Phys 218 – Spring 2017
All Sections

Physics 218 – Comprehensive

[Learning objective(s)]

Short Problems:

A. (a) $a_{\parallel}(t) = 3.0\ \mathrm{m/s^2}$ [17.1]
(b) $a_{\perp}(t) = (0.09\ \mathrm{m/s^4}t^2 + (0.12\ \mathrm{m/s^3}t + 0.04\ \mathrm{m/s^2}$ [18.1]

B. (a) None [32.1]
(b) 9.8 J [32.2]

C. (a) Both linear momentum and kinetic energy are conserved in elastic collisions [48.1, 50.1]
(b) If the stick together, it must be a (completely) inelastic collision [50.2]

D. (a) 6 m: not an equilibrium point; [42.1]
10 m: a stable equilibrium point; [42.2]
17 m: an unstable equilibrium point [42.3]
(b) $x_{\max} \approx 16$ m and $x_{\min} \approx 5$ m [43.1, 43.2]

E. (a) Any object undergoing SHM has $a = -\omega^2 x$. With $F = ma \Rightarrow F \propto -x$, so the force is restorative. [66.1]
(b) $\omega = \sqrt{\frac{3}{C}}\, B$ [66.2]
(c) $x(t) = x_{\max}\cos(\omega t + \phi_0)$, where $x_{\max}$ is the amplitude and ϕ_0 is the phase offset [66.3]

Problem 1:

(a) $I_{\mathrm{rod}} = 1.0\ \mathrm{kg\,m^2}$ [51.1]

(b) $\alpha = 10\ \mathrm{rad/s^2}$ [55.1]

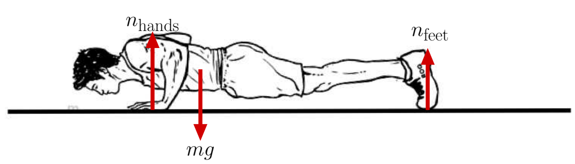
(c) $\omega(t = 2) = 20\ \mathrm{rad/s}$ [14.1]

(d) $K_{\mathrm{rot}} = 200$ J [35.1]

(e) It is not conserved because the motor is applying an external torque to the rod [58.1]

Problem 2:

(a) [23.1, 26.1, 26.2]



(b) $n_{\mathrm{feet}} = 285$ N [3.1, 21.1, 31.1]

(c) $x = 0.58$ m [3.2, 31.2, 54.1, 54.2]

(d) $n'_{\mathrm{hands}} = 423$ N [1.1, 3.3, 31.3]

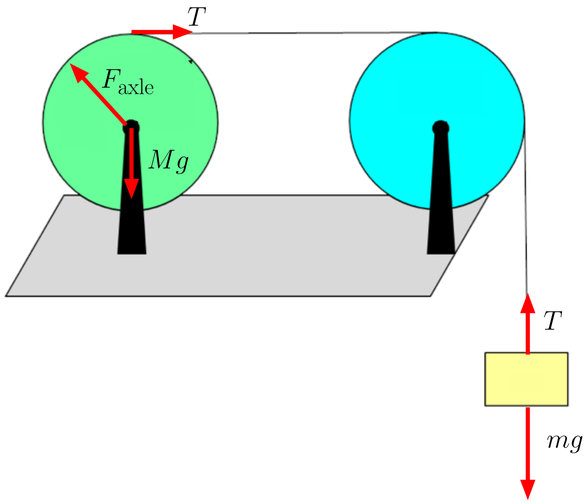
Problem 3:

(a) The bullet stops in the block, so the collision is completely inelastic; kinetic energy is not conserved in these cases (there is friction which brings the bullet to rest) [40.1]

(b) $v' = \left(\frac{m}{M+m}\right) v$ [57.1, 57.2, 59.1]

(c) $h = \frac{1}{2g}\left(\frac{mv}{M+m}\right)^2$ [3.4, 34.1, 38.1, 39.1]

Problem 4: (a) [23.2, 23.3, 24.1, 24.2, 26.3]



(b) $\alpha = \frac{-mg}{(m+\frac{2}{3}M)R}$ [3.5, 21.2, 51.2, 54.3, 55.2]

(c) $L = 90 \text{ kg m}^2/\text{s}$ [54.4, 57.3]

Problem 5: (a) $a = 5.05 \text{ m/s}^2$ [21.3, 60.1]

(b) $T = 8.33 \times 10^3 \text{ s} = 2.31 \text{ hr}$ [18.2, 19.1]

(c) $U = -3.14 \times 10^{10}$ J [61.1]

(d) $E = -1.57 \times 10^{10}$ J [40.2]

(e) It is bound because the total energy is less than zero [62.1]