

Central Kowloon Route (CKR) – Tunnel Construction Worksheet (Secondary School)

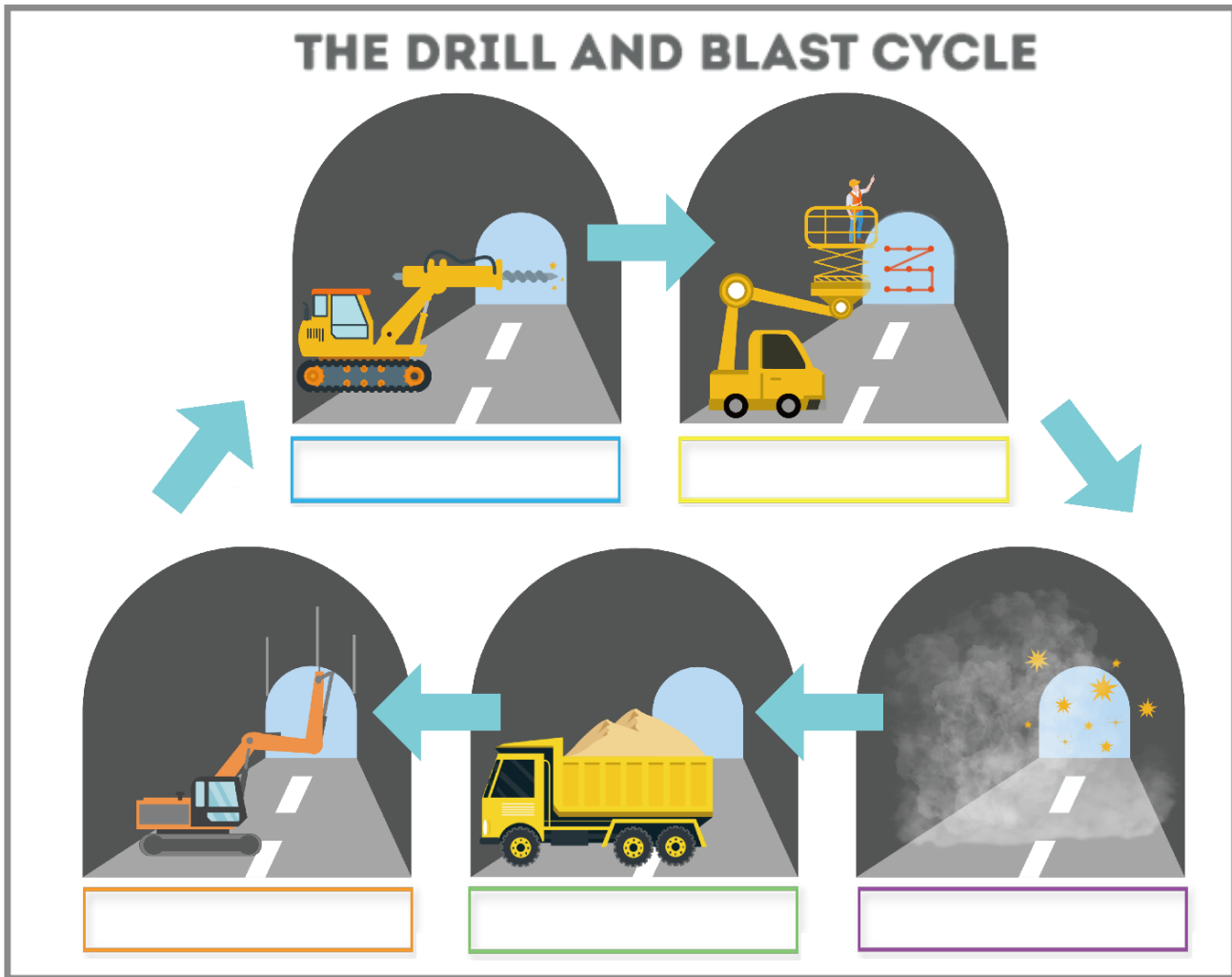
Name : _____ (____) Class : _____

Date : _____

CKR is a 4.7 km long trunk road comprising a 3.9 km tunnel. Drill and blast is one of the many common construction methods of underground tunnel. This method is also adopted in the CKR-Central Tunnel contract.

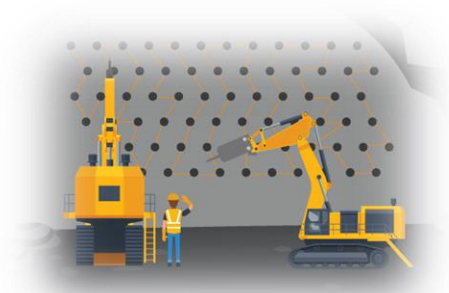
A. Choose the correct answer and fill in the blanks below.

Blasting	Drilling Blast Hole	Installing Temporary Supports
Mucking Out	Charging Explosives	



The drilling and blasting technique involve tunnel excavation, which includes drilling multiple holes and filling them with explosives at the excavation site, followed by detonation.

Before the blasting work starts, the contractor is required to submit a detailed design of the blasting project. To ensure that the blasting work does not adversely affect adjacent buildings, the engineer will consider the calculation of the detonation location and the dosage of explosives based on the resistance of vibration to different building structures.



The following formula is used to calculate the

Magnitude of Vibration, where PPV:

$$B = K \left(\frac{R}{\sqrt{W}} \right)^{-b}$$

B : Peak Particle Velocity (mm/s)

K : Rock Transmission Constant, given 644

R : Distance between Blast and Measuring Point (m)

W : Maximum Charge Weight per Delay Interval (kg)

b : Attenuation Exponent, given 1.22

The following formula is used to calculate the **depth of drilling**.

$$PF = \frac{W}{V}$$

PF : Explosive Density (kg/m³)

W : Total Weight of Explosive (kg)

V : Volume (m³)

B. Please try to use the formula to calculate the questions as below.

- 1) Tin Hau Temple, Yaumatei is a historic building located about 50m away from the underground tunnel blasting work. If the allowable blast vibration of the historic building is limited 5 mm/s, please calculate the maximum explosive weight for each borehole.

- 2) Assuming the cross-sectional area of the tunnel is 180 square meters, the amount of explosives used is 918 kilograms, and the explosive coefficient is 1.7 kilograms per cubic meter. Please calculate the depth of the borehole in meters.

In general, blast vibration limits of **25mm/s** are proposed for the buildings and structures in favorable and fair condition that **13mm/s and 5mm/s** is adopted for those structures in poor condition or sensitive receivers.

*This is just a theoretical value. Other factors, such as geological conditions and explosive performance, need to be considered when actually used.



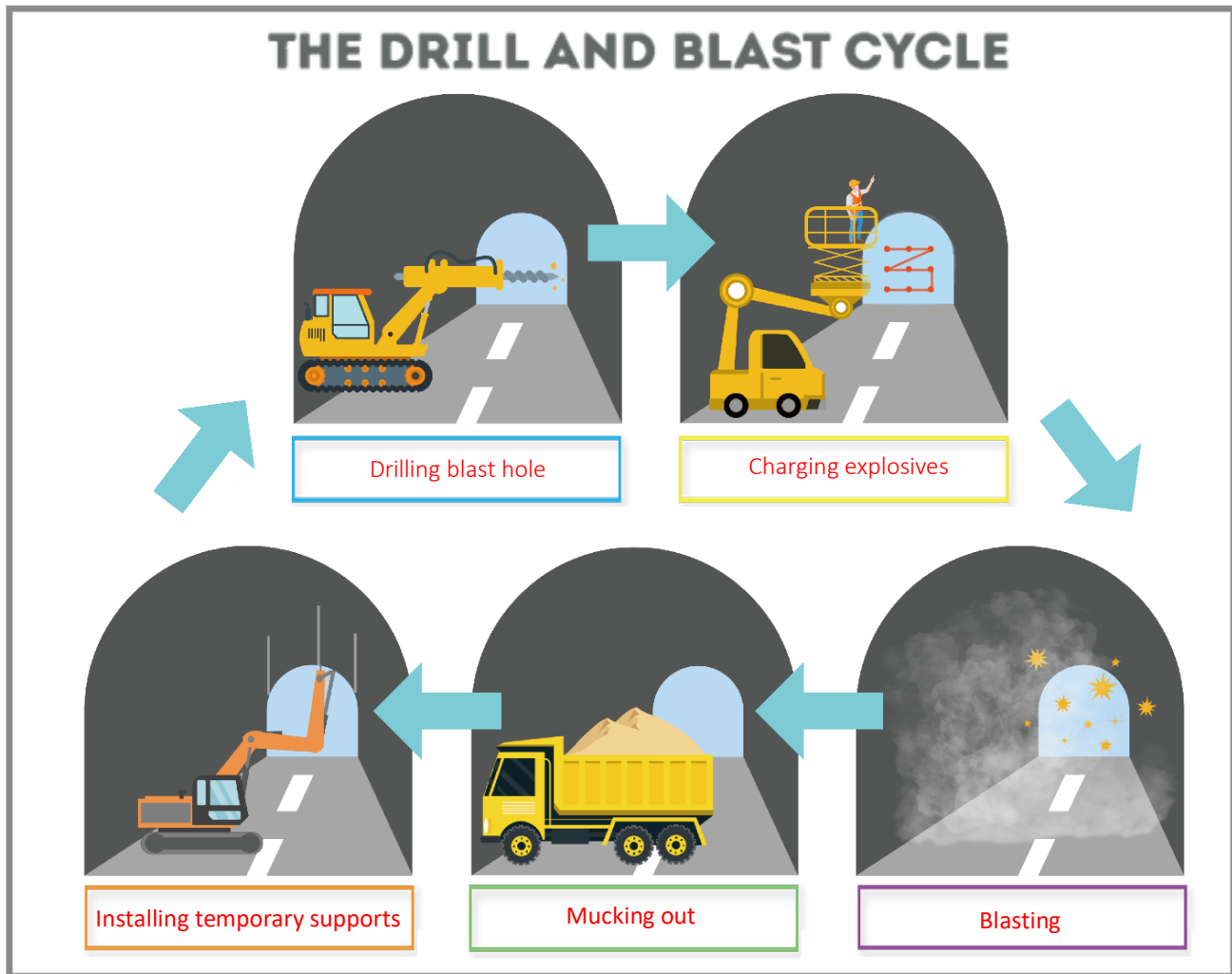
Central Kowloon Route (CKR) – Tunnel Construction

Answer of Worksheet (Secondary School)

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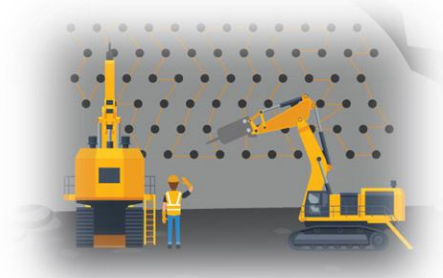
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$$B = K \left(\frac{R}{\sqrt{W}} \right)^{-b}$$

$$5 = 644 \left(\frac{50}{\sqrt{W}} \right)^{-1.22}$$

$$0.0077639 = \left(\frac{0.0084578}{W^{-\frac{1.22}{2}}} \right)$$

$$W^{-0.61} = 1.088665$$

$$W = 0.869 \text{ kg}$$

- 2) Assuming the cross-sectional area of the tunnel is 180 square meters, the amount of explosives used is 918 kilograms, and the explosive coefficient is 1.7 kilograms per cubic meter. Please calculate the depth of the borehole in meters.

$$PF = \frac{W}{V}$$

$$1.7 = \frac{918}{180 * D}$$

$$180D = 540$$

$$D = 3\text{m}$$

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