6. Ventilate the accompanying plan, having due regard to the requirements of haulage. Use the conventional reference signs to indicate your method.

SUBJECT 4.—*Dealing with Old Workings and other Sources of Danger.*

1. Describe how you would build a dam in a drive against a possible static head of 1,000 ft. It is found that the only place in the drive where it is possible to build the dam is in faulted and broken ground near a dyke: what special precautions would you use in such case, and how would you provide for the safety of your men during the building of the dam and after its completion? Give sketches.

2. In approaching old and extensive coal-workings containing 50 fathoms of water, for safety what should be—

(*a*.) The maximum width of the drive;

(*b*.) The minimum length and largest diameter of boreholes;

(*c*.) The angle of and distance apart of flank-holes;

(*d*.) The quantity discharged in gallons per minute from such borehole when the water is tapped, if—

h = static head
d = diameter of hole } in feet;
l = length of hole

v = velocity of water at the point of issue (in feet per minute)

$$= 2837{\cdot}5\sqrt{\frac{h\,d}{l}}$$

3. To prevent accidents from falls—

(*a*.) To what height should the first lifts during high-pillar extraction be limited?

(*b*.) What should be the maximum width of bords and cut-throughs respectively, both when breaking away and subsequently?

SUBJECT 5.—*Steam Boilers and Engines used about Mines.*

1. Give a sketch of the kind of steam-boiler you consider suitable for colliery-work. Show fittings in respective positions on boiler, and give the name of each. Also state the requirements of the Coal-mines Act regarding boilers.

2. The area of the piston of a steam-engine is 450 in.; the mean effective pressure is 45 lb. per square inch; length of stroke, 60 in.; speed, 40 strokes per minute: state the H.P.

3. Find the working-pressure of a steam-boiler 6 ft. diameter made of half-inch plate (steel), double-riveted.

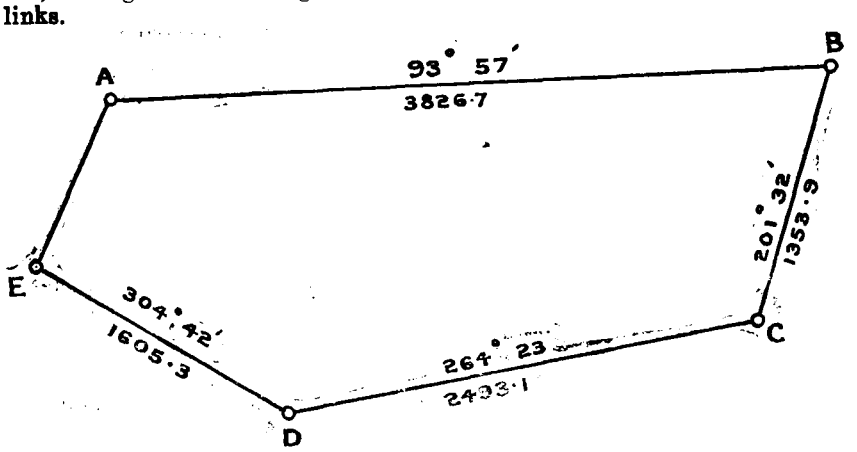
4. Assume the weight of cage and full tubs of coal, and find size of rope required to raise the load from a depth of 800 ft.

SUBJECT 7.—*Geology, Surveying, and making Plans.*

1. Describe the methods by which you would make a survey so as to ascertain the approximate amount of coal in a lease of 1,000 acres, situated in mountainous country (2,000 ft. to 3,500 ft. high), and showing numerous coal-outcrops.

2. In going up a gentle slope from east to west on a New Zealand coalfield the following data, among others, are obtained: At 1 chain, 6 ft. of coal dipping 10° to the west outcrops; at 3 chains is a strong, well-marked fault dipping at 75° to the east; at 3½ chains is 6½ ft. of coal dipping 9° to the west; at 12 chains is 7 ft. of coal dipping 25° to the east; at 21 chains is 7¼ ft. of coal dipping 8° to the west. In each case the rocks above and below the various coal-outcrops are much alike; the roof being coarse sandstone or grit, and the floor shale. Make a rough sketch embodying these data, and state how many coal-seams are probably present.

3. The underground workings of a mine are given in the figure below: compute and tabulate the co-ordinates of the stations, giving the total distances on the meridian and perpendicular from Station A; and give the bearing and distance between Stations E and A. The distances are given in links.



4. Compute the area in acres, &c., of the above figure.

5. The angles of elevation from Station D, allowing for height of instrument and signals, are 3° 43′ to Station C and 2° 15′ to Station E: give the difference of height between Stations C and E in feet.