

- (a.) What form of shaft do you prefer, and why? Give the dimensions of a shaft suitable for raising 500 tons a day from a depth of 600ft., allowing for pumps.
- (b.) What is tubbing? Describe the process of fixing and finishing it.
- (c.) How do you secure pumps in a shaft lined with tubbing?
- (d.) Draw a sketch of a sinking-bucket, showing attachment to rope.
- (e.) Give a plan and section of a long wall stall, showing timbering.
- (f.) What is meant by dividing a mine into districts? What is to be gained by this proceeding?

*Subject 2.*—The various methods adopted in securing shafts and workings in a mine, showing the relative advantage and efficiency of each class of material used:—

- (a.) What materials are used for securing shafts? Under what circumstances should each be employed?
- (b.) Give sketches of timbering workings—(1) for a steep seam, and (2) for a hard roof and soft floor.
- (c.) What is the best form of timbering to resist a creep?
- (d.) Give a sketch indicating how sprags should be set.

*Subject 3.*—The various methods of ventilation, and the construction of airways so as to produce a good circulation of fresh air in any part of the mine:—

- (a.) Describe fully what is known as natural ventilation. Is this always to be relied on? and, if not, give the reason.
- (b.) What system of ventilation should you adopt—(1) in a fiery mine, 450ft. deep; (2) in a non-fiery mine, 2,000ft. deep?
- (c.) Which is more easy to ventilate—(1) a rise heading, or (2) a dip heading? Explain fully.
- (d.) What is a “dumb drift”? Explain its use, and state any objections to it.
- (e.) What precautions are necessary, in erecting a fan, to guard against damage from any catastrophe in the pit?
- (f.) Describe the various methods by which the air-current is measured.
- (g.) How much pressure per square foot does 3in. of water-gauge represent?
- (h.) Draw a sketch of a district in a fiery mine where the bords are 18ft. wide and the pillars 48ft. thick, showing direction of air-current.
- (i.) Describe and draw—(1) overcast, (2) ventilating-door, and (3) regulator. What are they used for?
- (j.) If you have an old working, 30ft. high, approached on each side by a road 10ft. in height, and a small blower of gas exists in the top of the large excavation, what steps would you take to prevent an accumulation of gas?

(2 p.m. to 5 p.m.)

*Subject 4.*—On the areas of air-ways, the velocity and divisions of air-currents, and the deductions to be made for friction:—

- (a.) At what velocity should air traverse the workings of a mine?
- (b.) What is the cause of friction of air in mines?
- (c.) In an airway measuring 9ft. by 17ft. the air travels 72ft. in nine seconds: what is the quantity passing?
- (d.) What do you understand by splitting the air? What is the advantage of this proceeding?
- (e.) What is the rubbing-surface of an airway measuring 8ft. 6in. by 9ft. 2in., and 1,150ft. in length?
- (f.) If we require to treble the quantity of air in the same airways, how much must we increase the power?
- (g.) What is the objection to small airways?
- (h.) Find the weight of a cubic foot of air at 30in. barometric pressure and 61° Fahrenheit.
- (i.) Which is preferable, an airway measuring 4ft. by 12ft. or one measuring 8ft. by 6ft.? Give your reasons.

*Subject 5.*—On the nature and composition of explosive and dangerous gases occurring in coal-mines, and on spontaneous combustion:—

- (a.) What dangerous gases are met with in coal-mines? Give them in the order of their specific gravities (the lightest first), and state their compositions and characteristics.
- (b.) At what point does a mixture of firedamp and air become most explosive, and how much air is required to dilute it to such a point that it will not explode at a naked light?
- (c.) What means have we of discovering the presence of light carburetted hydrogen?
- (d.) What is choke-damp? In what portions of the workings is it most likely to be found?
- (e.) What effect has the addition of carbonic-acid gas on an explosive mixture of air and firedamp?
- (f.) What is a “gob-fire” or “goaf-fire”? Give theories as to its origin. What means are usually taken to prevent these fires?
- (g.) What are the preliminary symptoms of a gob-fire?
- (h.) Recently a man descended a coal-mining shaft in which there had been for some time no ventilation, and fell back against the side, overpowered by gas. Close to the mouth of the shaft was a water-wheel driven by a race, but not available for winding. There was only one man at the top of the shaft. What ought he to have done?
- (i.) Under what circumstances, if any, will a mixture of ninety-eight parts of air and two of firedamp explode?

SECOND DAY (9 a.m. to 12 noon).

*Subject 6.*—On the drainage of mines, and pumping-appliances:—

- (a.) Show by sketch the method of fixing supports in shafts for pumps and rising mains.