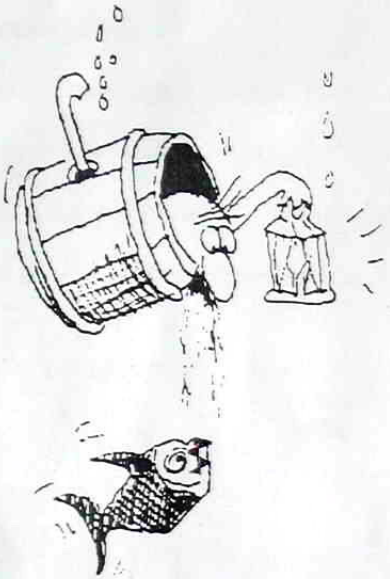

Test yourself

SECTION SEVEN

Introduction

The questions are laid out under the headings of each section. The answers are at the back of this section, with occasional comments and references.

Questions in *italics* are a repeat of the examples found in each section. Try them, and if you have a problem, look in the appropriate section and see how it should be done.

Use these values:

Density of fresh water 1 kg/L 1 t/m^3 10 lbs/gal 62.5 lbs/ft^3

Density of sea water 1.03 kg/L 1.03 t/m^3 10.3 lbs/gal 64.38 lbs/ft^3

Divers gas consumption 35 L/min 1.25 ft^3/min

Divers gas consumption from a bail out bottle in an emergency;
40 L/min 1.5 ft3/min

Metabolic oxygen consumption in chambers
0.7 m^3/day or 0.5 L/min per diver
25 ft^3/day or 0.018 ft^3/min per diver

The questions

1 What is the absolute pressure at a depth of 254 msw?

2 What is the absolute pressure at a depth of 254 fsw?

(If you can't do these questions, stop here!)

How long have you got?

3 *A diver is working at 120 msw for 4 hours. What volume of gas will he use?*

4 *A diver is working at 100 fsw for 30 minutes. What volume of gas will he use?*

5 Two divers are working out of the bell at 75 msw. What volume of gas will they use in 4 hours?

quad will be changed over at 500 psi)

19 A diver is working at 380 fsw. He's breathing from a quad which contains 22,500 ft3 of gas at a pressure of 3000 psi. The quad will be changed over at 450 psi. How long could the diver work for?

20 A quad contains 5400 ft3 at a pressure of 2800 psi. It can be used until the pressure drops to 400 psi. What volume of gas is available to the diver?

21 *An LP compressor supplies 30 ft3/min at 300 psi. The diver plans to work at 100 fsw. Is the air supply sufficient?*

22 *A lightweight LP compressor delivers 250 l/min at a pressure of 15 bar. Two divers are planning to work at 30 msw. Is the air supply sufficient?*

23 Two divers are planning to work at 60 fsw, using an LP compressor. What is the minimum delivery volume and pressure that they require?

24 *A bail out bottle has a floodable volume of 12 litres. How much time has a diver got if his surface supply fails at 200 msw ?*
The bail out bottle is at a pressure of 180 bar.

25 A bail out bottle contains 100 ft3 at 3500 psi. It's at a pressure of 3000 psi. If the diver's surface supply fails at 500 fsw, how long has he got to get back to the bell?

26 *After filling to 200 bar, a bail out bottle is at a temperature of 30oC. What will the pressure be when the temperature drops to 4oC?*

27 After filling to 3500 psi, a bail out bottle is at a temperature of 40oC. What will the pressure be when the temperature drops to 4oC?

Breathing the right gas

28 *A diver at 250 fsw is breathing a 15% mix. What is the PPO2 in his mix?*

29 *In a chamber at 80 msw, the oxygen percentage reading is 4.5%. What is the PPO2 in the chamber?*

30 *A diver at 125 msw is breathing a 4% mix. What is his PPO2?*

31 A diver at 165 msw is breathing a 4% mix. What is the PPO2 in his mix?

32 A diver at 340 fsw is breathing a 6% mix. What is the PPO2 in his mix?

33 A diver at 60 msw is breathing an 18% mix. What is the PPO2 in his mix?

34 What is the PPO2 in a chamber at 50 fsw if the oxygen percentage is 23%?

35 The PPO2 in a chamber at 108 msw is 400 mb. What is the oxygen percentage?

36 The PPO2 in a chamber at 327 fsw is 0.42 AT. What is the percentage of oxygen in the chamber?

37 During a saturation dive at 600 fsw, the divers require a PPO2 between 0.5 and 0.7 AT. What is a suitable mix?

38 If the PPO2 must lie between 1.2 and 1.6 bar, what is the greatest depth (in msw) at which you could use a 15% mix?

39 During a bounce dive to 80 msw, the divers require a PPO2 between 1.2 and 1.6 bar. What is a suitable mix?

40 During a saturation dive at 208 msw, the divers require a PPO2 between 550 and 750 mb. What is a suitable mix?

41 Assuming that air contains 21% oxygen and 79% nitrogen, what is the PPO2 and PPN2 in air at 165 fsw?

42 A hydrox mix contains 1% oxygen. How deep could the diver go without exceeding a PPO2 of 750 mb?

43 A dive is planned to 290 fsw, using a 15% mix. Which USN Partial Pressure Table should be used? (The tables go from a PPHe of 60 fsw to 360 fsw in steps of 10 fsw)

44 A dive is planned to 155 fsw, using an 18% mix. Which USN Partial Pressure Table should be used?

45 A dive is planned to 170 fsw, using a 20% mix. Which USN Partial Pressure Table should be used?

Gas mixing

46 *You want to make 200 bar of 8%, using 4% and 23%. What pressure of each gas do you need?*

47 You want to make 180 bar of 6%, using 2% and 18%. What pressure of each gas do you need?

48 You want to make 3000 psi of 23%, using 12% and 50%. What pressure of each gas do you need?

49 You want to make 2500 psi of 12%, using 2% and 18%. What pressure of each gas do you need?

50 *You have 70 bar of 4% and you want to turn it into 6%, by pumping in 10%. What will the final pressure of the mixture be?*

51 You have 45 bar of 2% and you want to turn it into 10%, by pumping in 18%. What will the final pressure of the mixture be?

52 You have 1800 psi of 1.5% and you want to turn it into 4%, by pumping in 16%. What will the final pressure of the mixture be?

53 You have 600 psi of 2% and you want to turn it into 6%, by pumping in 18%. What will the final pressure of the mixture be?

54 *You have 50 bar of 2%, 40 bar of 4% and you want to mix them together and add 23% to make the mix up to 8%. What will the final pressure be?*

55 You have 500 psi of 6%, 400 psi of 4% and you want to mix them together and add 16% to make the mix up to 12%. What will the final pressure be?

Chambers and bells

56 *You want to pressurise a chamber to 90 msw, using 12% and 2%. The final PPO2 must be 600 mb. What depth of 12% should you add to start the pressurisation?*

57 *You want to pressurise a chamber to 250 fsw, using 16% and 2%. The final PPO2 must be 0.5 AT. What depth of 16% should you add to start the pressurisation?*

58 You want to pressurise a chamber to 500 fsw, using 18% and 1%. The final PPO2 must be 0.6 AT. What depth of 18% should you add to start the pressurisation?

59 You want to pressurise a chamber to 120 msw, using 20% and 1.5%. The final PPO2 must not exceed 650 mb. What depth of 20% should you add to start the pressurisation?

60 A chamber system has a volume of 40 m3. What volume of gas would it take to pressurise it to 150 msw?

61 A chamber system has a volume of 1200 ft3. What volume of gas would it take to pressurise it to 500 fsw?

62 A chamber system has a volume of 38 m3. What volume of gas would it take to pressurise it to 212 msw?

63 A chamber system has a volume of 875 ft3. What volume of gas would it take to pressurise it to 355 fsw?

64 A chamber system has a volume of 30 m3. It is to be pressurised to 90 msw, with 21 msw of 12% and 69 msw of 2%. What volume of each gas would be needed?

65 A chamber system has a volume of 1100 ft3. It is to be pressurised to 620 fsw, with 39 fsw of 18% and 581 fsw of 1%. What volume of each gas would be needed?

66 A chamber system has a volume of 45 m3. It is to be pressurised to 197 msw, with 7 msw of 16% and 190 msw of 1.5%. What volume of each gas would be needed?

67 A saturation pressurisation is aborted at 70 msw, when the PPO2 is 400 mb. You have bounce dive tables for 78 msw using a 18% mix, 80 msw using 16% and 82 msw using 16%.

Choose a suitable bounce table to decompress the divers.

68 A saturation pressurisation is aborted at 95 msw, when the PPO2 is 450 mb. You have bounce dive tables from 100 msw to 112 msw, all using 12%

Choose a suitable bounce table to decompress the divers.

69 *A saturation pressurisation is aborted at 300 fsw. The PPO2 is 0.4 AT. Which USN PPHe table could you use to decompress the divers? (The tables go from a PPHe of 60 fsw to 360 fsw in steps of 10 fsw)*

70 A saturation pressurisation is aborted at 180 fsw. The PPO2 is 0.45 AT. Which USN PPHe table could you use to decompress the divers?

71 *A medical lock is 0.8 metres long and 0.3 metres in diameter. the chamber is at 160 msw. How much gas is used when the lock is operated.*

72 An equipment lock is 4 ft long and 2ft 6 ins in diameter. The chamber is at 510 fsw. How much gas is used when the lock is operated.

73 *9 divers are in saturation for 5.5 days. How much oxygen will they use in the chamber? (answer in m3)*

74 6 divers are in saturation for 12 days. How much oxygen will they use in the chamber? (answer in ft3)

75 *A decompression from 95 msw takes 2 days, with a PPO2 of 600 mb. There are two divers in the chamber, and the chamber volume is 10 m3. How much oxygen is used?*

76 A decompression from 180 msw takes 4 days, with a PPO2 of 600 mb. There are two divers in the chamber, and the chamber volume is 10 m3. How much oxygen is used?

77 *4 divers are in saturation for 8 days at 110 msw, with a PPO2 of 400 mb. Before starting the decompression, the PPO2 is raised to 600 mb. The decompression takes 3 days.The chamber volume is 15 m3. How much oxygen is used?*

78 During a saturation, the PPO2 in the chamber is maintained at 400mb. Before starting decompression, the level is raised to 600 mb. If the chamber volume is 17 m3, what volume of oxygen is required raise the PPO2?

79 6 divers are in saturation at 275 fsw for 10 days with a PPO2 of 0.4 AT. The PPO2 is then raised to 0.6 AT for a decompression which lasts 2 days. The chamber volume is 500 ft3. How much oxygen is used altogether?

80 *A chamber is at 145 msw and 28oC. At the start of the shift, the temperature was 32oC. If the life support crew had not added gas to maintain depth, by how much would the depth have decreased?*

81 A chamber is at 345 fsw and 31oC. The temperature drops to 26oC. If the life support crew took no action, what would the depth decrease by?

82 *Chamber 1 is at 97 msw, with a PPO2 of 400 mb. It is blown down to 130 msw, using 2%. What is the PPO2 at 130 msw?*

83 A chamber is blown down from 180 fsw to 210 fsw using 4%. If the PPO2 was 0.4 AT at 180 fsw, what is it at 210 fsw?

84 After a serious leak, a chamber is at 50 msw with a PPO2 of 180 mb. The chamber is blown back to the living depth of 125 msw using 5%. What is the PPO2 at living depth?

85 *Chamber 1 is at 320 fsw, with a PPO2 of 0.4 AT, percentage 3.74% It is bled to 265 fsw. What is the PPO2 at 265 fsw?*

86 A chamber is at 186 msw, with an oxygen percentage of 2.1% It is bled to 143 msw. What is the PPO2 at 143 msw?

87 *After equalisation, Chamber 1 has a volume of 12 m3 and a PPO2 of 480 mb. Chamber 2 has a volume of 8 m3 and a PPO2 of 400mb.*

What is the final PPO2 when the atmospheres are completely mixed?

88 Chamber 1 has a volume of 400 ft3 and the PPO2 is 0.45 AT. Chamber 2 has the same volume, but the PPO2 is 0.38 AT.

What is the final PPO2 when the chamber atmospheres are fully mixed?

89 Chamber 1 has a volume of 18 m3 and the PPO2 is 420 mb
Chamber 2 has a volume of 12 m3 and the PPO2 is 400 mb
Chamber 3 has a volume of 15 m3 and the PPO2 is 600 mb

What is the final PPO2 when all the chamber atmospheres are fully mixed?

90 *A chamber and bell are at 185 msw, with a PPO2 of 400 mb. For the*

dive, the bell is separated from the chamber and blown down on 4% to a working depth of 200 msw. What is the PPO2 in the bell at working depth?

91 Divers are being pressurised in a chamber using 2% straight from the surface. The pressurisation is aborted at 70 fsw when the oxygen percentage is 8%. The chamber is bled straight back to surface. What is the PPO2 on the surface? How do the divers feel about this?

92 *The bellman uses a chemical sampling tube to take a CO2 reading in the bell. The scale reading is 1.4%. If the bell is at 400 fsw, give the true percentage of CO2, the PPCO2 and the SEP.*

93 The bellman uses a chemical sampling tube to take a CO2 reading in the bell. The scale reading is 2%. If the bell is at 145 msw, give the true percentage of CO2, the PPCO2 and the SEP.

$\frac{145}{10} + 1 = 15.5 = .13$ $\frac{2\%}{10} = 20mb$ 2% is the scale reading

Lifting things

94 *A diving bell displaces 5 m3 of sea water and weighs 4.8 tonnes. Is the bell positively buoyant?*

95 Would the bell in Question 90 be positively buoyant in fresh water?

96 *A diving bell displaces 180 ft3 of sea water and weighs 5.2 imperial tons (that's 2240 lbs). Is the bell positively buoyant?*

97 A diving bell displaces 180 ft3 of sea water and weighs 5.2 US tons (that's 2000 lbs). Is the bell positively buoyant?

98 *A block of concrete, 1m by 1m by 1m, is lying on the seabed. The density of concrete is 2400 kg/m3. How much force is required to lift the block clear of the seabed? (Ignore any suction)*

99 A welding habitat weighs 25 tonnes in air. It displaces 12 m3. What does it weigh in sea water?

100 A closed length of pipe weighs 12 imperial tons (2240 lbs) and displaces 140 ft3. How many 1 ton lifting bags would you need to lift it clear of the seabed? (Ignore suction)

The answers

1 ~~35.4~~ bar 26·4 Bae
2 8.69 AT
3 *109.2 m³ (See page 4)*
4 *151 ft³ (See page 4)*
5 142.8 m³
6 70.45 ft³
7 *320 m³ (See page 5)*
8 *192 m³ (See page 7)*
9 *6 hours 32 minutes (See page 7)*
10 *4 hours 39 minutes (See page 8)*
11 560 m³
12 105 m³ It's only a 12 bottle quad!
13 2.15 m³
14 1 hour 18 minutes
15 3480 ft³
16 4639 ft³
17 19125 ft³
18 *26 hours 14 minutes (See page 9)*
19 20 hours 22 minutes
20 4629 ft³
21 *Yes. (See page 11)*
22 *No. (See page 12)*
23 7.04 ft³ per minute, 12.82 AT
24 *2.1 minutes (See page 13)*
25 3.1 minutes
26 *183 bar (See page 14)*
27 3097 psi
28 *1.287 AT (See page 17)*
29 *405 mb (See page 18)*
30 *540 mb (See page 21)*
31 700 mb
32 0.678 AT
33 1.26 bar
34 578 mb
35 3.39%
36 3.85%
37 *Anything between 2.6% and 3.6% (See page 22)*
38 *96.6 msw (See page 23)*
39 Anything between 13.3% and 17.78%
40 Anything between 2.52% and 3.44%
41 1.26 At, 4.74 AT
42 740 msw
43 *The exact value is 274 fsw, so use the 290 fsw table. (See page 24)*

44 The exact value is 154.6 fsw, so use 170 fsw table.
45 The exact value is 162.4 fsw, so use the 180 fsw table.
46 *158 bar of 42% 42 bar of 23% (See page 30)*
47 135 bar of 2, 45 bar of 18%
48 2132 psi of 12%, 868 psi of 50%. Be careful with the 50%!
49 938 psi of 2%, 1562 psi of 18%
50 *105 bar (See page 31)*
51 90 bar
52 2175 psi
53 800 psi
54 *121 bar (See page 33)*
55 2450 psi
56 *21 msw (See page 38)*
57 *33 fsw (See page 39)*
58 ~~42~~ fsw 46.3 fsw.
59 14 msw/[illegible]
60 *600 m^3 (See page 42)*
61 *18182 ft^3 (See page 42)*
62 805.6 m^3
63 9413 ft^3
64 *63 m^3 of 12%, 207 m^3 of 2% (See page 43)*
65 1300 ft^3 of 18%, 19367 ft^3 of 1%
66 ~~3~~ m^3 of 16%, 855 m^3 of 1.5%
67 *Use the 82 msw, 16% table (See page 44)*
68 Use the 109 msw table
69 *Use the 330 fsw table (See page 45)*
70 Use the 210 fsw table
71 *0.912 m^3 The answer may vary slightly, depending on the value that you use for π. This answer uses 3.1415927, straight off the calculator. If you use 3.14 you get 0.905 m^3. (See page 46)*
72 303.44 ft^3 As above, answers may vary. 3.14 gives 303.3 ft^3.
73 *34.65 m^3 (See page 48)*
74 1800 ft^3
75 *16.6 m^3 (See page 49)*
76 23.26 m^3
77 *56.16 m^3 (See page 50)*
78 3.4 m^3
79 2570 ft^3 You need 100 ft^3 to make up the PPO2 to 0.6 AT, 1800 ft^3 in total for metabolic use and 670 ft^3 for the decompression
80 *2.05 msw (See page 53)*
81 6.2 fsw
82 *466 mb (See page 55)*
83 0.436 AT
84 555 mb

85 *0.338 AT (See page 55)*

86 321 mb

87 *448 mb (See page 56)*

88 0.415 AT

89 474 mb Just like the others. Find the total volume of oxygen and divide by the total chamber volume.

90 *460 mb (See page 57)*

91 0.08 AT 0·0106

92 *True percentage 0.08%, PPCO2 0.014 AT, SEP 1.4% (See page 59)*

93 True percentage 0.13%, PPCO2 20 mb, SEP 2.0%

94 *Yes, the upthrust is 5.15 tonnes (See page 66)*

95 Yes, the upthrust is 5 tonnes

96 *No, the upthrust is 5.17 imperial tons (See page 66)*

97 Yes, the upthrust is 5.79 US tons

98 *1.37 tonnes (See page 67)*

99 12.64 tonnes

100 You need a lift of 7.98 tons, that's 8 lifting bags.