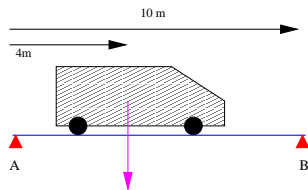


Workshop 1, Week 1

Please follow the instructions of your supervisor regarding timing of these problems.

Physics Problems

- * A car of mass 1000 kg is traveling at 100 km/hour, and hits a brick wall. Calculate the energy that is dissipated in the collision. Express your answer in scientific notation. (Hint: kinetic energy is $\frac{1}{2}mv^2$.)
- * The visual magnitude of a star is the $-2.5 \log_{10}$ of the intensity of the light received on earth, $l = -2.5 \log_{10}(I/I_0)$, with I_0 a reference intensity. Calculate
 - the change in intensity if the magnitude increases by a factor of 2;
 - the change in magnitude if the intensity increases by a factor of 2;
 - the apparent magnitude of an unresolved binary star, consisting of a star of magnitude 5 and one of magnitude 6.
- * A truck with mass 5000 kg stops on a bridge of length 10 m, with its centre of mass 4 m from the left end. Calculate the forces at the two support points.



- A paper clip of mass 1g is suspended from an elastic band, with "string constant" 1.6 N/m. The band is stretched, and the paper clip is released 2cm below equilibrium.
 - Calculate the acceleration at the time of release;
 - Calculate the vibration frequency;
 - Calculate the position after 1s.
- A cannonball of mass 1 kg is launched with an initial velocity of 100 m/s, under an angle of 30° with the horizontal. Calculate
 - Its position as a function of time;
 - The time of impact;
 - The distance traveled;
 - The highest point reached.

Maths Review

- Expand the following by multiplying out the brackets

$$\begin{aligned} * \text{ (i)} \quad & (x^2 + 1)(x - 2)(x + 3), \\ \text{ (ii)} \quad & (1 + 2x - y)^2(x - y). \end{aligned}$$

- Solve the following equations for x

$$\begin{aligned} * \text{ (i)} \quad & \frac{x-1}{x+3} = 3, & \text{ (ii)} \quad & y = \frac{3}{x+2} + 4, \\ * \text{ (iii)} \quad & \frac{1}{\sqrt{1-x^2}} = y, & \text{ (iv)} \quad & x^2 + 4x - 1 = 0, \\ * \text{ (v)} \quad & 2x^2 + 2x + 3 = 0, & \text{ (vi)} \quad & x^2 + 3x - 10 = 0, \\ \text{ (vii)} \quad & 2x^2 - 5x - 3 = 0, & * \text{ (viii)} \quad & \begin{cases} x + 2y = 8 \\ 2x - 3y = -5 \end{cases}, \\ \text{ (ix)} \quad & \begin{cases} 4x + y = 10 \\ 3x - 2y = 13 \end{cases}. \end{aligned}$$

Maths Practice

- Guess a root for the cubic equation $x^3 - 4x^2 + x + 6 = 0$ and hence factorise to find the remaining roots. Now sketch a graph of the function $x^3 - 4x^2 + x + 6$.
- Simplify and, if possible, find values of the following (without using a calculator!)

(i) $2^5 3^{-2}$,	(ii) $(2^4)^2$,
(iii) $100^{1/4}$,	(iv) $x^{\ln y}$.
- Simplify and find values of the following (without using a calculator!)

(i) $\log_9 3$,	(ii) $\log_e 2 + 3 \log_e 4$,
(iii) $\log_{10}(\sqrt{10})$,	(iv) $\log_5 1$,
(v) $\log_e(1/e^2)$,	(vi) $\log_5 49 + \log_9 125$,
(vii) $e^{\log_e x + 2 \log_e y}$	(viii) $\ln[2(x^2 - 1)] - \ln(x + 1)$.

Reading for next week: Chapter 3