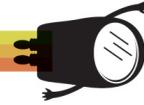# CHASING A STAR

A-LEVEL MATHS QUESTIONS

Mechanics and Statistics - Day 5

COMPLETE ALL QUESTIONS

1.Calculator check time

1. Let $X \sim N(10, 9)$. Using your calculator, evaluate

$$P(6 < X < 12)$$

2. Let $Y \sim B(10, 0.7)$. Using your calculator, evaluate

$$P(Y = 6)$$

3. Let $Y \sim B(10, 0.7)$ Using your calculator, evaluate

$$P(Y \geq 5)$$

2. A sample of 20 bags of sugar has a mean mass of 1.05kg. Determine if at a 5% level there is evidence to say that the population mean of 1kg has changed, given that the population standard deviation is 0.03kg

3. The miles per gallon of a car are monitored. Long term performance indicate a mean value of $46mpg$, with a variance of $9mpg^2$. On a long journey of 870 miles, 18 gallons of fuel are used. Perform a two-tailed hypothesis test to determine if this evidence of a change in performance at a 5% level.

4. A force, $\underline{F} = 4\underline{i} - 3\underline{j}$ acts on a particle, with a mass of 2kg and an initial velocity of $\underline{u} = 8\underline{i} + 26\underline{j}$ for a period of 10 seconds. Calculate the velocity of the particle after 10 seconds, and the displacement of the particle at 10 seconds.

5. The position of a particle is given by

$$\underline{r}(t) = \begin{pmatrix} \sin(t) \\ \cos(t) \\ 2t \end{pmatrix}$$

Determine the acceleration of the particle, and show that the **magnitude** of the acceleration is constant.

6. A particle has position vector

$$\underline{x}(t) = \begin{pmatrix} 4 + \sin(2t) \\ 5 - \cos(2t) \end{pmatrix}$$

Show that the particle's motion satisfies the differential equation

$$\frac{d^2\underline{x}}{dt^2} = k\underline{x} + \underline{c}$$

where k is a scalar and $\underline{c}$ a constant vector, to be determined.

7. A particle of mass 0.3kg is subject to a constant force, F. The particle is initially at the origin, and has an initial velocity of 8m/s. Given that the particle returns to the origin in 5 seconds time, determine what force is acting on the particle and the distance the particle travels in the five second period.