Solution **3**

(1) The left (1 marks)
and right cracks are spalling cracks. (1 marks)
No other cracks are spalling cracks. (1 marks)

(2) A drops first, (1 marks)
since the velocity of the shock wave is considerably higher than the velocity for the propagation of the cracks from the detonation hole. (2 marks)

(3) Spalling cracks are a result of the:

a) compressive shock waves emerging from the explosion source (detonator at the centre hole) (1 marks)
b) travelling towards the boundaries, and (2 marks)
c) by the tensile waves reflected. (2 marks)

(4) This is an open question. Marking guidance:

a. purpose (1 marks)
b. mechanism (2 marks)
c. performance (1 marks)

(5) The sound speed in concrete is around

$\sqrt{\frac{E}{\rho}} = \sqrt{\frac{30\times10^9}{2000}}$ km/s ~ 4km/s (4 marks)

Shock wave speed is higher compared with sound speed. (1 marks)

Solution **4**

(1) $c_0 \approx 5.3\text{km/s}$ (0.5 marks)

$s \approx 1.34$ (0.5 marks)

(2a) Solving the equation system

$$\begin{cases} P = \rho_0 c_0 u + \rho_0 s u^2 \\ P = \rho_0 c_0 \left(u_{\text{impact}} - u\right) + \rho_0 s \left(u_{\text{impact}} - u\right)^2 \end{cases}, \qquad \text{(4 marks)}$$

where P and u are pressure and particle velocity at the impact surface, respectively, one has

$$\begin{cases} u = 2\text{km/s} \\ P = 43\text{GPa} \end{cases}. \qquad \text{(4 marks)}$$

(2b) The shock velocity in the target B, D_B, can be found by using the shock-particle velocity Hugoniot

$$D_B = c_0 + su, \qquad \text{(1 marks)}$$

which gives

$$D_B = 8.0\text{km/s}, \qquad \text{(2 marks)}$$

(2c) The velocity of the shock running back into the slab A is (relative to the flying slab A)

$$D_A = c_0 + s\left(u_{\text{impact}} - u\right), \qquad \text{(2 marks)}$$

which gives

$$D_A = 8.0\text{km/s}, \qquad \text{(2 marks)}$$

(2d) The density of the 6061 aluminum in slab B after shock is

$$\rho_0 \frac{D_B}{D_B - u} = 2.703 \times 10^3 \frac{8}{8-2} \text{kg/m}^3 = 3.6\text{kg/m}^3, \qquad \text{(4 marks)}$$