一、　A cylindrical capacitor consists of two coaxial cylinders of radii a and b and length l as shown in Fig. 1. What is the capacitance of the structure? The dielectric constant of the air is ε_0. Assume that the capacitor is very long (i.e. $l \gg b$) so that we can ignore the fringing of the lines of force at the ends for the purpose of calculating of the capacitance. (15%)
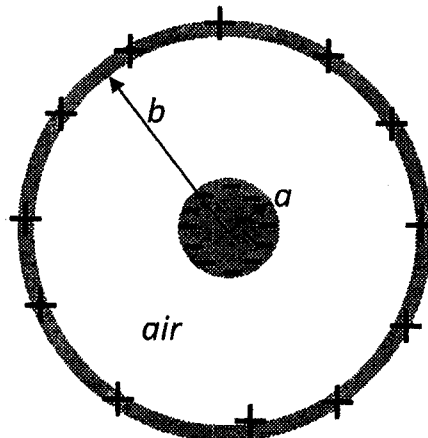

Figure 1 A cross section of a cylindrical capacitor.

二、　As the light propagates in a medium with refractive index larger than 1, the velocity of the light is slower or faster than that of the light propagating in vacuum? (10%)

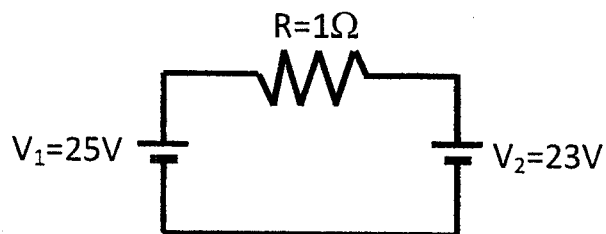三、　Assume that the batteries in Fig. 2 have negligible internal resistance. Find the current in the circuit. (10%)

Figure 2

四、　Figure 3 shows a charge $+q$ arranged as a uniform conducting sphere of radius a and placed at the center of the spherical conducting shell of inner radius b and outer radius c. The outer shell carries a charge of $-q$. Find the electric field inside the shell (b<r<c). (15%)
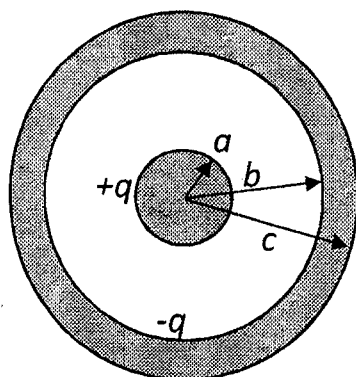

Figure 3

注意：背面有試題

五、In the movie "Speed", the bus driver tried to fly a bus over a broken bridge. Two possible cases are shown in Figure 4. Assume the bus has 5000-kg weight and its length can be neglected. Please answer the following questions.

(一) Which case (1 or 2) can work in practice? (4%)

(二) Please provide brief explanation for your answer in (一). (4%)

(三) For the case you select, how much velocity at least should the bus have right before it leaves the bridge? Assume $\triangle$d is negligible. (10%)
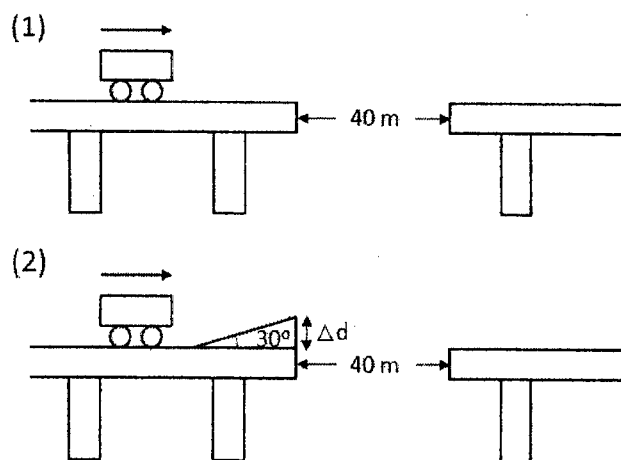

Figure 4

六、A safety net (安全網) has a spring constant of 80 N/m. It is designed to keep a 60-kg human falling from 10-m height from injured. Please find the minimum displacement of the safety net along the direction of gravity to achieve this safety requirement. (10%)

七、There are three objects. The first one is an iron ball with density of 7.87 g/cm^3 and diameter of 3 cm. The second one is an aluminum cylinder with density of 2.70 g/cm^3 and diameter of 5 cm. The third one is a gold ring with density of 19.32 g/cm^3 and diameter of 1 cm. When these three objects roll down from a hill without sliding, which one reaches the button of the hill the fastest? (6%)

八、When you stand in front of two mirrors at a 45° angle, how many images can you see in the mirrors? How many images are left-right reversal? If there is a mirror at the button, how many images can you see and how many of them are left-right reversal? (16%)

注意：背面有試題