# UNCERTAINTIES TUTORIAL 1.0

1 Three packages have to be added to the payload of the Space Shuttle. Their masses have been measured as follows:  
m1 = (112 ± 1) kg m2 = (252 ± 2) kg and m3 = (151 ± 1) kg.  
Calculate the total mass to be added and the uncertainty in the total.

2 When using a travelling microscope the following measurements were made.  
Reading 1 = (112.1 ± 0.2) mm Reading 2 = (114.5 ± 0.2) mm.  
Calculate:

(a) the percentage uncertainty in the sum of these readings

(b) the percentage uncertainty in the difference of these readings

(c) Which of these, sum or difference, is usually needed for the travelling microscope?

3 A block of building material has been carefully machined to undergo tests. Its dimensions and mass are as follows:  
 length = 0.050 ± 0.001 m  
 breadth = 0.100 ± 0.001 m  
 height = 0.040 ± 0.001 m  
 mass = 0.560 ± 0.002 kg  
(a) From this data, calculate the density of this material.  
(b) Find the uncertainty in this value of density and express it as a percentage.

4 The radius of a sphere is measured to be (1.2 ± 0.1) x 10-2 m.   
The volume of a sphere is given as  r3 , where r is the radius of the sphere. Calculate the volume of the sphere, quoting the uncertainty in your answer.

5 A uniform disc is to be used as a flywheel in a new design of small engine. Its moment of inertia has to be known. The following method is used:  
  
The diameter of the disc is measured with a metre stick at 8 different positions round the rim and its mass is measured on a balance which was accurate to 10 g.  
**Diameters**  0.245 m 0.249 m 0.255 m 0.248 m  
 0.243 m 0.247 m 0.251 m 0.246 m  
**Mass**  4.04 kg  
Use the formula for the moment of inertia = M R2 , where R is the radius of the disc. Find the moment of inertia, quoting a value for the uncertainty associated with your answer.

6 Calculate the refractive index of a glass block, including the uncertainty, from the following information:  
Angle of incidence = (46 ± 1)° Angle of refraction = (28 ± 1)°.