

6. Give the properties, symbols, and specific gravities of the following gases, and state how each affects the human body :—
  - (a.) Carbon-monoxide.
  - (b.) Hydrogen-sulphide.
  - (c.) Carbon-dioxide.
  - (d.) Firedamp.
7. Give sketches and describe the various air-crossings you are acquainted with, and state which you consider the best means of constructing such crossings, giving your reasons for preference.
8. Describe fully the principle of ascensional ventilation, and say why it is advantageous; also give sketch of not less than five working-places showing how same is applied.
9. Ventilate the accompanying plan, having regard to haulage. Show by conventional signs position of doors, air-crossings, stoppings, &c.

*SUBJECT 3.—General Mining, Steam Boilers and Engines.*

1. Suppose a beam of kauri timber 12 in. deep by 8 in. wide 12 ft. long: what weight will be sufficient to break it in the following cases :—
  - (a.) Fixed at both ends and loaded uniformly.
  - (b.) Supported at both ends and loaded in the middle.
  - (c.) Fixed at one end and loaded at the other.
2. What size plough-steel mining-rope would you put on a shaft 600 yards deep to wind 150 tons per hour? Show by calculation. Describe the form of capping you would use, say how often you would recap, and state factor of safety you would adopt.
3. Describe and give sketches of what you consider a suitable boiler for colliery work, showing all fittings in position, and state the factor of safety which you consider should be adopted for boilers.
4. Assume a steam-engine with cylinders 12 in. diameter, 24 in. stroke, receiving steam at 80 lb. initial pressure, and cutting off steam at five-eighths of stroke; speed, 400 ft. per minute: what horse-power would be exerted at 80 per cent. efficiency?
5. Describe the appliances required to guard against accidents from overwinding, and state which of them you consider should be made compulsory under the Coal-mines Act.
6. Give briefly your views regarding any branch of coal-mining to which you may have given special study.
7. Having regard to the dangers which may arise from accumulations of coaldust in the passages and roadways of collieries, describe what means you consider should be applied to minimize these.

*SUBJECT 4.—Mine Drainage and Haulage; also Practical Electricity.*

1. What quantity of water should an electrically driven three-throw pump deliver per hour against a total head of 500 yards—size of ram, 6 in. diameter, stroke 9 in., gear ratio 12 to 1, and speed of motor 750 revolutions per minute? What horse-power motor would be required?
2. Having to design a pair of winding-engines to raise 1,000 tons per eight-hours shift from a depth of 600 yards, describe clearly the method you would adopt, having regard to balancing the load, controlling the speed, and minimizing the risk of accidents.
3. What plant would you put down to provide power for two electric haulage motors of 80 horse-power each, at bottom of a shaft 300 yards deep, to work endless-rope haulage? Describe—
  - (a.) Generating plant.
  - (b.) Cables you would use, and how you would support them in the shaft.
  - (c.) The precautions necessary to prevent accident where electric cables are taken underground.
4. In laying down electrical plant what special precautions are to be taken to provide for the greatest safety and efficiency? What are the names of the four electrical units or terms in common use? and explain their meaning. What do you consider a commercially safe voltage to use for power purposes?
5. Make sketches showing a cross-section through a steam-engine cylinder and slide-valve with steam and exhaust ports shown.
6. Describe any system with which you are acquainted for pumping water from dip workings, and state what system you consider most economical and suitable for a fiery mine.
7. Describe what you consider a suitable lighting plant for lighting the surface and pit-bottom of a colliery raising 1,000 tons daily from a depth of 1,000 ft., giving particulars of the dynamo and size of main cables.
8. Describe what provisions you would insist on working to prevent destruction of surface plant and erections by fire, and possible injury to men employed underground should such occur.