Eliminating $F(r)$ gives

$$\frac{\alpha'(r)}{\alpha(r)} = -\frac{1}{r},$$

so that $\alpha(r) = \lambda/r$ where λ is a constant. Hence $F(r) = \lambda/r^2$, the familiar inverse square force. For such a force the equation (3) can be integrated trivially to yield the first integral

$$\mathbf{h} \times \dot{\mathbf{r}} = \lambda\mathbf{r}/r + \mathbf{k},$$

where $\mathbf{k}$ is a constant vector (the so-called Lenz-Runge vector).

The equation of motion (1) is a second-order differential equation, and so its general solution will involve two arbitrary constant vectors of integration. Since $\mathbf{h}$ and $\mathbf{k}$ are just two such vectors, one would expect the orbit of the particle to be expressed in terms of $\mathbf{h}$ and $\mathbf{k}$. This can be done by computing $\mathbf{k}.\mathbf{r}$:

$$\mathbf{k}.\mathbf{r} = (\mathbf{h} \times \dot{\mathbf{r}}).\mathbf{r} - \lambda r = -(\mathbf{r} \times \dot{\mathbf{r}}).\mathbf{h} - \lambda r = -h^2/m - \lambda r.$$

Hence

$$kr\cos\theta = -h^2/m - \lambda r,$$

or

$$\frac{1}{r} = \frac{-\lambda m}{h^2}\left(1 + \frac{k}{\lambda}\cos\theta\right),$$

which is the familiar polar form of the orbit.

C. D. COLLINSON

Department of Applied Mathematics, The University, Hull HU6 7RX

Correspondence

Selecting university mathematicians

DEAR EDITOR,

Recently, one of my pupils attended for interview at the mathematics department of a university. The 'interview' consisted, in part, of a problem-solving session done on a blackboard under the scrutiny of the interviewers. For this pupil, who is by nature a quiet reserved person, the interview became an ordeal and mathematical thinking was impossible.

I feel very concerned at the inclusion of a seemingly unnecessary factor into consideration of a prospective undergraduate. Please will any university interviewer reading this letter be more appreciative of the reactions of young people if a similar procedure is contemplated?

Yours sincerely,

R. E. HAWORTH

Fleetwood Grammar School, Lancs.

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