-Environmental Protection

(Sample Examination)

Choose the best answer to the following Multiple Choice Questions.

1. The physical difference of the water spray patterns developed by the high velocity tip and low velocity applicator is due to _____.
- (A) the method of breaking up the water stream
 - (B) the type of fire being fought
 - (C) the capacity of the fire pump
 - (D) a difference in water pressure

If choice A is selected set score to 1.

2. The principle personnel hazard unique to Halon fire extinguishers is _____.
- (A) skin irritation
 - (B) displacement of oxygen
 - (C) eye irritation produced immediately after discharge from cylinder
 - (D) inhaling toxic vapors produced when exposed directly to a flame for extended periods

If choice D is selected set score to 1.

3. Which of the following statements concerning immersion suits is correct?
- (A) Suits are not required to automatically turn an unconscious person face-up in the water.
 - (B) The immersion suit seals in all body heat and provides protection against hypothermia for weeks.
 - (C) The suit is flameproof and provides protection to the wearer while swimming through burning oil.
 - (D) The suits provide for limited body movement such as walking, climbing a ladder, and picking up small objects like a pencil.

If choice D is selected set score to 1.

4. Which extinguishing agent is the best for use on electrical fires?
- (A) Water fog
 - (B) CO₂
 - (C) Dry chemical
 - (D) Foam

If choice B is selected set score to 1.

5. 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 12" duplex double acting reciprocating bilge pump, operating at 96% efficiency, to keep the bilge water level from continuing to rise? Illustration SF-0034
- (A) 45 strokes per minute
 - (B) 56 strokes per minute
 - (C) 87 strokes per minute
 - (D) 98 strokes per minute

If choice C is selected set score to 1.

6. Which of the gases listed is the poisonous gas most likely to be found in a closed compartment involved in a fire?
- (A) Nitrogen
 - (B) Hydrogen
 - (C) Carbon dioxide
 - (D) Carbon monoxide

If choice D is selected set score to 1.

7. It is necessary to cool the bulkheads and decks surrounding a compartment where there is a fire in order to _____.
- (A) cool the metal below its ignition temperature
 - (B) form a dense coating of smothering steam
 - (C) prevent oxygen from reaching the flames
 - (D) prevent the fire from spreading by the conduction of heat

If choice D is selected set score to 1.

8. As chief engineer, you are discussing with a new engineer the methods of fighting an engine room fire. You ask the engineer to explain how to proceed in the event of an engine room fire when you cannot gain entry to the control room. Which of the following should be included in the engineer's response?
- (A) Open the steam smothering to the main engine.
 - (B) Secure the ventilation and allow the fire to burn itself out.
 - (C) Immediately dump the fixed CO₂ system without securing the ventilation.
 - (D) Secure the fuel pumps and ventilation from the emergency station outside the engine room.

If choice D is selected set score to 1.

9. Why is an upper limit switch used when raising the lifeboat?

- (A) To stop the lifeboat from being lowered.
- (B) To prevent the davits from pulling up against the stops.
- (C) To assist in cranking in the lifeboat.
- (D) To keep the tricing lines from releasing or getting tangled.

If choice B is selected set score to 1.

10. Wooden shoring, with a cross-sectional dimension of 4" X 4" should not be longer than _____.

- (A) 8 feet
- (B) 10 feet
- (C) 16 feet
- (D) 20 feet

If choice B is selected set score to 1.

11. A specific document which identifies a chemical, and lists its physical properties, health hazards, required controls, firefighting procedures, cleanup methods, waste disposal, and the safe handling and storage requirements, is commonly called a _____.

- (A) Material Safety Data Sheet
- (B) Physical/Chemical Characteristics Document
- (C) Hazardous Chemical Information Sheet
- (D) Hazardous Chemical Loading Document

If choice A is selected set score to 1.

12. As chief engineer you should understand the fundamental principles of ship construction and theory and factors affecting trim and stability, including the concept of loll and its cause. An angle of loll is commonly caused by which of the following conditions?

- (A) A negative GM.
- (B) An off-center weight.
- (C) Free surface with G remaining below M.
- (D) High external force such as wind and current.

If choice A is selected set score to 1.

13. What term is listed on a Material Safety Data Sheet (MSDS) to describe a chemical that can produce life-threatening or seriously disabling health hazards?

- (A) Recommended toxicity
- (B) High toxicity
- (C) Low toxicity
- (D) Moderate toxicity

If choice B is selected set score to 1.

14. If a fire hose is left unattended and under pressure with the nozzle shut off, the fire hose will _____.

- (A) lash about violently
- (B) become elongated by 125%
- (C) remain motionless
- (D) burst under pressure

If choice C is selected set score to 1.

15. The fire extinguishing equipment shown in the illustration is a large _____. Illustration SF-0009

- (A) Halon 1301 hose reel system
- (B) CO₂ hose reel system
- (C) light water hose reel system
- (D) dry chemical hose reel system

If choice D is selected set score to 1.

16. Which of the following precautions are necessary when using any electrical equipment in a hazardous location, such as a cargo pump room?

- (A) Each compartment where flammable gas is expected to accumulate is to be closed and secured.
- (B) The adjacent compartments are to be gas free.
- (C) The pump room is to be gas free.
- (D) All of the above.

If choice D is selected set score to 1.

- 17.** Your vessel, of more than 1000 gross tons on an international voyage is crossing the Atlantic Ocean. The second engineer injures his hand while working on a pump. The injury requires more than basic first aid. As the senior officer onboard how would you proceed?
- (A) Read an outdated copy of the Ships Medicine Chest reference book found onboard to help treat the injury.
 - (B) Seek help from fellow crew members who have no medical training.
 - (C) Contact the medical advisory service contracted by your company to speak with a shore side doctor and address the injury as directed by the doctor.
 - (D) Call your company port engineer and ask for help.

If choice C is selected set score to 1.

- 18.** When a fuel oil tank is being topped off during bunkering operations, the tank valve should be closed _____.
- (A) rapidly to prevent overflow
 - (B) after the shore pumps are stopped
 - (C) to prevent gas from escaping through the pressure-vacuum relief valves
 - (D) slowly to prevent surge stresses

If choice B is selected set score to 1.

- 19.** The Oil Record Book must be maintained onboard the vessel for _____.
- (A) 6 months and then submitted to the nearest Marine Safety Office for review
 - (B) the duration of the ship's active employment
 - (C) an annual inspection
 - (D) not less than 3 years and be readily available for inspection

If choice D is selected set score to 1.

- 20.** The spreading of fire as a result of heat being carried through a vessel's ventilation system is an example of heat transfer by _____.
- (A) conduction
 - (B) convection
 - (C) radiation
 - (D) windage

If choice B is selected set score to 1.

21. A fire involving aluminum powder would be a class _____.

- (A) "A" fire
- (B) "B" fire
- (C) "C" fire
- (D) "D" fire

If choice D is selected set score to 1.

22. A vessel's stability is greatly reduced by liquid free surface. Which of the listed conditions would develop the greatest adverse effect?

- (A) Tanks which have been pressed up to full capacity.
- (B) Tanks which are 95% full.
- (C) Tanks which are 40% full.
- (D) Tanks which have been completely emptied.

If choice C is selected set score to 1.

23. A rigid lifesaving device designed for a group of survivors to hold on to while in the water is defined as a _____.

- (A) life raft
- (B) life cushion
- (C) life preserver
- (D) buoyant apparatus

If choice D is selected set score to 1.

24. By definition, an example of a flammable liquid is _____.

- (A) caustic potash
- (B) gasoline
- (C) kerosene
- (D) animal and vegetable oils

If choice B is selected set score to 1.

- 25.** Your ship has a low-pressure carbon dioxide system that covers the engine room. Fire has been reported in the engine room and the decision has been made to dump the carbon dioxide system into the engine room. While following the procedures to release carbon dioxide you find one engine room supply fan damper that will not close. How should you proceed?
- (A) Continue the release procedures and dump the carbon dioxide, after the release then try to seal the fan damper opening.
 - (B) Continue the release procedures and dump the carbon dioxide with the damper still open.
 - (C) Cover the fan damper opening with burlap bags to slow the flow of air into the engine room and then continue with the release procedures.
 - (D) Cover the fan damper opening with a plastic tarp to stop the flow of air into the engine room and then continue with the release procedures.

If choice D is selected set score to 1.

- 26.** Why is it essential to introduce CO₂ from a fixed fire extinguishing system, into a large engine room, as quickly as possible?
- (A) To keep the fire from spreading through the bulkheads.
 - (B) Updraft from the fire tends to carry the CO₂ away.
 - (C) Carbon dioxide takes a long time to disperse to all portions of a space.
 - (D) The fire may warp the CO₂ piping.

If choice B is selected set score to 1.

- 27.** If diesel fuel vapors in a compartment are considered to be within the flammable range _____.
- (A) the vapor air mixture is too rich to burn
 - (B) an explosion may occur if a source of ignition is present
 - (C) the upper explosive limit has been exceeded
 - (D) the vapor air mixture is too lean to burn

If choice B is selected set score to 1.

- 28.** During vessel familiarization, you find the vessel you are newly assigned to as chief engineer has a high-pressure CO₂ system for the engine room. In what way are the high-pressure CO₂ bottles released in the event of an engine room fire?
- (A) The master cylinder sends gas to the actuators on all bottles in the affected banks.
 - (B) The bottles are released individually.
 - (C) The pull wire releases all bottles in the banks.
 - (D) The smoke detection system automatically releases CO₂ to the engine room.

If choice A is selected set score to 1.

29. An LNG carrier has an approved type of gas detecting system to detect methane leaks in the _____.

- (A) cargo handling rooms
- (B) barrier spaces
- (C) boiler burner supply piping
- (D) all of the above

If choice D is selected set score to 1.

30. An "on-load" release system on a survival craft means the cable can be released _____.

- (A) only when the load is taken off the cable
- (B) only when there is a load on the cable
- (C) only when activated by the controls at the lowering station
- (D) at any time

If choice D is selected set score to 1.

31. You are providing onboard training to your engineers on the factors affecting trim and stability. What instructions do you give your engineers to stabilize the ship should it experience an unstable rolling behavior?

- (A) Discharge water from the forepeak tank.
- (B) Discharge dirty ballast from a centerline double bottom tank.
- (C) Add ballast to wing tank to the side of the ship with an angle of list.
- (D) Add ballast to a centerline double bottom tank.

If choice D is selected set score to 1.

32. Fire detecting systems on vessels may be arranged to sense _____.

- (A) ionized particles
- (B) smoke
- (C) rate of temperature rise
- (D) all of the above

If choice D is selected set score to 1.

33. A vessel's center of gravity is lowered when the _____.

- (A) reserve buoyancy increases
- (B) freeboard is increased
- (C) tanks are ballasted
- (D) trim is increased

If choice C is selected set score to 1.

- 34.** Which of the listed methods is the most effective to fight a fire on the open deck of a vessel if using a dry chemical type fire extinguisher?
- (A) Approach the fire from the windward side.
 - (B) Direct the extinguisher discharge at the base of the fire.
 - (C) Move the discharge stream back and forth in a rapid sweeping motion.
 - (D) All of the above.

If choice D is selected set score to 1.

- 35.** What is a major advantage of using a positive pressure type self-contained breathing apparatus?
- (A) Facial hair will not affect the mask performance.
 - (B) The equipment is lightweight and the wearer can work without difficulty in confined spaces.
 - (C) The average operating time is over an hour.
 - (D) The speed with which it can be put into operation is around 45 seconds.

If choice D is selected set score to 1.

- 36.** When taking samples of a tank atmosphere with an explosimeter, you should _____.
- (A) avoid sampling in the vicinity of deep webs to prevent false readings
 - (B) sample as much of the tank as possible, especially at the bottom
 - (C) only sample around the deck longitudinals as gases are lighter than air
 - (D) sample only near the ullage openings as all vapors accumulate there

If choice B is selected set score to 1.

- 37.** As team leader of the No.2 emergency squad you arrive at the scene of a fire in the Bosun's storeroom on the weather deck. How would you proceed to fight this fire?
- (A) First, size up the fire situation before committing crew members and equipment and then relay accurate information to the bridge.
 - (B) Open the storeroom door before any boundary cooling is done to determine what is burning.
 - (C) Pull the fixed fire suppressant system that covers the Bosun's storeroom to extinguish the fire.
 - (D) Immediately start boundary cooling the adjacent compartment.

If choice A is selected set score to 1.

- 38.** Your vessel has just been struck by another vessel. After meeting with the captain and chief mate, you have immediately ordered the vessel specific damage control procedures in the vessel's approved stability booklet to be enacted. Which of the following statements is true?
- (A) The Certificate of Documentation issued to the vessel will be the primary reference document in order to calculate free surface corrections.
 - (B) The universal station billet assigning crew member responsibilities will provide adequate reference information to determine the adequate damage control response.
 - (C) The Safety Management System will provide an IMO standard response for all collision response procedures, including damage control.
 - (D) The vessel general arrangement plan would be a critical reference document for your response providing accurate data showing watertight compartments, closures, vents and down flooding angles.

If choice D is selected set score to 1.

- 39.** With the sprinkler system and air system on, and all hatches shut, the survival craft will be protected from _____.
- (A) a nuclear environment
 - (B) a fire and toxic environment
 - (C) a hurricane
 - (D) a drop greater than ten feet

If choice B is selected set score to 1.

- 40.** You are on a vessel with a 30' mean draft. While maneuvering away from the dock at slow-speed the vessel grounds near the bow area on hard sand. In order to achieve an additional three foot of trim by the stern, you need to shift ballast from the forepeak, which is full, to the after peak, which is empty. Your ballast pump for this operation has a capacity of 85 tons per hour. How much tonnage needs to be shifted and how long should it take?
- (A) 9 tons shifted from the forepeak to the after peak in 0h 7m.
 - (B) 143 tons shifted from the forepeak to the after peak in 1h 41m.
 - (C) 1333 tons shifted from the forepeak to the after peak in 15h 41m.
 - (D) The tons to shift for a 36" trim exceeds the tank capacity.

If choice D is selected set score to 1.

41. As an engineer, you are standing by a fuel oil storage tank as a crew member is working inside the tank. Before entering the tank, the atmosphere was checked and determined safe for men to work. While standing by you notice that the crew member is not moving. After attempts to communicate with the downed mariner you receive no response, what action would you take?

- (A) Send another crew member, without a SCBA on, into the tank to retrieve the unconscious crew member.
- (B) Send two additional crew members, without a SCBA on, into the tank to retrieve the unconscious crew member.
- (C) Have additional crew members don a SCBA to enter the tank, to aid in the removal of the unconscious crew member.
- (D) Call the captain and ask him how you should proceed.

If choice C is selected set score to 1.

42. The blocking open or absence of fire dampers can contribute to _____.

- (A) the accumulation of explosive gases
- (B) faster cooling of the fire
- (C) the fire spreading by way of the ventilation system
- (D) fixed foam systems to be ineffective

If choice C is selected set score to 1.

43. Coast Guard regulations require a shipboard oil pollution emergency plan to be reviewed _____.

- (A) once a year
- (B) once every two years
- (C) once every four years
- (D) once every five years

If choice A is selected set score to 1.

44. A simple precaution to reduce the possibility of accidental fires in the paint locker is to _____.

- (A) label the fixed firefighting system
- (B) store paint cans on metal shelves only
- (C) not allow oily rags to accumulate in the space
- (D) place a portable fire extinguisher immediately outside the locker

If choice C is selected set score to 1.

45. Which of the petroleum products listed has a flash point below 150°F?

- (A) Light fuel oils
- (B) Road oils
- (C) Asphalt
- (D) Lubricating oils

If choice A is selected set score to 1.

46. The worst atmospheric condition for dispersion of hydrogen sulfide is _____.

- (A) full sun with high winds
- (B) heavy rain
- (C) nearly calm, clear nights or early morning
- (D) gusty winds with rain

If choice C is selected set score to 1.

47. Which of the following is NOT required to be provided as part of the appendixes of the Shipboard Oil Pollution Emergency Plan?

- (A) a list of agencies or officials of Coastal State administrations responsible for receiving and processing incident reports
- (B) a list of agencies or officials in regularly visited ports
- (C) a list of personnel duty assignments
- (D) a list which specifies who will be responsible for informing the parties listed and the priority in which they must be notified

If choice C is selected set score to 1.

48. Which of the following methods will reduce the possibility of producing an electrical spark?

- (A) Using a cargo hose with a built-in electrical bonding wire.
- (B) Connecting a bonding wire between the shore side piping and the vessel.
- (C) Placing an insulating flange or a section of non-conducting hose in the hose setup.
- (D) All of the above.

If choice D is selected set score to 1.

49. In the event of an exhaust duct fire, most dry chemical and carbon dioxide galley range fixed extinguishing systems are automatically activated through the action of a stainless steel cable, spring and a _____.

- (A) fusible link
- (B) stack switch
- (C) thermostat
- (D) pyrostat

If choice A is selected set score to 1.

50. As the senior engineer onboard a vessel, how would you instruct a new engineer to use the firefighting apparatus illustrated to fight an oil fire at the bunker station? Illustration SF-0020

- (A) This piece of firefighting equipment cannot be used to extinguish an oil fire.
- (B) Direct aqueous film forming foam off the overhead or nearby bulkhead, using a bank down or bounce off method to extinguish the fire.
- (C) Direct water off the overhead or nearby bulkhead, using a bank down or bounce off method to extinguish the fire.
- (D) Direct aqueous film forming foam in a straight stream into the fuel to extinguish the fire.

If choice B is selected set score to 1.

51. An acceptable method of temporarily sealing a crack formed in the hull of a vessel is to _____.

- (A) drill holes at each end
- (B) shore up the crack with welded braces
- (C) apply a patch of sheet packing backed by a strong back or shoring
- (D) tack weld a doubler plate over the crack

If choice C is selected set score to 1.

52. Which of the following statements is TRUE concerning life jackets?

- (A) Buoyant vests may be substituted for life jackets.
- (B) Life jackets are designed to turn an unconscious person's face clear of the water.
- (C) Life jackets must always be worn with the same side facing outwards to float properly.
- (D) Lightly stained or faded life jackets will fail in the water and should not be used.

If choice B is selected set score to 1.

53. The state of charge of a stored pressure type dry chemical fire extinguisher can be readily determined by _____.

- (A) visual inspection of the pressure gage
- (B) removing the lid and checking the level of dry chemical
- (C) weighing the CO₂ cartridge
- (D) weighing the cylinder

If choice A is selected set score to 1.

54. Good housekeeping on a vessel prevents fires by _____.

- (A) allowing better access in an emergency
- (B) eliminating potential fuel sources
- (C) eliminating trip hazards
- (D) improving personnel qualifications

If choice B is selected set score to 1.

55. An oxygen indicator will detect _____.

- (A) the presence of harmful amounts of carbon monoxide
- (B) an oxygen deficiency in a space
- (C) concentrations of explosive gas
- (D) all of the above

If choice B is selected set score to 1.

56. As the senior engineer of a vessel of more than 1600 gross tons on an international voyage, you have just activated the CO₂ release handle for the engine room to extinguish a fire. How would you direct the emergency team to re-enter the engine room?

- (A) Have the team wait two hours, then, with the team dressed in firefighting gear and SCBA, approach the engine room door. Crack the door open and advance, if no fire is detected.
- (B) Wait until there are no signs of smoke or heat, then, with the team dressed in firefighting gear and SCBA, approach the engine room door. Crack the door open with a charged fire hose at the ready and advance, if no fire is detected.
- (C) Wait until there are no signs of smoke or heat have the team dressed in firefighting gear and approach the engine room door. Crack the door open and advance, if no fire is detected.
- (D) Have the team wait two hours and crack the door open with a charged fire hose at the ready and advance, if no fire is detected.

If choice B is selected set score to 1.

57. Progressive flooding in the engine room may be minimized by securing watertight boundaries and _____.

- (A) evacuating the engine room
- (B) transferring reserve feed water
- (C) pumping out flooded compartments
- (D) dumping fuel oil

If choice C is selected set score to 1.

58. The atmosphere of an empty fuel tank is tested and designated "gas free". Which of the following statements is correct concerning this tank?

- (A) The gas free status is good as long as the initial conditions remain unchanged.
- (B) The concentration of flammable gas in the compartment is less than 10% of the lower flammable limit.
- (C) The tank should be frequently retested.
- (D) All of the above.

If choice D is selected set score to 1.

59. The amount of garbage disposed must be entered into the records maintained by each ship and stated in _____.

- (A) cubic yards convertible to long tons
- (B) cubic meters
- (C) weight in either kilogram or pounds
- (D) barrels, measured in 55 gallon drums

If choice B is selected set score to 1.

60. After fuel tanks have been filled and bunkers completed, which of the listed procedures should be followed next?

- (A) The tanks should be sounded to verify levels.
- (B) The pressure-vacuum relief valve should be reset.
- (C) The tanks should be made seaworthy to prevent contamination.
- (D) The tanks should be marked with a bull stamp on the manifold filling valve.

If choice A is selected set score to 1.

61. As chief engineer of a vessel, you and the assistant engineer are planning a welding job in a tank. How would you ensure that all safety precautions are reviewed prior to starting this job?

- (A) Have the engineer complete a hot-work permit after completing the job.
- (B) Have the engineer review the SOLAS manual prior to starting the job.
- (C) Have the engineer verbally review fire safety with crew working on the job.
- (D) Have the engineer complete a hot-work permit prior to starting the job.

If choice D is selected set score to 1.

62. The sections of an Oil Record Book preceding the log pages contain a _____.

- (A) detailed listing of all organizations to call in the event of an accidental oil spill
- (B) complete classification of hazardous materials
- (C) damage control plan for isolating fire main valves
- (D) list of machinery space operation items

If choice D is selected set score to 1.

63. You are reviewing emergency procedures with new crew members. How would you direct them to proceed if they hear the fire and emergency signal on the ship's general alarm or whistle?

- (A) Report to the bridge and wait further instructions.
- (B) Report to their stateroom and wait further instructions.
- (C) Report to their assigned duty station as posted on the Station Bill, so an accurate muster can be taken.
- (D) Report directly to the scene of the emergency to help.

If choice C is selected set score to 1.

64. If a fire occurs in an electric cable, in which the inner layers of insulation, or the insulation covered by armor is burning, you should _____.

- (A) separate the two ends
- (B) secure power to the cable
- (C) cut the cable with an insulated cable cutter
- (D) all of the above

If choice D is selected set score to 1.

65. Except in rare cases, it is impossible to extinguish a shipboard fire by _____.

- (A) removing the fuel
- (B) removing the heat
- (C) interrupting the chain reaction
- (D) removing the oxygen

If choice A is selected set score to 1.

66. A Type A fire has been reported onboard your vessel. What type of materials would your fire teams expect to find at the scene?

- (A) Electrical equipment where the use of a non-conducting extinguishing agent is of first importance
- (B) Ordinary combustible materials where the quenching and cooling effects of quantities of water, or solutions containing large percentages of water, are of first importance
- (C) Metals
- (D) Flammable liquids, greases, etc., where a blanketing effect is essential

If choice B is selected set score to 1.

67. A Type B fire has been reported onboard your vessel. What type of materials would your fire teams expect to find at the scene?

- (A) Flammable liquids, greases, etc., where a blanketing effect is essential
- (B) Electrical equipment where the use of non-conducting extinguishing agent is of first importance
- (C) Metals
- (D) Ordinary combustible materials where the quenching and cooling effects of quantities of water, or solutions containing large percentages of water, are of first importance

If choice A is selected set score to 1.

68. According to the Pollution Prevention Regulations (33 CFR), who is to make the final decision of when oil transfer may begin?

- (A) Any local Coast Guard representative
- (B) Captain of the Port officer
- (C) The senior deck officer present
- (D) Designated persons in charge of vessel and facility

If choice D is selected set score to 1.

69. In fighting a fire in a fuel tank, the FIRST action you should attempt is to _____.

- (A) secure all sources of fresh air to the tank
- (B) station someone at the fixed CO₂ release controls
- (C) top off the tank to force out all vapors
- (D) begin transferring the fuel to other tanks

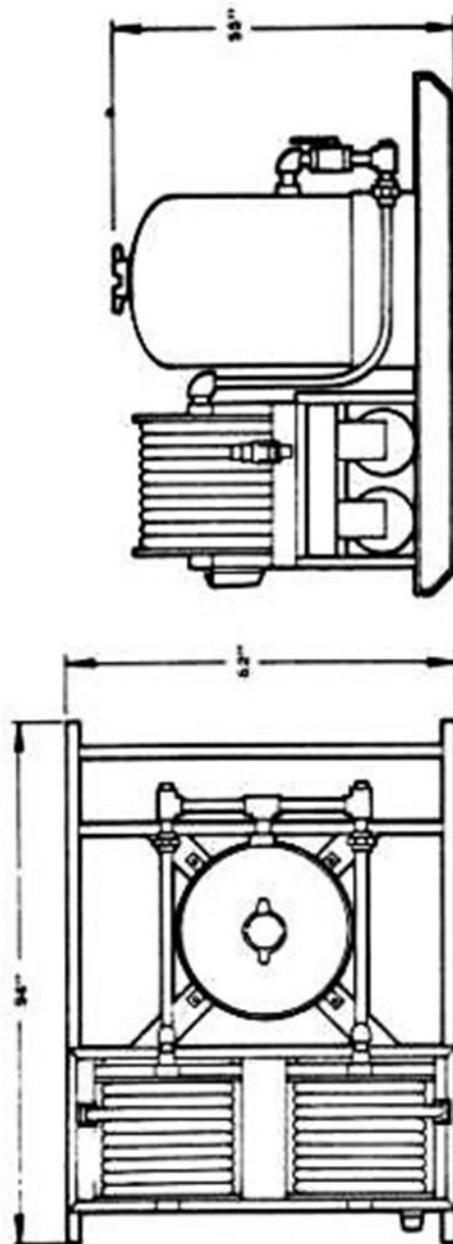
If choice A is selected set score to 1.

70. Which of the following must be carried out in order to manually launch an inflatable life raft not designed for float-free operation?

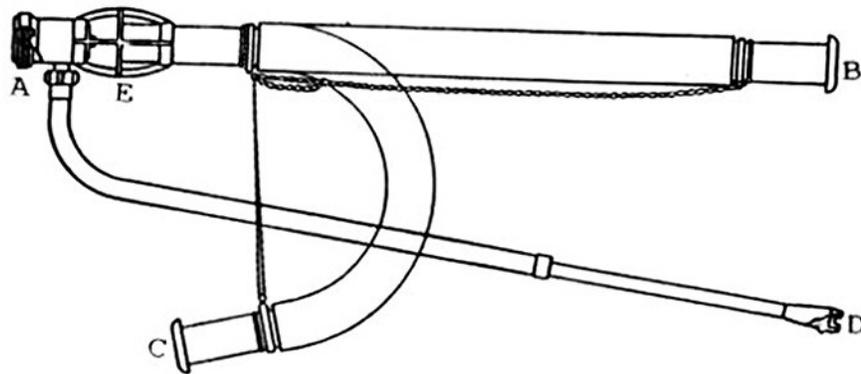
- (A) Cutting the container securing straps.
- (B) Attach the weak link to the vessel.
- (C) Simply breaking the weak link.
- (D) Depress the hydrostatic release button.

If choice D is selected set score to 1.

SF-0009



SF-0020



Adapted for testing purposes only from A Manual for the Safe Handling of Flammable and
Combustible Liquids and Other Hazardous Products
CG-174

SF-0034

Flow of Water Through Holes (Gallons per Minute)

HOLE DIA. IN INCHES	HEAD OF WATER IN FEET												
	2	4	6	8	10	12	14	16	18	20	24	28	32
1	28	40	49	56	63	69	74	79	84	89	97	105	112
2	111	157	192	222	248	272	294	314	333	351	384	415	444
3	250	354	433	500	559	612	661	707	750	790	866	935	1000
4	445	629	770	889	994	1089	1176	1257	1333	1405	1540	1663	1778
5	695	982	1203	1389	1553	1701	1837	1964	2083	2196	2406	2598	2778
6	1000	1414	1732	2000	2236	2449	2646	2828	3000	3162	3464	3741	4000
7	1361	1925	2357	2722	3043	3333	3601	3849	4083	4303	4714	5092	5444
8	1777	2514	3078	3555	3974	4354	4702	5027	5332	5620	6157	6650	7109
9	2249	3181	3896	4499	5030	5510	5951	6362	6748	7113	7792	8416	8997
10	2777	3927	4809	5553	6209	6802	7347	7854	8330	8781	9619	10390	11107
11	3360	4752	5820	6720	7514	8231	8890	9504	10080	10626	11640	12573	13441
12	4000	5655	6926	7997	8941	9795	10579	11310	11996	12645	13852	14961	15995
13	4693	6637	8129	9386	10494	11496	12417	13274	14079	14841	16257	17560	18772
14	5443	7697	9426	10885	12170	13331	14400	15394	16327	17210	18853	20364	21770
15	6246	8834	10820	12494	13969	15302	16528	17667	18740	19754	21640	23374	24988
16	7106	10051	12310	14214	15892	17409	18804	20102	21322	22475	24620	26593	28429
17	8024	11347	13897	16047	17942	19654	21229	22694	24071	25373	27795	30022	32095
18	8996	12722	15582	17992	20116	22035	23802	25445	26988	28448	31164	33660	35985
19	10024	14177	17363	20049	22416	24555	26523	28354	30073	31700	34726	37408	40098
20	11110	15710	19241	22218	24840	27211	29392	31421	33326	35129	38483	41566	44436
21	12244	17316	21208	24488	27379	29992	32396	34632	36732	38719	42416	45814	48977
22	13439	19008	23280	26881	30054	32923	35561	38016	40322	42503	46560	50290	53763
23	14688	20772	25441	29376	32844	35978	38861	41544	44064	46447	50881	54958	58753
24	15995	22622	27707	31993	35769	39183	42323	45245	47989	50585	55414	59853	63986
25	17356	24545	30061	34711	38809	42513	45920	49090	52067	54883	60122	64939	69424
26	18770	26546	32513	37542	41974	45980	49664	53093	56313	59359	65025	70235	75085
27	20242	28627	35061	40485	45264	49584	53557	57254	60727	64012	70122	75740	80971
28	21770	30787	37707	43539	48679	53325	57598	61574	65309	68842	75413	81455	87080
29	23353	33026	40449	46706	52220	57203	61787	66053	70059	73849	80898	87380	93414
30	24992	35345	43289	49985	55885	61219	66125	70690	74977	79033	86577	93514	99971
31	26683	37735	46216	53365	59665	65359	70597	75470	80048	84378	92432	99838	106732
32	28434	40212	49250	56868	63581	69649	75231	80424	85302	89916	98499	106391	113738

Adapted for testing purposes only

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