

gas renders the explosive force greatest? What is the weight of this gas as compared with atmospheric air?

3. Describe what gases you would expect to find in the different portions of the mine—viz., in goaves, roads, in the roof or floor of the mine. If gases are found to exist, what part of the Coal-mines Act would you be guided by in dealing with same?

4. What is meant by "spontaneous combustion" or "gob-fires" in a mine? How are they produced? And show how you would deal with a difficulty of this kind.

5. What do you understand by the terms "ascensional" and "descensional" ventilation? Which do you prefer? Give reasons.

6. How many cubic feet of air per minute would, in your opinion, be required for the adequate ventilation of a colliery in which 400 persons are employed underground in one shift? How many splits would you think desirable?

7. Describe the methods adopted for splitting, regulating, and crossing air-currents in mines worked under the long-wall and bord-and-pillar systems.

8. Describe and give sketch of any ventilating-fan of which you have knowledge, and say what system of ventilation you prefer, "fan" or "furnace," and give reasons.

SUBJECT No. 4.—On dealing with old Workings and other Sources of Danger.

1. State danger to be guarded against in approaching old workings known to contain an accumulation of water under pressure, and show by sketches the precautions you would adopt in carrying on the headings.

2. In opening up workings which have been standing idle for some time, what precautions would you take to guard against accident?

3. State requirements of Coal-mines Act as to shot-firing in fiery mines, and say what other precautions you would take, if any. What is a "missed shot" and what is a "blown-out shot"; and how may these be caused and what are the dangers arising from these?

4. How would you construct a dam in a tunnel 10 ft. by 6 ft., to withstand a pressure of 150 lb. per square inch? Give a sketch of same and details of materials to be used.

5. Is it necessary to maintain the ventilation of a mine when the mine is not working? Give reasons for your reply.

6. How may an explosion of coal-dust be caused in a mine, and what steps should be enforced to prevent such?

7. Describe the duties of a fireman under the Coal-mines Act.

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

1. Describe what you consider the best type of boiler for the safe and economical generation of steam for colliery use; and give sketch showing boiler with fittings in place, with description of same.

2. Assume a Lancashire boiler 25 ft. by 7 ft. 6 in.: give calculation showing thickness of plates and size of rivets required for a working-pressure of 100 lb. per square inch. Fix your own margin of safety.

3. If the safety valve is $4\frac{1}{2}$ in. diameter, and the lever is 30 in. long from centre of valve to centre of weight and $3\frac{3}{4}$ in. from the fixed point to the centre of the valve, and the weight on the lever is 75 lb., what is the pressure per square inch?

4. What is the nominal horse-power of a high-pressure engine the cylinder of which is 18 in. diameter by 36 in. stroke, the initial pressure of steam being 75 lb. per square inch? Fix your own speed.

5. State kind of ventilating-fans you would advise for passing 120,000 cubic feet of air per minute, speed of fan or revolutions, size of engine-cylinder or stroke; also explain how you would test the fan's efficiency.

6. A ventilating-fan running at 45 revolutions per minute produces a water-gauge of 1.75 in.: what will the water-gauge be if the fan-speed is increased to 60 revolutions per minute?

7. What are the principal points to be observed for the safe working of steam boilers and engines? Give these in detail and the steps you would take to have same effectually carried out.

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

1. Having to raise 200 gallons of water per minute up an inclined plane 600 yards long rising 1 in 5, what class of pump would you adopt? Give sketches showing style of pump, size of suction and delivery pipes, and state mode of actuating the pump and the pressure of the column of water against which it is required to work.

2. In a shaft where it is required to raise 500 gallons per minute from a depth of 600 ft., describe class of engine you would adopt, give size of the respective sets of pumps, show by sketch their position in shaft, and state horse-power required to do the work.

3. What are the principal purposes for which electricity is applied to the working of coal-mines? State experience you have had (if any) in the use of this power, and what advantages are obtainable by using it.

4. What size hauling-engine would be required to haul 50 tons of coal per shift by direct haulage up an incline 1,000 yards long rising 1 in 10, the effective steam-pressure to be 60 lb. per square inch? Assume your own weight of tubs and ropes.

5. In fitting up a shaft 250 yards deep, from which it is required to raise 500 tons per shift of eight hours, what size of engines and boilers would you erect? Give dimensions of cylinder, drums, head-gear, pulleys, and ropes.