

3. What indications does a safety-lamp give of the presence of firedamp under the following conditions?—

- (a) When a small amount only is present;
- (b) When gas is present as an explosive mixture.

4. Should a fall occur in your intake airway and a large amount of firedamp be given off, what steps would you take?

5. Give a sketch and description of a water-dam, and what would guide you as to the position you would place it.

6. What are the requirements of the Coal-mines Act as to shot-firing? What has to be done in the case of missed shots? and what extra precautions would you take to guard against accidents from missed shots?

7. What are the requirements of the Coal-mines Act as to safety-lamps and lamp-stations underground?

SUBJECT No. 5.—On Steam Boilers and Engines used about Mines.

1. Describe and give sketch of what you consider a suitable steam boiler for colliery use. Show positions of fittings, and the use for which they are applied.

2. What is the nominal h.-p. of a Lancashire boiler whose length is 30 ft. and 6 ft. diameter?

3. What is the available power of a pair of winding-engines with 24 in. cylinders, 5 ft. stroke, making 40 revolutions per minute, steam-pressure on boilers indicating 75 lb.?

4. Describe the size of engines, drums, and boilers you would use for raising 800 tons daily from a shaft 300 yds. deep, giving size of shaft, ropes, tubs, &c.

5. Describe the different methods employed of transmitting power from surface to machinery underground.

6. What is the breaking-strain of a $3\frac{1}{2}$ in. best plough-steel wire rope? and what is the safe working-load?

7. Describe the arrangements for banking and caging at top and bottom of a shaft to facilitate winding.

SUBJECT No. 6.—On Mine Drainage and Haulage and Appliances for same.

1. Draw a sketch of a siphon pump, and describe its action.

2. Describe by a sketch a plunger, or forcing set of pumps, worked by an engine on the surface. What are the advantages of such a set, as compared with a bucket or lifting pump, and what are the disadvantages?

3. What diameter of plunger would you require to pump 1,000 gallons per minute with a 6 ft. stroke and eight strokes per minute?

4. Give a description of the various means of lowering coal from working-faces into main levels or haulage.

5. It is required to raise 400 tons per day of eight hours up a haulage-road with a rise of 1 in 8 a distance of 40 chains by endless-rope haulage. Show what H.P. and size of engines you would require, the weight and number of tubs empty and filled, and how far apart, and the manner of attachment and size of rope.

6. Compare the relative advantages and disadvantages of electricity and compressed air when used as a motive power in a mine.

7. What do you consider the best method of pumping from dip workings? Give reasons.

SUBJECT No. 7.—On Geology, Surveying, and making Plans.

1. Describe the geological features of the coalfields you are acquainted with.

2. Explain the formation of country where you would be most likely to find coal. Explain the meaning of the terms: "Upthrow," "downthrow," and "reverse" faults, "anticlinal," "synclinal," "conformable," and "unconformable," as applied to mining.

3. Give shortly your ideas as to the origin of coal.

4. Candidate must produce plan showing survey of a portion of a mine surveyed by himself, and showing the connection between surface and underground work, the boundaries of surface to be not less than 20 acres; traverse to be calculated, and field-book shown.

5. A to B is on a bearing of S. 30° W., length 50 links;

A to C is on a bearing of S. 60° E., length 86.6 links;

What is the bearing and length from B to C?

6. Two pits, A and B, are exactly east and west of each other, and are 800 yds. apart from centre to centre. A third pit, C, is situated due north of B. All three pits are visible to each other. The exact distance of C from A and B cannot be measured direct, owing to an intervening river: Explain how you would calculate the distance.

7. Describe the method of levelling, and show how to keep a level-book, and reduce the levels.

SUBJECT No. 8.—Arithmetic, and a Knowledge of the Coal-mines Act.

1. A pillar of coal is 16 yards square and 12 ft. thick, how many tons will it contain?

2. How many bricks would it require to line a shaft 200 yards deep, 14 ft. in diameter, with 9 in. brickwork?

3. What weight of material would you wind in sinking a shaft 12 ft. in diameter 90 ft. deep (assume weight per cubic foot)?

4. If the horse-power of a fan engine be 30, and 35,000 cubic feet of air per minute are put in circulation: what would be the horse-power required, the quantity of air being increased to 100,000 cubic feet per minute?