A sampling pump for an oxygen analyser with a capacity of 100 *ml* per stroke, connected to a 10 *metre* sampling line with a capacity of 25 *ml* per metre is being used to obtain a sample of a cargo tanks atmosphere. How many strokes of the pump are required to ensure, that a truly representative sample is obtained in practice?

- ○ 4. ✅
- ○ 2.
- ○ 10.
- ○ 25.

According to the *ISGOTT* definition, what is a toxic gas?

- ○ A gas, which is harmful to human life. ✅
- ○ A gas, which is flammable.
- ○ A gas other than oxygen.
- ○ A gas mixture containing hydrocarbon gas.

For a correctly inerted cargo tank, what would be the expected oxygen content reading, obtained during checks with a portable oxygen analyser?

- ○ 8 % or less by volume. ✅
- ○ 11 % or less by volume.
- ○ Less than 21 % by volume.
- ○ Less than 20 % by volume.

From the options given select the one, that is generally accepted as the minimum oxygen content to support combustion:

- 11 %. ✅
- 16 %.
- 8 %.
- 21 %.

From the options given select the one, which is the best approximation of the make-up of normal atmospheric air:

- 21 % oxygen and 79 % nitrogen. ✅
- 79 % oxygen and 21 % nitrogen.
- 11 % oxygen and 89 % nitrogen.
- 89 % oxygen and 11 % nitrogen.

How is a time weighted average reading, obtained from a diffusion type detector tube, that has been used over a working period of eight hours?

- Divide the total reading on the tube by 8. ✅
- Multiply the total reading on the tube by 8.
- Take a direct total reading from the tube.
- Half the reading on the tube to get a mid-point reading.

How is the correct volume of the sample controlled when using short term gas detector tubes with a manually operated hand pump?

- ○ By using the indicated number of complete pump strokes for that particular tube. ✅
- ○ By always using a single complete stroke of the pump for each tube.
- ○ By always using a fixed number of complete strokes of the pump for each tube.
- ○ By always operating the pump for the same period of time for each tube.

How would gas detector tubes normally be used to simultaneously check for the presence and concentration of more, than one toxic gas?

- ○ Use a single sample pump with a preselected tube set in a multiple tube holder. ✅
- ○ Use a single detector tube, that will react with all of the gases to be checked.
- ○ Use a number of hand pumps, each fitted with tubes for detecting individual gases.
- ○ Use a single sample pump with a random selection of tubes in a multiple tube holder.

If the oxygen content in an enclosed space falls below 21 % during entry by personnel, what action should be taken?

- ○ Increase the ventilation and continue working.
- ○ Stop the work and put on breathing apparatus before carrying on.
- ○ Complete the work as quickly as possible.
- ○ Stop working and leave the space immediately. ✅

If the oxygen content of an enclosed space is less than 20 %, under what conditions should entry be made by personnel?

- ○ Only in pairs using breathing equipment.
- ○ Using breathing equipment.
- ○ For a short period only, using breathing equipment.
- ○ In an emergency only, using suitable breathing equipment. ✅

It is generally recommended, that non-metallic sampling lines and sensors are used, when obtaining gas samples from cargo tanks. What additional precautions are required, when taking samples during inerting of a cargo tank?

- ○ Samples should never be taken from a partly inerted tank.
- ○ The inerting operation should be stopped while samples are obtained.
- ○ It is safe to take samples during inerting.
- ○ The inerting operation should be stopped for, at least, 30 *minutes* before introducing sampling equipment into the tank. ✅

Many of the oxygen analysers used on board ship use paramagnetic type sensors. What is meant by the term *"Paramagnetic"*?

- ○ That a material is repelled by a magnetic field.
- ○ That a material is non-magnetic under any circumstances.
- ○ That a material is permanently magnetized when exposed to a magnetic field.
- ○ That a material is temporarily magnetized when exposed to a magnetic field. ✅

Metal oxide semiconductor type sensors are increasingly being used in personal gas monitors. What is the operating principle of this type of sensor?

- ○ Conduction of heat from oxide surface by target gas.
- ○ Absorption of specific wavelengths of light.
- ○ Combustion of target gas on heated filament.
- ○ Change of electrical resistance as oxide adsorbs the target gas. ✅

Threshold limit values for exposure to toxic gases are often given as guidance to ensure safety of personnel working, where the gases may be present. Which of the threshold limits given in the options would normally have the highest numerical value?

- ○ *TLV-C.* ✅
- ○ *TLV-TWA.*
- ○ *TLV-STEL.*
- ○ *TLV-LTEL.*

What are the minimum checks, that should be carried out before a gas detecting instrument is used to check the contents of an enclosed space? Select all correct options:

- ○ Check for general condition. ✅
- ○ Check battery condition. ✅
- ○ Check calibration. ✅
- ○ Check condition of sample pump and lines and any filters. ✅

What are the two main reasons for measuring the oxygen content of an enclosed space on board a ship?

- ◯ To ensure the oxygen content is sufficient to allow safe entry. ✅
- ◯ To check, if the oxygen content is low enough to avoid flammable mixtures. ✅
- ◯ To check the amount of hydrocarbon gas present.
- ◯ To check the amount of toxic gases present.

What facility is normally provided for making a zero adjustment to a paramagnetic oxygen analyser?

- ◯ Alter relative position of optical system. ✅
- ◯ Change the rating of the light source lamp.
- ◯ Adjust the electrical circuit.
- ◯ Reposition the meter needle to zero.

What is meant by the term *"bump test"* in relation to gas detecting instruments?

- ◯ Checking the reading of the instrument against a known concentration of test gas. ✅
- ◯ Adjusting the zero settings in fresh air.
- ◯ Adjusting the span of the instrument.
- ◯ Knocking the instrument to see, if the meter needle is sticking.

What is the effect on the oxygen content of the atmosphere of an enclosed space, if hydrocarbon gases are present?

- ◯ Oxygen content is reduced. ✅
- ◯ Oxygen content is increased.
- ◯ The effect cannot be determined.
- ◯ No effect.

What is the generally accepted oxygen requirement necessary before safe entry into an enclosed space on board ship?

- ◯ 21 % by volume. ✅
- ◯ 19 % by volume.
- ◯ 16 % by volume.
- ◯ 1 % by volume.

What is the main advantage of using a personal gas monitor, rather than a long term gas detector tube when working in a potentially hazardous space?

- ◯ The personal monitor will give an alarm if the exposure limits are exceeded. ✅
- ◯ The personal monitor can be used to obtain a time weighted average.
- ◯ The personal monitor can be used to check total exposure throughout the working period.
- ◯ The personal monitor can check for any hazardous gas.

What is the most likely reason for the presence of high levels of *NOx* and *SOx* gases in the atmosphere of a cargo tank on an oil tanker?

- ○ Inert gas from the combustion of fuel oil has been used to inert the tank. ✅
- ○ Sour crude oil has been stored in the tank.
- ○ A cargo of heavy fuel oil with a high sulphur content has been carried in the tank.
- ○ The tank has been fully gas freed following discharge of cargo.

What is the normally accepted value for the lower explosive limit (*LEL*) for hydrocarbon gas in a cargo tank?

- ○ 1 % by volume. ✅
- ○ 21 % by volume.
- ○ 10 % by volume.
- ○ 8 % by volume.

What is the normally accepted value for the maximum oxygen content in an inerted cargo tank?

- ○ 1 % by volume.
- ○ 21 % by volume.
- ○ 5 % by volume.
- ○ 8 % by volume. ✅

What is the normally accepted value for the upper explosive limit (*UEL*) for the hydrocarbon gas in a cargo tank?

- ○ 1 % by volume.
- ○ 21 % by volume.
- ○ 10 % by volume. ✅
- ○ 8 % by volume.

What is the purpose of gas freeing a cargo tank?

- ○ To replace the contents with fresh air. ✅
- ○ To replace the contents with inert gas.
- ○ To remove the hydrocarbon gases only.
- ○ To remove the inert gas only.

What is the time period, that is normally used when stating threshold limit values for the short term exposure limit (*TLV-STEL*) for toxic gases?

- ○ 15 *minutes*. ✅
- ○ 5 *minutes*.
- ○ 1 *hour*.
- ○ 8 *hours*.

What is the time period, that is normally used when stating threshold limit values for the time weighted average for exposure (*TLV-TWA*) for toxic gases?

- ○ 15 *minutes*.
- ○ 24 *hours*.
- ○ 1 *hour*.
- ○ 8 *hours*. ✓

What might indicate, that a galvanic cell type oxygen measuring instrument requires a replacement sensor cell?

- ○ Unstable readings during calibration. ✓
- ○ Reading less, than 8 % oxygen when testing an inerted cargo tank.
- ○ Meter indicates maximum reading during test.
- ○ Reading of 20,9 % when testing fresh air.

What precautions should be taken prior to use when using an oxygen analyser, that has automatic calibration?

- ○ The analyser should be switched on in fresh air. ✓
- ○ The analyser should be switched on 30 *minutes* before use.
- ○ The analyser should be switched on with the sensor placed in the space to be tested.
- ○ No precautions are necessary.

What reading will be obtained if a explosimeter, with a range of 0-100 % (*LEL*), is used to check the hydrocarbon gas content in an atmosphere containing a concentration of hydrocarbon gas, which is three times the *LEL*:

- ◯ The meter needle will move to full scale deflection and then fall close to zero. ✅
- ◯ The meter needle will move to full scale deflection and remain there.
- ◯ The meter reading will stay at zero.
- ◯ The meter reading will oscillate between full scale deflection and zero.

What should be considered the main advantage of using a personal gas monitor when working in a space, where the presence of a toxic gas is a potential hazard?

- ◯ It gives continuous monitoring at the location of the work activity. ✅
- ◯ It gives a check of the initial pre-entry test readings.
- ◯ It eliminates the need for pre-entry checks of the atmosphere.
- ◯ It eliminates the need to have breathing apparatus standing by.

What should be used for the span adjustment of a galvanic cell type oxygen analyser, which is to be used for checking low concentrations of oxygen?

- ◯ A test gas with 2 % oxygen and 98 % nitrogen. ✅
- ◯ Fresh air.
- ◯ Inert gas with 8 % or less oxygen content.
- ◯ A test gas with 2 % butane and 98 % nitrogen.

What should be used when checking the span during calibration of a combustible gas or hydrocarbon gas detector?

- ○ A known concentration of butane in nitrogen. ✅
- ○ A known concentration of butane in air.
- ○ A known concentration of butane in inert gas.
- ○ Fresh air.

What simple test can be carried out to check for leaks in a bulb type aspirator pump for a gas detecting instrument?

- ○ Nip the inlet line after squeezing the bulb to see if it stays deflated. ✅
- ○ Nip the outlet line after squeezing the bulb to see if it stays deflated.
- ○ Pressure test the pump with gas from a span test canister.
- ○ Submerge the pump in liquid and check for bubbles as it is operated.

What two types of sensor are normally used in portable oxygen analysers on board ship?

- ○ Paramagnetic. ✅
- ○ Galvanic cell. ✅
- ○ Infra-red absorption.
- ○ Catalytic filaments.

What will happen to the meter reading, when using a non-catalytic heated filament combustible gas detector with a range setting of 0-100% *LEL* in an atmosphere, containing a high concentration of hydrocarbon gas?

- ○ Rise to a maximum and remain there until the concentration reduces. ✅
- ○ Rise to maximum and then fall back to zero.
- ○ Continuous unstable reading.
- ○ No reading.

What work related recommendations are covered by *IMO* Resolution A864 (20)?

- ○ The recommendations for entering an enclosed space on board a ship. ✅
- ○ Those for inerting a cargo tank on board a tanker.
- ○ Those for operating an inert gas plant on board a tanker.
- ○ Those for crude oil washing a cargo tank.

What would a portable instrument employing a paramagnetic sensor normally be used for during enclosed space checks on board ship?

- ○ Checking the oxygen content in the atmosphere. ✅
- ○ Checking the hydrocarbon gas content in the atmosphere.
- ○ Checking for the presence of toxic gases in the atmosphere.
- ○ Checking for the presence of combustible gases in the atmosphere.

What would be the effect, if any, on the meter reading of a catalytic filament type combustible gas indicator, if the oxygen content of the sample was less than 11 %?

- ○ The reading would be unreliable. ✅
- ○ The reading would be zero.
- ○ The reading would show full scale deflection.
- ○ There would be no effect and an accurate reading would be obtained.

What would be the likely outcome, if the combustion control of an independent inert gas generator, supplying inert gas to a cargo tank system, was incorrectly set, resulting in poor combustion?

- ○ Increased level of carbon monoxide in the inert gas. ✅
- ○ Increased level of hydrogen sulphide gas in the inert gas.
- ○ Increased level of oxygen in the inert gas.
- ○ Increased level of *NOx* and *SOx* in the inert gas.

What would be the most common source of hydrogen sulphide gas being present in on board spaces of a ship?

- ○ Sour crude or petroleum products from sour crude in tanks. ✅
- ○ Low sulphur marine fuel oil being used in a diesel engine.
- ○ Combustion of distillate fuel oil in the inert gas generator.
- ○ Incomplete combustion of fuel oil in a boiler furnace.

What would be the normal source of information, regarding the possible presence of a toxic gas, due to the carriage of a particular cargo?

- ○ Material safety data sheet for the cargo (*MSDS*). ✅
- ○ Code of safe working practices (*COSWP*).
- ○ Safety of life at sea (*SOLAS*).
- ○ International Safety Guide for Oil Tanker and Terminals (*ISGOTT*).

When calibrating an oxygen analyser, which two of the options given should normally be checked?

- ○ Zero setting. ✅
- ○ Span (21 % by volume). ✅
- ○ Full scale deflection.
- ○ Span (8 % by volume).

When carrying out a span check of a combustible or hydrocarbon gas detector the sample gas should normally be taken from a gas bag, rather than direct from the gas canister? Why should this procedure be followed?

- ○ To avoid excess pressure or flow in the instrument. ✅
- ○ To control the quantity of test gas used.
- ○ To reduce the temperature of the test gas by expanding it into the bag.
- ○ Connection of the gas bag to the instrument is easier.

When carrying out checks of the atmosphere in a cargo tank following gas freeing how many levels in the tank should be taken to ensure, there are no variations in the tank atmosphere?

- ◯ At least three levels. ✅
- ◯ At least two levels.
- ◯ One level is sufficient.
- ◯ Samples should be taken every metre depth in the tank.

When obtaining a representative sample of the atmosphere of an enclosed space for purposes of determining the oxygen content, what action should be taken with the ventilation of the space?

- ◯ It should be stopped for 10 *minutes* before sampling. ✅
- ◯ It should be increased for 10 *minutes* before sampling.
- ◯ It should be reduced for 10 *minutes* before sampling.
- ◯ Normal ventilation should be maintained during sampling.

Where would you expect to find specific procedures regarding entry into enclosed spaces and atmosphere testing for a vessel you are sailing on?

- ◯ Safety Management Manual (*ISM* Manual). ✅
- ◯ M Notes or similar issued by Flag State Authorities.
- ◯ Code of Safe Working Practices.
- ◯ *MAIB* reports.

Which gas would be most likely to affect the reading from a refractive index type hydrocarbon gas measuring instrument?

- ○ Carbon dioxide. ✅
- ○ Oxygen.
- ○ Nitrogen.
- ○ Hydrogen sulphide.

Which material is normally used to remove dirt and moisture from a gas sample prior to entry into a combustible gas indicator?

- ○ Cotton wool. ✅
- ○ Soda lime.
- ○ Cardboard.
- ○ Paper.

Which material is recommended for the removal of carbon dioxide from a gas sample when measuring the hydrocarbon gas content of an inerted cargo tank atmosphere with a refractive index or infrared absorption type detector?

- ○ Cotton wool.
- ○ Soda lime. ✅
- ○ Silica gel.
- ○ Gauze.

Which measuring range would be most likely on a single range combustible gas detector (explosimeter)?

- 0-100 % *LEL*.
- 0-10 % *LEL*.
- 0-100 % *LEL* by volume.
- 0-10 % *LEL* by volume.

Which of the following toxicity threshold limit exposure terms would normally have the lowest numerical value?

- *TLV-TWA*.
- *TLV-STEL*.
- *TLV-C*.
- *TLV*.

Which of the following types of combustible and hydrocarbon gas instruments is usually referred to as an Interferometer?

- Refractive index type.
- Infra-red absorption type.
- Non-catalytic heated filament type.
- Catalytic filament.

Which of the options given would normally be associated with colorimetric testing in relation to the detection of toxic gases?

- ○ Chemical gas detector tubes. ✅
- ○ Catalytic filament instruments.
- ○ Galvanic cell instruments.
- ○ Infra-red absorption devices.

Which term is normally used to describe the property of a gas, that has a harmful effect on a living organism as a result of a single short term exposure?

- ○ Acute toxicity. ✅
- ○ Chronic toxicity.
- ○ High toxicity.
- ○ Short toxicity.

Which term is normally used to describe the property of a gas, that has a long term harmful effect on a living organism, as a result of repeated or long term exposure to even low concentrations of the gas?

- ○ Acute toxicity.
- ○ Chronic toxicity. ✅
- ○ High toxicity.
- ○ Short toxicity.

Which two of the following gases are likely to result in poisoning of the sensor element in a catalytic filament type combustible gas detector?

- ○ Hydrogen sulphide. ✅
- ○ Carbon monoxide. ✅
- ○ Oxygen.
- ○ Carbon dioxide.

Which two types of combustible/hydrocarbon gas detectors rely on resistance change with temperature for their operation?

- ○ Catalytic filament type. ✅
- ○ Non-catalytic heated filament type. ✅
- ○ Refractive index type.
- ○ Infra-red absorption type.

Which type of hydrocarbon gas detecting instrument uses thermal conductivity of the gas, as the means of measuring gas content in a sample?

- ○ Catalytic filament type.
- ○ Non-catalytic heated filament type. ✅
- ○ Refractive index type.
- ○ Infra-red absorption type.

Why do galvanic type oxygen sensors have a limited life?

- ○ Anode is consumed during operation. ✅
- ○ Cathode is consumed during operation.
- ○ Electrolyte is consumed during operation.
- ○ Membrane is consumed during operation.

Why is it necessary to check the oxygen content of an enclosed space atmosphere before using a catalytic filament type combustible gas detector (explosimeter)?

- ○ The instrument requires a minimum level of oxygen to function correctly. ✅
- ○ The instrument will only function in the absence of oxygen.
- ○ There is a risk of explosion if oxygen is present.
- ○ In order to calibrate the instrument.

Why is purging of a cargo tank with inert gas normally carried out?

- ○ To reduce the hydrocarbon gas content to below the critical dilution level. ✅
- ○ To inert the tank.
- ○ To reduce the oxygen content to 8 % or less.
- ○ To ensure the tank atmosphere is over rich.

With respect to gas detection instruments what is the purpose of carrying out a *“bump test”*?

- ◯ To check of the instrument reading against a known concentration of gas. ✅
- ◯ To check the effect of a heavy impact on the instrument reading.
- ◯ To establish the zero setting of the instrument before use.
- ◯ To recalibrate the instrument for a fixed reading of gas concentration.