PHYS 2311 Ch. 2 HW

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Problem 2.

$$\frac{235\,\text{km}}{2.85\,\text{h}} = \boxed{82.5\,\text{km/h}}$$

Problem 3.

$$\vec{v}_{avg} = \frac{\Delta\vec{x}}{\Delta t} = \frac{8.5\,\text{cm} - 5.2\,\text{cm}}{5.4\,\text{s}} = \frac{3.3\,\text{cm}}{5.4\,\text{s}} = \boxed{0.61\,\text{cm/s}}$$

Average speed cannot be calculated, as "negative time" does not make physical sense. Speed is a scalar value, not a vector, and a negative end result is not possible.

Problem 5.

(a)

$$\frac{210\,\text{km}}{95\,\text{km/h}} = 2.2\,\text{h}$$

$$4.5\,\text{h} - 2.2\,\text{h} = 2.3\,\text{h}$$

$$2.3\,\text{h} \times 65\,\text{km/h} = 149.5\,\text{km}$$

$$149.5\,\text{km} + 210\,\text{km} = \boxed{360\,\text{km}}$$

(b)

$$\overline{S} = \frac{l}{\Delta t} = \frac{360\,\text{km}}{4.5\,\text{h}} = \boxed{80\,\text{km/h}}$$

Problem 6.

(a)

$$\overline{S} = \frac{l}{\Delta t} = \frac{38\,\text{m} + 19\,\text{m}}{7.4\,\text{s} + 1.8\,\text{s}} = \frac{57\,\text{m}}{9.2\,\text{s}} = \boxed{6.2\,\text{m/s}}$$

(b)

$$\vec{v}_{avg} = \frac{\Delta\vec{x}}{\Delta t} = \frac{38\,\hat{\imath}\text{m} - 19\,\hat{\imath}\text{m}}{9.2\,\text{s}} = \boxed{2.1\,\hat{\imath}\text{m/s}}$$

Problem 7.

(a)

$$\overline{S} = \frac{l}{\Delta t} = \frac{8 \times 400\,\text{m}}{14.5\,\text{min}} = \frac{3200\,\text{m}}{870\,\text{s}} = \boxed{3.7\,\text{m/s}}$$

(b) After 8 laps around a track, the person's displacement would be 0, since they stop in the same place they began.

$$\vec{v}_{avg} = \frac{\Delta\vec{x}}{\Delta t} = \frac{0\,\text{m}}{870\,\text{s}} = \boxed{0\,\hat{\mathbf{i}}\text{m/s}}$$

Problem 14.

$$\frac{1900\,\text{km}}{720\,\text{km/h}} + \frac{2700\,\text{km}}{990\,\text{km/h}} = 5.4\,\text{h}$$

$$\overline{S} = \frac{l}{\Delta t} = \frac{4600\,\text{km}}{5.4\,\text{h}} = \boxed{850\,\text{km/h}}$$

Problem 23.

$$v_i = \frac{\Delta d}{\Delta t} = \frac{120\,\text{m}}{5.0\,\text{s}} = 24\,\text{m/s}$$

$$v = v_0 + at$$

$$0 = 24\,\text{m/s} + a \times 3.7\,\text{s}$$

$$a = \frac{-24\,\text{m/s}}{3.7\,\text{s}} = |-6.5\,\text{m/s}^2| = \boxed{6.5\,\text{m/s}^2}$$

$$\text{Acceleration in g's } = \frac{6.5\,\text{m/s}^2}{9.80\,\text{m/s}^2} = \boxed{0.66\,\text{g}}$$

Problem 24.

$$v = v_0 + at$$

$$120\,\text{km/h} = 65\,\text{km/h} + 1.8\,\text{m/s}^2 t$$

$$55\,\text{km/h} = 1.8\,\text{m/s}^2 t$$

$$55\,\text{km/h} \times \frac{1000\,\text{m}}{1\,\text{km}} \times \frac{1\,\text{h}}{3600\,\text{s}} = 15\,\text{m/s}$$

$$15\,\text{m/s} = 1.8\,\text{m/s}^2 t$$

$$\frac{15\,\text{m/s}}{1.8\,\text{m/s}^2} = t = \boxed{8.3\,\text{s}}$$

Problem 25.

(a)

$$\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t} = \frac{360\,\hat{\mathbf{i}}\mathrm{m}}{17.0\,\mathrm{s}} = \boxed{21.2\,\hat{\mathbf{i}}\mathrm{m/s}}$$

(b)

$$\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t} = \frac{45.0\,\mathrm{m/s} - 11.0\,\mathrm{m/s}}{17.0\,\mathrm{s}} = \frac{34.0\,\mathrm{m/s}}{17.0\,\mathrm{s}} = \boxed{2.00\,\mathrm{m/s^2}}$$

Problem 26.

$$v(t) = \frac{d}{dt}x(t) = \frac{d}{dt}(4.8t + 7.3t^2) = 4.8 + 14.6t$$

$$a(t) = \frac{d}{dt}v(t) = \frac{d}{dt}(4.8 + 14.6t) = \boxed{14.6\,\mathrm{m/s^2}}$$

Problem 27.

(a) A is m/s and B is m/s^2.

(b)

$$v(t) = \frac{d}{dt}x(t) = \frac{d}{dt}(At + Bt^2) = A + 2Bt$$

$$a(t) = \frac{d}{dt}v(t) = \frac{d}{dt}(A + 2Bt) = \boxed{2B\ \mathrm{m/s^2}}$$

(c)

$$v(6.0) = A + 2Bt = A + 2B \times 6.0\,\mathrm{s} = \boxed{A + 12B\ \mathrm{m/s}}$$

$$a(6.0) = \boxed{2B\ \mathrm{m/s^2}}$$

(d)

$$v(t) = \frac{d}{dt}(At + Bt^{-3}) = \boxed{A - 3Bt^{-4}\ \mathrm{m/s}}$$

Problem 35.

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{9\,\mathrm{m/s}}{6.5\,\mathrm{s}} = \boxed{1.4\,\mathrm{m/s^2}}$$

$$\frac{13\,\mathrm{m/s} + 22\,\mathrm{m/s}}{2} = 17.5\,\mathrm{m/s}$$

$$17.5\,\mathrm{m/s} \times 6.5\,\mathrm{s} = \boxed{114\,\mathrm{m}}$$

Problem 36.

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(x - x_0)$$

$$(11.5\,\text{m/s})^2 = 2\vec{a}(18.0\,\text{m})$$

$$132.25\,\text{m}^2/\text{s}^2 = 2\vec{a}(18.0\,\text{m})$$

$$\vec{a} = \boxed{3.67\,\text{m/s}^2}$$

$$\vec{v} == \vec{v}_0 + \vec{a}t$$

$$11.5\,\text{m/s} = 3.67\,\text{m/s}^2 t$$

$$t = \boxed{3.13\,\text{s}}$$

Problem 37.

$$\vec{v} == \vec{v}_0 + \vec{a}t$$

$$0\,\text{m/s} = 28.0\,\text{m/s} + \vec{a}8.60\,\text{s}$$

$$-28.0\,\text{m/s} = \vec{a}8.60\,\text{s}$$

$$\vec{a} = -3.26\,\text{m/s}^2$$

$$x = x_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$$

$$x = 28.0\,\text{m/s} \times 8.60\,\text{s} + \frac{1}{2}(-3.26\,\text{m/s}^2(8.60\,\text{s})^2)$$

$$x = \boxed{120\,\text{m}}$$

Problem 38.

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}\big(x - x_0\big)$$

$$0 = \vec{v}_0^2 + 2(-6.00\,\text{m/s}^2)(45\,\text{m})$$

$$-\vec{v}_0^2 = -540\,\text{m}^2/\text{s}^2$$

$$\vec{v}_0 = \sqrt{540\,\text{m}^2/\text{s}^2}$$

$$\vec{v}_0 = \boxed{23.2\,\text{m/s}}$$

Problem 53.

(a)

$$x = x_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$$

$$x = \frac{1}{2}\vec{a}t^2$$

$$t = \sqrt{\frac{2x}{\vec{a}}}$$

$$t = \sqrt{\frac{2(380\,\mathrm{m})}{9.80\,\mathrm{m/s^2}}} = \boxed{8.8\,\mathrm{s}}$$

(b)

$$\vec{v} = \vec{a}t$$

$$\vec{v} = 9.80\,\mathrm{m/s} \times 8.8\,\mathrm{s} = \boxed{86.2\,\mathrm{m/s}}$$

Problem 54.

$$\vec{v} = \vec{v}_0 + at$$

$$55\,\mathrm{km/h} = (9.80\,\mathrm{m/s^2})t$$

$$\frac{55\,\mathrm{km}}{1\,\mathrm{h}} \times \frac{1\,\mathrm{h}}{3600\,\mathrm{s}} \times \frac{1000\,\mathrm{m}}{1\,\mathrm{km}} = 15.28\,\mathrm{m/s}$$

$$\frac{15.28\,\mathrm{m/s}}{9.80\,\mathrm{m/s^2}} = \boxed{1.56\,\mathrm{s}}$$

Problem 55.

$$t_{up} = \frac{2.6\,\mathrm{s}}{2} = 1.3\,\mathrm{s}$$

$$\vec{v} = \vec{v}_0 + gt_{up}$$

$$0 = S - 9.80\,\mathrm{m/s^2} \times 1.3\,\mathrm{s}$$

$$S = \boxed{12.74\,\mathrm{m/s}}$$

$$x = x_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$$

$$x = (12.74\,\mathrm{m/s})(1.3\,\mathrm{s}) + \frac{1}{2}(-9.80\,\mathrm{m/s^2})(1.3\,\mathrm{s})^2$$

$$x = \boxed{8.3\,\mathrm{m}}$$

Problem 56.

(a)

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(x - x_0)$$

$$0 = (22\,\mathrm{m/s})^2 + 2(-9.80\,\mathrm{m/s^2})(x)$$

$$-484\,\mathrm{m^2/s^2} = -19.6\,\mathrm{m/s^2}(x)$$

$$\frac{-484\,\mathrm{m^2/s^2}}{-19.6\,\mathrm{m/s^2}} = x$$

$$x = \boxed{24.7\,\mathrm{m}}$$

(b)

$$\vec{v} = \vec{v}_0 + \vec{a}t_{up}$$

$$0 = 22\,\mathrm{m/s} + 9.80\,\mathrm{m/s^2}t_{up}$$

$$t_{up} = \frac{|-22\,\mathrm{m/s}|}{9.80\,\mathrm{m/s^2}} = 2.24\,\mathrm{s}$$

$$t = 2.24\,\mathrm{s} \times 2 = \boxed{4.48\,\mathrm{s}}$$

(c) We are ignoring air resistance. We are also using $9.80\,\mathrm{m/s^2}$ as our constant of acceleration, when Earth's gravity changes consistently depending on the location.