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Solid State Physics

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Physics 1 for Nano: written Exercises

WS 2019 (sheet 2)

Exercise 7.

A luge and its rider with total mass of 95kg, emerge from a downhill track onto a horizontal straight track with an initial speed of 39 m/s. If a force slows them to a stop at a constant rate of 2.5 m/s², (a) what magnitude F is required for the force, (b) what distance d do they travel while slowing, and (c) what work W is done on them by the force ? What are (d) the force F, € the distance d, and (f) the work W if they, instead, slow at 4.5 m/s²

Exercise 8.

A 700g block is released from the rest at height h_0 above a vertical spring with spring constant k= 450 N/m and negligible mass. The block sticks to the spring and momentarily stops after pressing the spring by d=18cm. How much work is done (a) by the block on the spring and (b) by the spring on the block? c) What is the value of h? (d) of the block is released from 2.0 h_0 above the spring, what would be the maximum compression, d, of the spring?

Excercise 9.

Each second, 1200 m³ of water passes over the waterfall 100m high. Three-fourth of the kinetic energy gained by the water in falling is transferred to electric energy by a hydroelectric generator. At what rate does the generator produce electric energy? (The mass of 1 m³ water is 1000kg).

Excercise 10.)

A 1800kg car starts from the rest on a horizontal road and gains a speed of 75km/h in 30s. (a) what is its kinetic energy at the end of 30s? (b) what is the average power required of the car during the 30s interval? (c) what is the instantaneous power at the end of the 30s interval, assuming that the acceleration is constant?

Excercise 11.

A child whose weight is 267 N slides down a 6.5m playground slide that makes an angle of 20° with the horizontal. The coefficient of kinetic friction is 0.15. (a) How much energy is transferred to thermal energy? (b) of she starts at the top with speed v=0.57 m/s, what is her speed at the bottom?

Excercise 12. The Lennard-Jones potential in molecule physics is

$$U = \frac{A}{r^{12}} - \frac{B}{r^6},$$

where r is the separation of two atoms of the molecules (like O_2, N_2…) and A and B are positive constants. This potential energy is accociated with the force that binds the tow atoms together. (a) Find the equilibrium separation – that is the distance between the atoms at which the forces ateach atom is zero. (b) Is this force repulsive or attractive if the separation becomes smaller than the equilibrium sepraration?

Note:
Exercises have to give back at lecture 29.10.19. It will be discussed in exercise hours at 30.10.18