1. The acceleration, a = (24-4)/(7+3) = $2m/s^2$ (0.5 Mark)

Applying Newtons equation to any of the blocks will give F=F' = 10N (0.5 Mark)

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2. Pressure = $h\rho g$ = .07 x 13600x9.8 = 9330 Pa (1 Mark)

Using the incorrect height will lead to a penalty of 0.5.

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3. Both the bullets will hit the ground at the same time (0.7 Marks)

Since they are shot horizontally from the same height both undergo exactly same free fall (0.8 Marks)

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4. $(1/4\pi\varepsilon_0)$ qe/ $(12)^2$ = mg (Gravity Balanced by electrostatic attraction) - 1Mark

Solving q= $(9.8 \times 9.1 \times 10^{-31} \times 144)/(1.6\times 10^{-19} \times 9\times10^{9})$ =

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5. When S is open , I = 30/24 = 1.25 A (1 Mark)

When S is closed , I = 30/(12+6) = 1.67 A (1 Mark)

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6. While Falling for the first time the ball travels 8m. Between the first and second bounce it travels 2 [8(¾)] m . Between second and third bounce it travels 2 $[8(¾)^2]$ m etc.

So the total distance travelled , S = 8 + 16[¾ + $(¾)^2$ + $(¾)^3$ + …] = 8+ 16 (¾ /(1- ¾)) = 56m

Missing the factor of 2 in between bounces will carry a penalty of .8 marks.

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7. The height gained after the first bounce is h' = 8(¾) = 6 m .

Thus the associated KE is mgh' = 1 x 9.8 x 6 = 58.8 J (1 Mark – NO partial marks)

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8. As P = I^2R (while the resistance is held fixed) , doubling the current will lead to 4 fold increment of the power dissipated. (1 Mark – NO partial marks)

9. $t_1 + t_2 = 2.7s$

Free fall gives $h = ½ gt_1^2$ while sound propagation gives $h = 330\ t_2$.

So $½ gt_1^2 = 330\ t_2$ (Setting up this equation deserves 1 mark)

Solving for t_1 and t_2 gives 2.6s and .1s respectively (.5 mark)

Using these h= 33m (0.5 m)

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10. None – as all are waves (1 mark – NO partial marks)

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11. Refractive index of diamond = $1/\sin(24.4^0)$ =2.42 (0.5 Marks)

Refractive index of diamond wrt water = 2.42/(4/3) = 1.815 (0.5 Marks)

Critical angle between water and diamond , = $\sin^{-1}$(1/1.815) = 33.42 degrees (0.5 Marks)

12.The angle of refraction = $\tan^{-1}$(8/17) = 25.2 degrees (1 Mark)

Refractive index = sin(40) / sin (25.2) = 1.51(1 Mark)

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13. The generated heat = $½ (½ mv^2)$ = 2000J (1 Marks)

Temperature rise = 2000/ (0.05 x 390) = 102.6 K (1 Marks)