



The British Sub-Aqua Club

# FIRST CLASS DIVER

**DIVING KNOWLEDGE EXAM    March 2004**  
**ANSWERS GIVEN HERE ARE A GUIDE ONLY.**

Name:

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Please read the following instructions carefully before you begin answering the questions.

- **Answer all 30 questions.** Write your answers in the spaces on the question paper. Please remember to put your name on the paper.
- Brief answers are possible for most questions. Answer as concisely as possible. Use diagrams where these help your answer or where they are asked for.
- There are 2 marks for each question.
- The time allowed is 60 minutes.
- Write all answers in ink, as clearly as possible.
- You may use a calculator but please show all calculations.
- You will need your own copy of the complete BS-AC'88 Tables, levels 1-4 and BSAC Nitrox Tables. No other reference material of any kind is allowed.
- All questions assume sea water (density 1.025 kg/litre) and the prevailing conditions in the United Kingdom unless otherwise stated.
- Please check your work very carefully. A mistake at an early stage of some questions may result in a series of wrong answers and a loss of marks.

**Please note that the mark awarded by the examiners for your performance on this paper is final and under no circumstances can the examiners enter into any correspondence or discussion with you regarding this paper.**

**1. Name ONE type of ear barotrauma and show using a sketch how the barotrauma occurs.**

*Burst Eardrum*

*Cause – diving with cold or not clearing ears on descent*

*OR*

*Reverse ear*

*Cause – tight hood or Eustachian tube becoming blocked at depth due to decongestants wearing off.*

*Also a diagram which correctly describes the event.*

**2. Describe the steps you would take to ascertain if a diver had decompression illness?**

- 1. Orientation – who, where, when*
- 2. Muscle strength – shrug shoulders, arm strength, leg strength, pain.*
- 3. Sensory perception – feeling all over, numb areas, rashes.*
- 4. Eyes – vision, and peripheral vision, pupils equal.*
- 5. Face – sensation, smile, whistle, jaw muscles*
- 6. Hearing – working?*
- 7. Swallowing reflex – adam's apple moving*
- 8. Tongue – tongue should come straight out*
- 9. Balance and Co-ordination – finger to nose eyes closed, heel down shin, balance standing up.*

**3. Describe the difference between a constant flow mask and a demand mask on an oxygen administration set? What percentage of oxygen would each administer to the casualty and when would you use them.**

*Constant flow masks 10 litres per minute 30-40 % use for unconscious casualty*

*Demand valve ON DEMAND, 50 - 100% percentage depends on casualty maintaining seal and not talking, used on conscious breathing casualty*

- 4. Draw a diagram to explain why objects appear larger under water. Order these colours in the order that they are absorbed as you descend. Yellow, Red, Blue, Orange, Green.**

*Diagram as per Sports Diving manual showing refracted rays passing from water to air in mask space.*

*Red, orange, yellow, green, blue*

- 5. Draw a simple diagram to show where the major sinuses are in the head? Can you name them?**

*Frontal – above eyes, Maxillary – cheekbones, Ethmoid and Sphenoid - behind nose. Diagram as per Sports Diving Manual.*

- 6. Would you give oxygen to a casualty who had shown symptoms of CNS oxygen toxicity? Explain your answer.**

*If the casualty was still showing signs of O<sub>2</sub> toxicity or had had previously shown signs of oxygen toxicity the response would be to not give oxygen.*

*However if the casualty is suffering from DCI or hypoxia as a result of the oxygen convulsion then clearly oxygen administration is appropriate, should the casualty exhibit symptoms of O<sub>2</sub> toxicity as a result of administration, the administration should be stopped.*

- 7. Explain what advice you would give a BSAC diver who has recently become diabetic.**

*Insulin dependent diabetics are only allowed to dive after being granted a medical by a diving medical referee. The medical is normally granted after the diver has*

*been able to demonstrate that the blood sugar levels are controlled over an extended period of time – often a year. Once allowed to dive, advice is normally to carry both insulin and a glucose dose (paste) on the boat, and to take a oat/honey bar before diving to prevent low blood sugar occurring on the dive. Buddy and Dive Marshall are to be made aware of condition.*

## Decompression

### **8. Why does using a high oxygen decompression mix reduce the amount of required decompression?**

*Reduced partial pressure of nitrogen in inhaled gas increases the gradient of nitrogen whilst at decompressing depths thus encouraging off-gassing of nitrogen from the tissues into blood and out through expired gas.*

### **9. List what should the decompressing diver do to minimise the risk of DCI whilst carrying out lengthy decompression stops?**

*Maintaining accurate stop depths and times*

*Horizontal attitude*

*Good hydration*

*Use of high ppO<sub>2</sub> to a maximum of 1.4 bar*

*Gentle exercise to enable good blood circulation*

*Be warm*

*Take good deep flushing breaths.*

*Consider using a point of reference e.g. trapeze to ease stress of long decompressions*

### **10. What are 'deep stops' and why do some divers perform them?**

*'Deep stops' are decompression stops taken on ascent deeper than those normally prescribed by dive tables such as BSAC 88 or Buhlmann. The theory is to control inert gas (micro)bubble formation by slowing and flattening the ascent curve. Evidence is accumulating that 'deep stops' reduce the incidence of sub clinical DCI.*

**11. What are the risks of decompressing for extended periods on high oxygen percentage decompression gases? What precautions can be taken to minimise these risks?**

*CNS toxicity.*

*Dive planning to take into account %CNS not to exceed 80%, avoid high ppO<sub>2</sub> at depth and on decompression < 1.4 bar. Break sequence of repetitive dives with a day off. Consider air breaks in extensive decompression schedules.*

*Avoid CO<sub>2</sub> build up as this increases likelihood of CNS toxicity. Consider use of full face masks.*

**12. What procedure would a decompressing diver follow to indicate to the surface cover that more gas is required?**

*Important answer looked for here is that the signal needs to be prearranged. Also suggested system needs to be workable.*

### Equipment

**13. What function(s) does a GMDSS system perform in a distress situation over and above that of a basic VHF radio system?**

*Through Digital Selective Calling it permits transmission of accurate location from link with GPS, transmission of MMSI (a unique identifying number), nature of emergency automatic through simple button pushes, achieves greater range for distress alerts and other DSC calls, automatically alerts to incoming calls including notice of sudden storm warnings and distress alerts.*

**14. Explain 'voting logic' in Closed Circuit rebreathers.**

*Voting logic refers to the method of control in a closed circuit rebreather. The two closest oxygen cell readouts will vote out the third. It assumes that the majority is correct – this might not necessarily be correct (for example in the case of two cells aging together) and CCR divers need to be aware of the voting logic process.*

**15. You need to raise a steel object approximating a volume of 0.005 m<sup>3</sup> (Density 8000 kg/m<sup>3</sup>) from 40m. How much air is needed to lift the object? Draw a diagram, labelling the size of lifting bag(s), of how you would set up this lifting exercise.**

$$\begin{aligned}\text{Weight of steel object in water} &= (0.005 \times 8000) - (0.005 \times 1.025) \\ &= 40 - 0.005125 \\ &= 39.995 \text{ kg}\end{aligned}$$

$$\text{Air to lift object} = 39.995 * 5 \text{ bar} = 199.975 \text{ litres}$$

*Set up – needs to be balanced and with a controlling bag – eg 2 18 litre bags filled first and a 5 litre bag filled last with a controllable dump.*

**16. Explain why it is not recommended for nitrox cylinders to be filled to 300 bar.**

*Accurate prediction of mix is difficult due to ideal gas law differences from real gas laws.*

*Heat generated and higher pressure of oxygen during filling operations makes process more hazardous.*

**17. Which knot would you use**

**a) for a roped diver?**

*Bowline*

**b) to fix a line to a shot?**

*Anchor bend*

**c) to tie your RIB to a ring on a harbour wall?**

*Clove hitch or Round turn and 2 half hitches*

**18. How should a trimix diving cylinder be marked and how often should it be tested?**

*Brown with Black and White shoulders*

*TRIMIX*

*Oxygen content*

*Helium content*

*MOD*

*O2 Clean Inspection sticker*

*Tested every 5 years hydrostatically/ every 2.5 years visual*

*Every 1 year O2 clean*

**Dive planning and techniques**

Scott, Jane, Simon, John, Maggie and Laurent are on a diving expedition to Tory Island, an exposed island off North-West Ireland. Martin and Simon are closed circuit rebreather divers, Maggie and Laurent are diving semi-closed rebreathers and John and Jane are diving open circuit twin 12 litre cylinders filled with Air.

**19. On a 40m wreck dive, each having the same dive time and using dive computers designed to suit each method of diving, which dive pair would you expect to have the least required decompression time and why?**

*Closed circuit divers would have the least decompression because they are diving an optimal oxygen/nitrogen fraction ratio at a fixed partial pressure of oxygen (normally 1.3 bar) at all stages of the dive thereby reducing the amount of nitrogen on gassing at depth and increasing the nitrogen off gassing at decompression.*

**20. And which pair would you expect to have most required decompression time and why?**

*Open circuit air divers would have the most decompression, due to the highest partial pressure of nitrogen in the gas at all stages of the dive, both at depth and for decompression.*

**21. Draw the set up of a decompression trapeze that could be used by these divers**

*A diagram showing two or three bars at 9, 6 and 3m linked by rope, with buoys at the surface. A transfer line, quick release at both ends, soft weight at deep end, spare gas on the lowest (or all) bars, tagging system at the bottom of the transfer line, transfer line linked to the shot.*

**22. If you were using a decompression trapeze what order you would put these pairs in the water?**

- 1. Open circuit**
- 2. SCR**
- 3. CC**

*Would enable open circuit divers who have most decompression to do to be on the trapeze first; trapeze to be released by CC divers and then to all finish decompression together (safety) within similar surfacing times.*

**23. John and Jane have decided instead to use BSAC 88 air tables to dive and they are hesitating about carrying an additional 3 litre pony of 50% Nitrox. What advice on the carrying of the nitrox would you give them?**

*If they are qualified to use the 50% nitrox they should carry and use it as although they are diving on air tables it will give them a greater safety margin against DCI. Analyse gas carefully, mark MOD on cylinder, mechanism for preventing mistaken identification of an AAS. Buoyancy check prior to dive.*

**24. What surface detection aids would you advise your divers to carry on this expedition?**

*DSMB, flares, mirror, flags, Personal EPIRB, air horn, dye*

### Weather & Seamanship

**25. You are planning to navigate to a wreck 15 nautical miles from the harbour in a RIB capable of 25 knots? On a chart you measure the heading as 94°. The compass rose indicates that the variation is 5°20' W 1993 (5'E). What is your planned heading and how long would it take you to get there?**

*Variation 2004 = 5°20' minus (11 years \* 5'E) = 55'E = 4°25' W*

*Magnetic bearing = 94° + 4°25' W (west is best, east is least)  
= 98°25'*

*Time to travel = (15/25) x 60 = 36 min*

**26. What symbols would you find on meteorological chart to show .....**

**a) warm front?**

*Curved line with semi circles along it*

**b) cold front?**

*Curved line with triangles along it*

**c) occluded front?**

*Curved line with alternate semi circles and triangles.*

**27. What conditions cause the generation of a sea breeze?**

*Sea breezes develop in coastal areas when convection over the land on a warm sunny day causes strong up currents of air. The rising air is replaced by an inflow of air from over the sea which creates an on shore wind.*

**28. Away on a hard boat, your echo sounder has broken and you have arrived in a small harbour for the night. You want to moor in an area that will ensure your boat does not bottom out over night. The draught of your vessel is 2.1m and when you use a weight and line the depth of the water is 5 m, it is 18.00. The harbour master tells you that the tide details for a nearby port are High Water 16.00 4.2m and LW 22.00 1.2m. Are you safe where you are? Show your working.**

$$\begin{aligned}
 \text{Present height of tide at nearby port} &= 4.2m - (3/12 \times 3m \text{ range}) \\
 &= 4.2m - 0.75m \\
 &= 3.45m
 \end{aligned}$$

$$\text{Depth by line in harbour} = 5m$$

$$\text{Tidal difference of harbour on Port} = 5m - 3.45m = +1.55m$$

$$\begin{aligned}
 \text{At low water, height in harbour is} &= 1.2m + 1.55m \\
 &= 2.75m
 \end{aligned}$$

$$\text{Draught of vessel} = 2.1m$$

*Vessel is safe.*

**29. Draw an isolated danger mark? What lights would you find on this mark at night?**

*Red and black horizontally striped with two black balls on top,  
Light is White GP Fl 2*

**30. You have divers down and are displaying a large 'A' flag, despite this a large yacht is speeding directly towards your divers. You have a horn on board, what signal would you give them? What other action would you take?**

*Five Short blasts on horn repeated as necessary.*

*White flare*

*Wave A flag*

*Try to call boat on Ch 16.*

*Position boat between yacht and divers but be aware of need to avoid collision in final instance.*

*Call Coastguard if time allows.*