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Set #7 Ch 9: CQ 27, 31, 49 / Ex 12, 13, 19
Ch 10: CQ 1, 7 / Ex 3, 5

9: CQ27: If a rising elevator is slowing down its acceleration, $\vec{A}$, is directed downward towards the earth. Therefore the pseudo force, $-m\vec{A}$, is directed upward and the reading on the scale is reduced as compared with the reading in the elevator at rest, because $F_{scale} + F_G + F_{pseudo} = 0$ for a mass which is at rest in the accelerated frame. That is $F_{scale} = -\vec{F}_G + m\vec{A}$ has a smaller magnitude than $|\vec{F}_G| = mg$.

9: CQ 31 Consider first an inertial frame. Then BALANCE of the equal arm balance indicates that the downward force on book, $W_B = M_B g$, equals the downward force on standardized masses, $M_S g = W_S$. Whatever the value of g, BALANCE indicates that masses are the same and that forces are the same. In an accelerated frame the downward force is altered by the addition of the PSUEDO FORCE, $F_{ps} = -m\vec{A}$, for an object of mass, m. Then BALANCE indicates that $W_B' = W_B - M_B\vec{A} = M_B(g-\vec{A}) = W_S - M_S\vec{A} = M_S(g-\vec{A}) = W_S'$ i.e. the Forces in the accelerated frame are still equal, although modified from the values in the inertial frame. This same equality guarantees that the MASSES are also still equal, and HAVE the same values as they had in the inertial frame.

Therefore, the answer is "YES, you get the same (balanced) result and the two masses have the same values as their inertial frame values." But the weights, although equal, have different values from those in the inertial frame, as a spring scale would show by its altered extension in the accelerated frame.

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9: C.Q. 49. Recall that Coriolis force is the pseudo-force which must be added to the physical forces in order to make Newton's laws work in a rotating frame. The Coriolis force is always directed ⊥ the axis of rotation, and ⊥ the velocity, $\vec{v}$, of the moving object (here the pendulum bob).

Consider the horizontal plane tangent to the earth's surface. The velocity of a swinging pendulum lies in this plane, and the rotational angular velocity of the earth is directed along a N-S line in this plane. To be ⊥ to BOTH the N-S line and (any) other direction in the plane, the Coriolis force must be ⊥ to this horizontal plane; i.e. $\vec{F}_{Coriolis}$ is directed VERTICALLY for a pendulum on the equator.

But a Coriolis force can rotate the plane of a pendulum ONLY if it has a component ⊥ the pendulum plane. Therefore at the equator the Coriolis Force DOES NOT rotate the plane of the pendulum, because it is directed vertically, lies within the pendulum plane, and therefore has no component ⊥ that plane.

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CH 9

9: EX 12 $\vec{F}_{scale} + \vec{F}_G + \vec{F}_{pseudo} = 0$ in frame with $\vec{A} = -\vec{g}/4$. Also $\vec{F}_{pseudo} = -m\vec{A} = \frac{+m\vec{g}}{4}$

Then $\vec{F}_{scale} = -m\vec{g} - \frac{m\vec{g}}{4} = -\frac{5}{4}mg = -\frac{5}{4}\cdot 800 = -1000\,N$

$\boxed{|\vec{F}_{scale}| = 1000\,N}$ & is directed upward.

9: Ex 13 $\vec{F}_{scale} = -m\vec{g} - m\vec{g}/4$, so that $|\vec{F}_{sc}| = mg + \frac{1}{4}mg = \frac{5}{4}\cdot 8\cdot 10 = \boxed{100\,N}$ & scale exerts force upward

9: Ex 19 $a = v^2/r = \frac{(20)^2}{40} = \boxed{10\,m/s^2}$ {same as g_{EARTH}!}

10: CQ 1. No. Because all physical laws are the same in every inertial frame, and that includes any frame moving with any constant velocity in an inertial frame. It is not ever possible to determine one's constant velocity by any physical measurement.

10: CQ 7: He will obtain exactly the value c for speed of light in vacuum. The great conclusion of Michelson & Morley's experiment, and the centerpiece of Einstein's relativity is that the speed of light has the same value for all observers, regardless of their speeds

10: EX 3: $t = d/v$ and $v = 3\times10^8$ m/sec for light: $t = \frac{2.45\times10^6\times10^3\,m}{3\times10^8\,m/sec} = \boxed{300\,s}$

10: Ex 5: $\gamma = \frac{1}{\sqrt{1-v^2/c^2}} = \frac{1}{\sqrt{1-[(0.4)\cancel{c}/\cancel{c}]^2}} = \frac{1}{\sqrt{1-0.16}} = \frac{1}{\sqrt{.84}} = \boxed{1.091 = \gamma}$