

**Note.** Do **not** approx.: If your result is “ $\sin(\sqrt{\pi})$ ” then write that rather than  $.9797\ldots$ . Write expressions unambiguously e.g., “ $1/a+b$ ” should be bracketed either  $[1/a]+b$  or  $1/[a+b]$ . (Be careful with **negative** signs!) Use **lb** for pound(s), **mi** for mile(s), **mph** for miles-per-hour, and **ppf** for parsecs-per-fortnight.

**Z4:** Show no work.

**[z]** Professor King sometimes gives freebie questions.  
**Circle** one: **True**    **Right On!**    **Who?**

**[a]** Let  $\beta$  denote the angle between a hyperdiagonal and an edge of a regular octahedron. Then  $\cos(\beta) =$  \_\_\_\_\_.

**[b]** The distance from  $\text{Plane}(2\hat{i}, 2\hat{j}, 2\hat{k})$  to the point  $12\hat{k}$  is \_\_\_\_\_.  
[Hint: Can you do this “by inspection”?]

**[c]** On a certain uniform-density radius=300mi planetoid you weigh  $P \cdot \text{lb}$ . You climb a 100mi tall tower and now weigh  $\text{lb}$ .

You descend to the bottom of a 100mi deep hole and you now weigh  $\text{lb}$ .

**[d]** The dark planet MALFOY has two satellites in circular orbit, CRABBE and GOYLE. CRABBE's orbital-speed is 1000mph and his orbital-radius is 18000mi. GOYLE's orbital-speed is 1500mph, so his orbital-radius is \_\_\_\_\_ mi.

Out in CRABBE's orbit, the from-MALFOY escape-speed is \_\_\_\_\_ mph.

(You may express your answer as an arithmetic combination of 1000, 1500, 18000 and other numbers.)

**[e]** In  $\mathbb{R}^4$ , consider the line  $\mathbb{L}$  passing through points  $P := (2, 3, 1, 0)$  and  $Q := (-1, 0, -5, 3)$ . Then  $(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}, \underline{\hspace{1cm}}, \underline{\hspace{1cm}})$  is the closest point on  $\mathbb{L}$  to the origin.

**[f]**

The quadratic surface  $x^2 + y^2 + 2y = 6z - z^2$  is a/an/the: **Circle** one:

**Hufflepuff-Hume—study-lounge**

**Cylinder-over-a-parabola**

**Paraboloid**

**Firebolt-2000-racingbroom**

**Saddle-surface**

**2-sheeted-hyperboloid**

**1-sheeted-hyperboloid**

**Gryffindor-student**

**Ellipsoid**

**Single-point**

**Empty-set**

**Blast-ended Skrewt**

[Hint: Most of these are improbable...]

End of Z-class

**Z-home:** \_\_\_\_\_ 350pts

**Z4:** \_\_\_\_\_ 170pts

**Total:** \_\_\_\_\_ 520pts

**HONOR CODE:** *“I have neither requested nor received help on this exam other than from my professor (or his colleague).”*  
Name/Signature/Ord  
\_\_\_\_\_