

## Worksheet 0

1. Differentiate each of the following functions.

(a)  $f(x) = \arctan(x^3)$

(b)  $h(r) = 3r(12 - 2r^2)^{-3}$

(c)  $n(w) = \sqrt[3]{1 - aw - (aw)^2}$

2. Differentiate each of the following functions.

(a)  $g(t) = \frac{\ln(t)}{t}$

(b)  $m(q) = qe^q$

(c)  $p(z) = az \sin^3(\cos(az^2))$

3. Evaluate each of the following integrals. Assume that  $a$  is a positive constant.

(a)  $\int_1^4 \frac{ax^3 + x}{a^2x^2} dx$

(b)  $\int r \sin(ar^2) \cos(ar^2) dr$

(c)  $\int_1^{\sqrt[3]{3}} \frac{4z}{1 + z^2} dz$

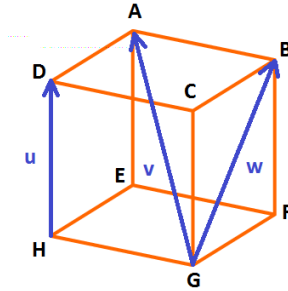
4. Evaluate each of the following integrals. Assume that  $a$  is a positive constant.

(a)  $\int_1^{e^2} \frac{(\ln t)^2 + (\ln t)^4}{t} dt$

(b)  $\int \frac{e^{3q} - 1}{e^q} dq$

(c)  $\int_1^{\sqrt[3]{3}} \frac{4z}{1 + z^4} dz$

5. In the cube shown below, the vertices are labeled  $A$  through  $H$ . Three vectors  $\vec{u}$ ,  $\vec{v}$ , and  $\vec{w}$ , each of which runs from one vertex of the cube to another, are shown in the diagram. Using the operations of vector addition, subtraction and scalar multiplication, write each of the following vectors in terms of  $\vec{u}$ ,  $\vec{v}$ , and/or  $\vec{w}$ .



- (a) The vector  $\overrightarrow{AG}$ .
- (b) The vector  $\overrightarrow{GE}$ .
- (c) The vector from the center of the cube to the center of the square face  $HEAD$ .
- (d) The vector  $\overrightarrow{HB}$ .
6. Let  $\vec{q} = -\vec{i} + \vec{j} - 3\vec{k}$ , and  $\vec{r} = 2\vec{i} - 3\vec{j} - \vec{k}$ . Compute each of the following quantities, and draw relevant pictures.
- (a)  $\vec{q} - \vec{r}$
- (b) The component of  $\vec{q}$  parallel to  $\vec{r}$ .
- (c) The component of  $\vec{q}$  perpendicular to  $\vec{r}$ .
7. A large ship is being towed by two tugs. The larger tug exerts a force which is 25% greater than the smaller tug and at an angle of 30 degrees north of east. Which direction must the smaller tug pull to ensure that the ship travels due east.