Errata for The Theoretical Minimum

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Introduction

As the authors have both read the entire book at least four times we do not see the errors any longer. We rely on readers to tell us where we screwed up! So let us know.

Errata

Page 5: Add this sentence at the end of paragraph one: "The value of n is a sequence of natural numbers beginning with 1."

Page 9: Fourth line from the bottom: "evan" should read "even".

Page 13: Figure 15, the diagram squares should be labeled $Q = -1$, $Q = +1$, and $Q = 0$.

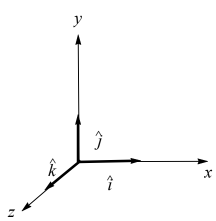
Page 17: Paragraph 1: "We could pick the Big Bang to be the origin, or the birth of Jesus, or just the start of an experiment" should read "We could pick the origin to be the Big Bang, or the Birth of Jesus, or just the start of an experiment."

Page 19: The radian should be $\frac{180^\circ}{\pi}$ not $\frac{\pi}{180^\circ}$.

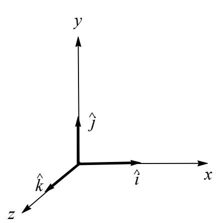
Page 19: Exercise 1: $x(t) = \sin^2 x - \cos x$ should read $x(t) = \sin^2 t - \cos t$.

Page 25: Fourth line from the bottom reads: "...tells us we are dealing with unit (or basis) vectors" should read "...tells us we are dealing with unit vectors."

Page 26: Figure 14 is



this should be



Page 28: Exercise 4 should read: **Let** $(A_x = 2,\ A_y = -3,\ A_z = 1)$ **and** $(B_x = -4,\ B_y = -3,\ B_z = 2)$**. Compute the magnitude of** $\vec{A}$ **and** $\vec{B}$**, their dot product, and the angle between them**.

Page 33: Second Paragraph: "The derivative is zero—this is the case for any function that does't change." should read "The derivative is zero—this is the case for any function that doesn't change."

Page 34: In Equations (2) $\frac{d(\log t)}{dt} = \frac{1}{t}$ should be $\frac{d(\ln t)}{dt} = \frac{1}{t}$.

Page 37: Exercise 1: $x(t) = \sin^2 x - \cos x$ should be $x(t) = \sin^2 t - \cos t$.

Page 44: Figures 2 and 3 have horizontal axes marked θ, they should be marked t.

Page 46: Exercise 7 should read: **Show that the position and velocity vectors of the previous section are orthogonal**.

Page 54; The integral formula $\int e^t\, dt = e^t$ should read $\int e^t\, dt = e^t + c$

Page 57: Just before Exercise 4: "The integral $\int \sin x\, dx$ is on our list: it's just $\cos x$. I'll leave the rest to you." should read, The integral $\int \sin x\, dx$ is on our list: it's just $-\cos x$. I'll leave the rest to you."

Page 74: First paragraph under Partial Derivatives: "Moreover, there can be more or fewer then three." should read "Moreover, there can be more or fewer than three."

Page 76: Exercise 1: The function $\frac{x}{y} e^{x^2+y^2}$ should read $\frac{x}{y} e^{(x^2+y^2)}$

Page 82: "*If the determinant and the trace of the Hessian is positive then the point is a local minimum.*" shuld read, "*If the determinant and the trace of the Hessian are positive then the point is a local minimum.*"

Page 83-84: The Trace of the Hessian is actually negative,

$$\mathrm{Tr}\,H = \frac{\partial^2 F}{\partial x^2} + \frac{\partial^2 F}{\partial y^2} = -\sin x - \sin y$$

so the function at the point $x = \pi/2$, is

$$\mathrm{Tr}\,H = -1 - 1 = -2$$

thus we have a positive determinant and a negative trace, the point is a maximum.

Page 91: The equation $p_i = m_i\, v_i$ should be $p_i = m\, v_i$.

Page 92: The equation

$$\dot{p}_i = F_i\,\{(x_i\})$$

should read,

$$\dot{p}_i = F_i\,\{(x\}).$$

Page 102: Paragraph 2 begins: "To picture what is going on, imagine that the terrain has a frictionless ball rolling on it." It should read, "To picture what is going on, imagine that the terrain has a ball rolling on it with no energy being lost to friction."

Page 103: Exercise 2 has the sentence, "The particle has mass *m*, equal in both directions." It should read, "The particle has mass *m*."

Page 110: At the bottom of the page, we have, "To do you a flavor, I will write down their form", it should read, "To do you a favor, I will write down their form."

Page 116: The sentence on the second to last paragraph reads, "A second physicist—George—is moving and he wants to know how to describe the object relative to his own coordinates." it shouldread, "A second physicist—George—is moving, without rotation relative to Lenny, and he wants to know how to describe the object relative to his own coordinates."

Page 117: First paragraph: "The easiest way to do this is to *transform* the equations of motion from one coordinate system to another is to use the principle of least action, or the Euler-Lagrange equations." Should read, "The easiest way to *transform* the equations of motion from one coordinate system to another is to use the principle of least action, or the Euler-Lagrange equations."

Page 117: The last equation should read,

$$\mathcal{A} = \int_{t_0}^{t_1} \left[\frac{1}{2}\, m\left(\dot{X} + \dot{f}\right)^2 - V(X)\right] d\,t.$$

Page 119: The equation

$$\dot{y} = -\dot{X}\ \ \sin\omega\, t\ - \omega\, X \cos\omega\, t + \ \dot{Y}\cos\omega\, t$$
$$-\omega\, Y \sin\omega\, t.$$

should read

$$\dot{y} = -\dot{X}\sin\omega\, t\ - \omega\, X \cos\omega\, t + \ \dot{Y}\cos\omega\, t$$
$$-\omega\, Y \sin\omega\, t.$$

Page 120: The equation

$$V = -m\,\omega^2\left(X^2 + Y^2\right),$$

should read,

$$V = -\frac{m\,\omega^2}{2}\left(X^2 + Y^2\right).$$

Page 121: Exercise 3 reads Use the Euler-Lagrange equations to derive the equations of motion from this Lagrangian." It should read "Use the Euler-Lagrange equations to derive the equations of motion from the Lagrangian in Eq. (12)."

Page 124: The sentence preceding the last equation reads: "Using $\dot{p} = m\,\ddot{r}$ and canceling *m* from both sides, we can write this equation in the form" should read, "Using $\dot{p}_r = m\,\ddot{r}$ and canceling *m* from both sides, we can write this equation in the form".

Page 127: The equation

$$p_+ = 2\,m\,\dot{x}_+ = m\,\dot{x}_1 + m\,\dot{x}_2.$$

should read

$$p_+ = 2\,m\,\dot{x}_+ = m\,\dot{x}_1 + m\,\dot{x}_2.$$

Page 133: The second paragraph should read: “For the more complicated case of Eq. (3), where the potential depends on $a\,q_1 - b\,q_2$, the symmetry is less obvious. Here is the transformation:”

Page 133: Equation (7) should read

$$\begin{aligned} q_1 &\to q_1 - b\,\delta \\ q_2 &\to q_2 + a\,\delta. \end{aligned}$$

Page 135: Eq. (12) should read

$$\begin{aligned} \delta_v\,x &= y\,\delta \\ \delta_v\,y &= -x\,\delta. \end{aligned}$$

With the added sentence at the end of the next paragraph, “The variation is δ_v.”

Page 136: Equation (13) should read:

$$\delta_v\,q_i = f_i(q)\,\delta.$$

Page 136: Equation (14) should read

$$\delta_v\,\dot{q}_i = f_i(\dot{q})\,\delta.$$

Page 137: Equations (15) should read

$$\begin{aligned} \delta_v\,\dot{x} &= \dot{y}\,\delta \\ \delta_v\,\dot{y} &= -\dot{x}\,\delta. \end{aligned}$$

Page 139: Back to Examples: “In the first example, Eq. (1), the variation of the coordinates in Equations (12) defines both f_1 and f_2 to be exactly 1.” should read, “In the first example, Eq. (1), the variation of the coordinates in Equations (6) defines both f_1 and f_2 to be exactly 1.”

Page 140: Paragraph 1: “Next let’s look at the second example, in which the variations of Equations (12) imply $f_1 = b$, $f_2 = -a$.” should read “Next let’s look at the second example, in which the variations of Equations (7) imply $f_1 = b$, $f_2 = -a$.”

Page 140: Paragraph 2: “From Eq. (14) we obtain $f_x = y$, $f_y = -x$.”, should read. “From Equations (12) we obtain $f_x = y$, $f_y = -x$.”

Page 154: Remove the numbering from Eq.s (8) and renumber the equation below it Eq. (8).

Page 154: Paragraph 3: We have, “From the second of Equatons (8) we get” should read “From Eq. (8) we get”

Page 159: “In fact Eq. (16)...” should read “In fact Eq.s (16)...”

Page 161: Equations (18) should read

$$\begin{aligned} \frac{\partial H}{\partial p_i} &= \dot{q}_i \\ \frac{\partial H}{\partial q_i} &= -\frac{\partial L}{\partial q_i}. \end{aligned} \tag{1}$$

Page 161: The middle equation is

$$\frac{\partial L}{\partial \dot{q}_i} = \dot{p}_i\,.$$

it should read

$$\frac{\partial L}{\partial q_i} = \dot{p}_i\,.$$

Page 175: The sentence following Eq. (5), “Equations (2) and (3) define the linearity property of PB’s.” should read, “Equations (4) and (5) define the linearity property of PB’s.”

Page 183: The equation

$$\{p_i, L_j\} = \epsilon_{ijk} \, p_k.$$

should read

$$\{p_i, L_j\} = \sum_k \epsilon_{ijk} \, p_k.$$

Page 188: Third paragraph, "You guessed it—the time derivative of the PB of the quantity with H" should read, "You guessed it—the PB of the quantity with H.."

Page 193: Eq. (3) reads

$$\left(\vec{V} \times \vec{A}\right)_i = \sum_k \sum_j \epsilon_{ijk} \, V_j \, A_k.$$

should read

$$\left(\vec{V} \times \vec{A}\right)_i = \sum_j \sum_k \epsilon_{ijk} \, V_j \, A_k.$$

We can also rewrite

$$\left(\vec{\nabla} \times \vec{A}\right)_i = \sum_k \sum_j \epsilon_{ijk} \, \frac{\partial A_k}{\partial x_j}.$$

should read

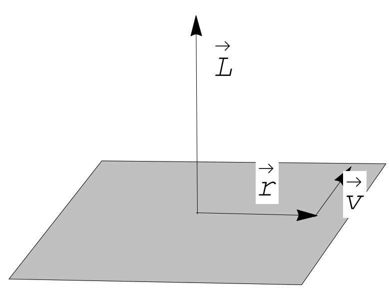
$$\left(\vec{\nabla} \times \vec{A}\right)_i = \sum_j \sum_k \epsilon_{ijk} \, \frac{\partial A_k}{\partial x_j}.$$

Page 205: Second paragraph: The reference to Eq. (12) should be to Eq. (11).

Page 211: Third paragraph: "and the fact that physical phenomal do not change," should read, "and the fact that physical phenomena do not change".

Page 214: N2 reads: "The force is inversely proportional the square of the distance between the masses." should read, "The force is inversely proportional to the square of the distance between the masses."

Page 217 Fig 2 should be



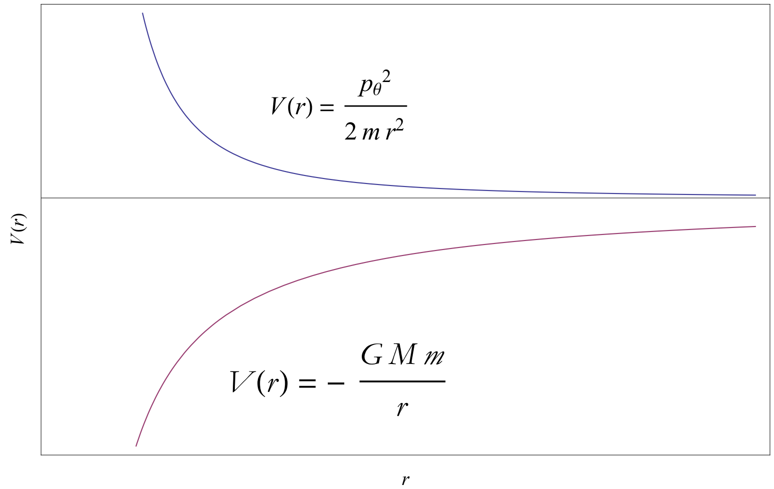
Page 218 Eq. (5) reads,

$$\ddot{r} = r \dot{\theta} - \frac{G M}{r}$$

should read

$$\ddot{r} = r \dot{\theta}^2 - \frac{G M}{r}$$

Page 221: Figure 3 should be:



Page 227: The period should be

$$\tau = \frac{2\,\pi}{\omega}.$$

The last equation should read

$$\tau^2 = \frac{4\,\pi^2}{G\,M}\,r^3.$$