

Air

**PROGRAMMED**  
**NCB TEXT** **8**  
**INDUSTRIAL**  
**TRAINING BRANCH**

**Air**

**NCB Industrial Training Branch 1970**

# INTRODUCTION

The purpose of this booklet is to tell you something about Air; how it is made up, how it supports life and the special jobs it has to do in a pit.

One of these special jobs is to blow away 'accumulations of gas' which could occur if the mine was not properly ventilated with air. You can read about the gas 'firedamp' in another programme in this series of programmed texts.

Other subjects in the series include:

Introduction to Coalmining

Flame Safety Lamps

Firedamp

Methods of Mining

More Mine Gases

## INSTRUCTIONS

This booklet has been written in the form of a 'programmed' course of instruction. This means that it has been designed to help you learn more easily.

Turn to page 1 and read through it carefully. You will find that you are expected to complete a sentence by filling in a missing word. If you know the answer, write it down on your Response Sheet. Then turn to page 2, there you will see the missing word in the box at the top of the page. Now mark your answer, using the narrow column on the right-hand side of the Response Sheet. When you have worked through the book to page 27, turn it upside down and start again at page 28.

Of course, it is possible to cheat ! But, if you do, you won't learn as much about this very important subject. So it's pointless to do so !

Your tutor for this study is Robert Flanders.

You have already learned that the Mines and Quarries Act states that a coalmine must be properly ventilated.

In other words, we must supply the mine with plenty of ... (1).



(1) air

We must supply plenty of air underground.

There are several reasons why this is necessary. Let's take a look at our miner in order to find out why.

You can see him at work in the drawing below. He is having to break up the coal.

Nowadays, this sort of work is usually done by machines. However, when coal is broken up, whether by machine or by hand, g. (2) is released.



(78) absorbed by the trees  
and plants

And that's the end of that. Don't worry if you made some mistakes. The important thing is to learn from them. Look back over the programme and see where you went wrong. Try to make sure you get the answers correct the next time you are tested. Thank you for your attention.

(2) gas

3

Gas is released when coal is broken up.

Now, you probably already know that this gas will b... (3). In fact, if there is enough of it mixed with air it may ex..... (4).

And, lastly, what happens to the carbon dioxide in the air? It is ..... by the ..... and ..... (78).

(77) 1 1/2%

52



- (3) burn  
(4) explode

If a large amount of gas (we call it an ACCUMULATION of gas) was allowed to collect in any one place there could be an explosion.

So here is one reason for ventilating a coalmine. A strong current of air will blow away an acc..... of g.. (5).

What is the largest amount of carbon dioxide permitted by the Mines and Quarries Act? (77).

(76) 19%



(5) accumulation of gas

5

A strong current of ... (6) will blow away an  
..... of ... (7).

What is the least amount of oxygen permitted  
in the air by the Mines and Quarries Act? (76).

(75) you would suffocate

50

(69) accumulation of gas  
 (70) poisonous fumes  
 (71) shotfiring  
 (72) diesel engines  
 (73) dust  
 (74) coal

What would happen if the air around you contained 10% oxygen? (75).

(6) air  
 (7) accumulation of gas

You will learn more about using a current of air to blow away an accumulation of gas in another lesson. Now let's go on to another reason for ventilating a coalmine.

You can see our miner drilling in the drawing below. When he has completed the job, the hole will be filled with explosive, and the stone or coal will then be 'fired' down.

When firing takes place **POISONOUS FUMES** are given off.

Similarly, when a diesel engine is used small quantities of p..... f.... (8) are given off.





(68) absorbed by the trees  
and plants

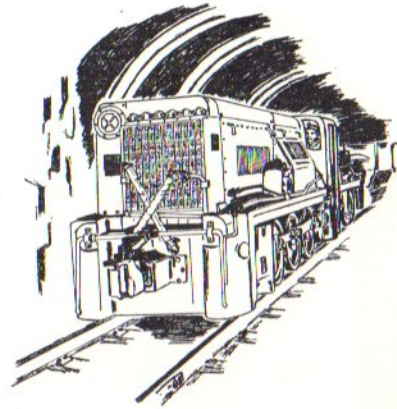
As I have told you, apart from providing the  
miner with oxygen for breathing, there are four  
other reasons for ventilating a mine. What are  
they?

- 1 To blow away an ..... of ... (69)
- 2 To blow away pol..... (70) caused by  
s..... (71) and d..... (72)
- 3 To blow away .... (73)
- 4 To keep the miner c.... (74)

(8) poisonous fumes

7

When shotf..ing (9) takes place or when a  
diesel e..... (10) is operated underground,  
p..... f..... (11) are given off.



The carbon dioxide that we breathe out is  
 ab..... by the ..... and ..... (68).

(65) oxygen  
 (66) carbon  
 (67) carbon dioxide

(9) shotfiring  
 (10) engine  
 (11) poisonous fumes

Poisonous fumes are caused by shotfiring and diesel locomotives.

So here is a second reason for having plenty of air in a coalmine. A strong current of ... (12) will blow away the poisonous f.... (13) caused by s.....ing (14) and d..... e.....s (15).



(64) 1% carbon dioxide

When we breathe in, the ..... (65) in the air  
combines with the ..... (66) in our bloodstream,  
and so we breathe out ..... (67).

- (12) air
- (13) fumes
- (14) shotfiring
- (15) diesel engines

So far I have told you two reasons for having ventilation. Let's think of another.

In the drawing below you can see our miner is working at the coalface. Coal is being broken up. You know that when coal is broken up gas is given off. And something else happens. A lot of d..t (16) is formed.

In fact, unless we do something about it, our miner will find himself working in a cloud of d... (17).



(16) dust

(17) dust

Unless we do something about it our miner could find himself working in a CLOUD OF DUST.

So here is another reason for ventilating a coalmine. A strong current of air will blow away a cl... of d... (18).

Air normally consists of:  
 78% nitrogen  
 21% oxygen  
 ?% ..... (64) and some other gases.

(63) 21%



(18) cloud of dust

11

So far I have told you three reasons why we ventilate a coalmine. A strong current of air will blow away :

- 1 an acc..... of ... (19)
- 2 the p..... .... (20) caused by sh.....ing (21) and d..... e.....s (22)
- 3 a cl... of .... (23)

How much oxygen is there normally ? (63).

44

(62) oxygen

- (19) accumulation of gas
- (20) poisonous fumes
- (21) shotfiring
- (22) diesel engines
- (23) cloud of dust

Let's take another look at our coalminer below. You can see that he is wiping his brow. This is because he is sweating. He is sweating because he is h. (24).



Which gas is the most important to man ? (62).

(61) 78%



(24) hot

13

Working has made our miner very hot.

He cannot work if he is too ... (25). So a current of air will help him to keep c... (26).



Nitrogen has the greatest volume. How much is there normally? (61).

(60) nitrogen

42

(25) hot  
(26) cool

A strong current of air helps to keep the miner cool.

There is another reason why we must supply air underground. But before I tell you about it let's find out what air really is. As you probably know already, air itself is not a gas. It consists of several g...s (27) mixed together.

There must not be more than  $1\frac{1}{2}\%$  carbon dioxide present in the air underground.  
Try to remember those figures for oxygen and carbon dioxide. I'll ask you about them again later on.  
Now let's recap what I have told you in this lesson. Which of the gases found in the air has the greatest volume? (60).

(59)  $1\frac{1}{2}\%$



There must not be less than 19% oxygen  
in the air underground.  
The Act also states what is the largest amount  
of carbon dioxide permissible in British mines.  
How much is it? (59).

(58) 19%

(27) gases

15

Air is a mixture of gases. They are :

- (1) Oxygen
- (2) Nitrogen
- (3) Carbon Dioxide
- (4) Other gases

As far as we are concerned, the most important of these gases is o..... (28). Without it we would die.

(28) oxygen

16

Oxygen is the most important gas as far as we are concerned.

The reason for this is that we **MUST** have oxygen in order to stay al... (29).

VENTILATION PRODUCED IN A PART OF A MINE SHALL BE DEEMED ... NOT TO BE ADEQUATE FOR THE PURPOSE OF PROVIDING AIR CONTAINING A SUFFICIENCY OF OXYGEN UNLESS THE AMOUNT OF OXYGEN IN THE GENERAL BODY OF THE AIR IN THAT PART OF THE MINE IS NOT LESS THAN NINETEEN PER CENT BY VOLUME.

Nothing harmful would happen. Air normally consists of 21% oxygen. In fact the Mines and Quarries Act tells us how much oxygen there must be. You can see a passage taken from the Act printed below. What is the **least** amount of oxygen permitted in the general body of the air in British mines? (58).

(57) nothing

39



(29) alive

17

We must have ..... (30) in order to stay alive.

As before, you would suffocate. This time there  
was too much carbon dioxide.  
What do you think would happen if you  
breathed air that consisted of:  
78% nitrogen  
21% oxygen  
1% carbon dioxide and other gases? (57).

(56) you would suffocate

38

(30) oxygen

18

We must have oxygen in order to stay alive.  
Impurities, including CARBON, are continuously being created in our bloodstream. These impurities, including the c..... (31), must be cleaned out.

Once again, you would suffocate. There was too much nitrogen.  
What do you think would happen to you if you tried to breathe air that consisted of:  
78% nitrogen  
10% oxygen  
12% carbon dioxide and other gases ? (56).

(55) you would suffocate

37

(31) carbon

19

Carbon must be cleaned out of our bloodstream.

We do this by pumping the impure blood into our lungs. Then we breathe in. The o..... (32) in the air is then used to clean out the c..... (33) from the blood.

Yes, of course, you would suffocate.  
What would happen to you if you tried to  
breathe air that consisted of:  
90% nitrogen  
9% oxygen  
1% carbon dioxide and other gases? (55).

36

(53) 21%  
(54) you would suffocate



If there was not enough oxygen in the air you would suffocate.  
 How much oxygen is there normally in the air? (53). What would happen if you tried to breathe air that had only 10% oxygen in it? (54).

(32) oxygen

(33) carbon

The oxygen in the air is used to clean out the carbon in the blood.

The CARBON combines with the OXYGEN, and so we breathe out c..... di...de (34).

The mixture would be too weak. There would not be enough ..... (52).

(34) carbon dioxide

When we breathe in, the o..... (35) in the air combines with the c..... (36) in our blood, and so we breathe out c..... d..... (37).

(35) oxygen

(36) carbon

(37) carbon dioxide

We breathe out carbon dioxide.

If you have worked through the programme called 'Introduction to Coalmining' you may remember what happens to the carbon dioxide in the air. It is absorbed by trees and plants. They store up the carbon, but they return the o..... (38) to the atmosphere.

Water dilutes cordial, and nitrogen dilutes oxygen.  
 Now you know that if you add too much water to cordial the mixture will be too weak. Similarly, if too much nitrogen is mixed with the oxygen in the air the mixture will be too .... (51).

(50) dilutes



32

(49) oxygen

We must have oxygen in order to live.  
We do not need nitrogen in order to live.  
We could manage quite well without it. All it  
does is to weaken the effects of the oxygen.  
It's like the water you add to fruit cordial.  
The water dilutes the cordial. Similarly nitrogen  
..... (50) the oxygen.

(38) oxygen

23

Carbon dioxide is absorbed by t.... and p..... (39).

(39) trees and plants

24

So far I've told you that air contains oxygen and carbon dioxide. It also contains some other gases. One of these is nitrogen. In fact, nearly four-fifths of the air consists of n..... (40).

Nitrogen has the greatest volume.  
Which gas must we have in order to live ?  
(49).

(48) nitrogen

31

- (45) nitrogen  
 (46) oxygen  
 (47) carbon dioxide  
 and some other gases

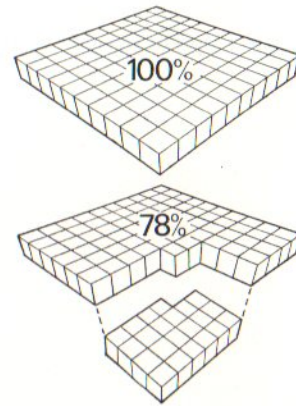
Air is a mixture of several gases. Which one has the greatest volume? (48).  
 (There is more of this gas than all the others put together.)

(40) nitrogen

25

Nearly four-fifths of the air consists of nitrogen. Or, to be more precise, seventy-eight per cent.

Do you know what is meant when we say that 'seventy-eight per cent of the air is nitrogen'? Well, if you could imagine that the air could be divided up into 100 parts, seventy-eight of these parts would consist of ..... (41).





And write them down again! Air consists of:

78% (45)

21% (46)

1% (47) and (47).

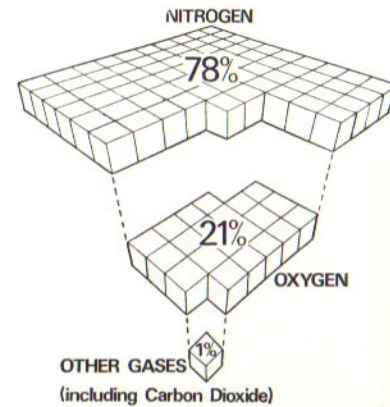
(41) nitrogen

You can see in the drawing below that air consists of nitrogen, oxygen, and some other gases (including carbon dioxide).

? % is nitrogen (42)

? % is oxygen (43) and

? % is carbon dioxide and some other gases (44).



Air consists of :

78% nitrogen

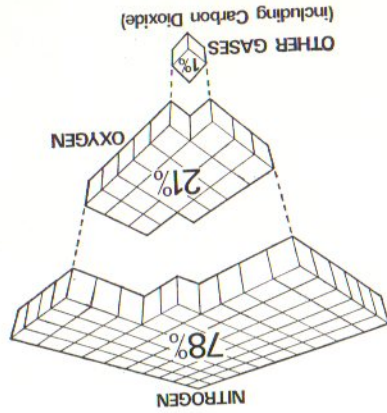
21% oxygen

1% carbon dioxide and some other gases.

Do you think you can remember these figures ?

Look at them again.

*Now turn to next page*



(42) 78%

(43) 21%

(44) 1%

Now turn the book over and continue this lesson at page 28.

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