



# INEQUALITIES and EQUATIONS

## STAGE 5 - MATHEMATICS



**THE SAFETY OF LANDING A HELICOPTER CAN DEPEND ON INEQUALITIES AND EQUATIONS?**



## MEASUREMENT

Students to watch the following video link

<http://www.youtube.com/watch?v=bC2XIGMI2kM>

## MEASUREMENT

### TEACHER STIMULUS QUESTIONS:

- i) What does
- ii) What does  $< 4$  indicate?
- iii) What does 8.3 indicate?

Think of these answers to the above by considering a **numberline** for each case.

#### Question 1

Draw a separate numberline graphs for each of the above statements for i) ii) and iii).  
A Real Life Example using the application of Inequalities

#### DETERMINING THE CO-EFFICIENT OF FRICTION ON A NAVY SHIP FLIGHT DECK

After a new paint scheme has been applied to a Navy flight deck, the surface has to be tested to ensure it has the correct co-efficient of friction to make it operationally **safe** for Navy pilots to land helicopters on the deck. If it's **too slippery**, helicopters may **not land** safely or correctly in rough seas.

A co-efficient of friction, also called a drag co-efficient, is the ratio of the force of friction between two bodies and the force pressing them together. It has no units. The coefficient of friction depends on the materials used; for example, ice on steel has a low coefficient of friction, while rubber on pavement has a high coefficient of friction. Coefficients of friction range from near zero to greater than one.

To determine the co-efficient of friction on a flight deck, a testing rig is built and we use a known certified weight (ie a 15 kg gym weight) and a force meter. A number of **sample tests** are taken over the entire area of the deck.

The relevant formula is:

$$\mu = F / W$$

Where

$\mu$  = Drag co-efficient

F = Force (Newtons)

W = Test weight (Kg)

## MEASUREMENT

### International Marine Coatings advises:

- For **new** coatings, the **coefficient of friction** must be  $\geq 0.8$  (Dynamic); and
- During **service** the **coefficient of friction** may deteriorate to a **minimum of 0.6** before the deck has to be partially or fully re-painted.

### Question 2

Write down statement **a** ( directly above) using in the inequation (use teacher stimulus i) as a guide )

### Question 3

Write down statement **b** ( directly above) using in the inequation (use teacher stimulus ii) as a guide )

### Question 4

Using the formula  $\mu = \frac{F}{W}$  find the co-efficient of friction where  $F = 15 \text{ N}$  and  $W = 21 \text{ kg}$  correct to 1 decimal place.

### Question 5

Complete by rearranging the equation

maybe rewritten as  $F = \mu W$  or  $W = \frac{F}{\mu}$

Find either for each of the following cases.

i) if  $F = 10$  and  $W = 4.2$

ii) if

iii)  $W$  if

### Study the following example:

Using a force meter, what should the force (in Newtons) be when determining if the coefficient of friction meets the requirements of Navy?

For **new coatings**

$$\mu \geq 0.86$$

$$W = 15 \text{ kg}$$

$$F = ??$$

## MEASUREMENT

$$F \geq \mu w$$

$$F \geq 0.86 \times 15$$

$$F \geq 12.9 \text{ N}$$

i.e The Force required to stop slippage on this surface would be 12.9 N

### Question 6

- Based on the above if the Force meter read 12.3N would the co-efficient of Drag for **new** coatings be up to the Navy's requirement?
- If the force meter read 13.3 N would the co-efficient of Drag for **new** coatings be up to the Navy's requirement?

**Study the following example:**

### During service

$\mu \geq 0.6$  ( The co-efficient of Friction needs to be 0.6 during service)

$$W = 15 \text{ kg}$$

$$F = ??$$

$$F \geq \mu w$$

$$F \geq 0.6 \times 15$$

$$F \geq 9 \text{ N}$$

Therefore, if the force meter needs reads greater than or equal to **9 N** the flight deck can remain in service. If there are patches that read less than 9 N, the flight deck needs to be partially for fully repainted.

### Question 7

A force meter reads 8.5N, would that particular sample area still be serviceable for the helicopter to land or would the area require a **new coat** of paint?

### Question 8

A decision to repaint the entire deck depends on whether or not 4 out of the possible 28 areas pass the service criteria.

- What % is actually being tested?



## MEASUREMENT

b) If we test 3 areas and they pass the criteria for serviceability, but the next one fails and then the following area passes the test, what % of the total area has now been tested?

### Question 9

If the cost of testing 1 sample area is approximately \$120 and we need to test a minimum of 4 areas each time, find the total cost, if testing takes place twice a week over 8 weeks?

### Question 10

If you were the person testing the areas using the Force Meter, what two important force numbers in Newtons would you need to remember?