

The forces of model rocketry (Solutions)

Questions

- 1) Three forces predominantly act on a model rocket
 - a) Thrust
 - b) Drag
 - c) Gravity (weight)



If two rockets have the same type of engine inserted shouldn't they both launch to the same altitude? The answer to this question is Yes and No.

A model rocket is influenced by three forces, as mentioned above, during its flight. These are thrust of the rocket engine, the force of gravity and air resistance (drag) which both pull the model towards the ground.

So there are two forces trying to pull the rocket down, while

one force, thrust, must overcome these forces in order for the model to be propelled skyward.

It would, therefore, seem logical that if both rockets had identical engines that both rockets should travel to the same altitude (with all other things being equal). But the reason one rocket may travel higher is because differences in the drag force and also gravity (weight of the model).

Aerodynamic drag or simply, drag, is the resistance experienced by any object moving through air. All rockets have a drag force and it cannot be eliminated, but, can be reduced. Knowing what conditions or factors cause an increase in drag allow us to make rocket designs that will reduce this undesirable force so that the rocket can travel higher.

- i. How does the rocket create thrust?

The engine burns fuel to create hot gases that escape from the rear of the engine creating thrust that pushes the rocket skyward.

- ii. How does a rocket create drag?

As the rocket collides with air particles a force resisting the forward movement of the rocket is created known as drag.

- iii. How can the force of gravity be minimised?

By making the rocket lighter

- iv. What force or forces act against thrust?

Gravity and drag

- v. How does the force of drag change with the speed of the rocket?

As the rocket gets faster the air particles collide with greater force and frequency with the body of the rocket, especially the surfaces exposed at the top of the rocket, such as the nose cone.

- 2) Which of the three forces mentioned above is a contact force and which are non-contact forces?

Drag is a contact force because air particles need to collide with the surface of the rocket in order to create drag. Thrust is also a contact force because the exhaust gases collide violently with the walls of the engine to cause intense pressure to build up in the engine and therefore cause thrust. Gravity is a non-contact force. No two objects need to be in contact with each other for gravity to act on each object.

- 3) By shaping the nose cone, as shown on the right, the student building the rocket is trying to maximise the height reached by their rocket. Explain how?

Drag. By shaping the nose cone, as shown on the right, air particles flow around the cone rather than colliding with flat, exposed surfaces and so create less drag.



- 4) How do I know that an unbalanced force is acting on this rocket?

We know that an unbalanced force is acting if an object changes speed, direction or its shape. Here the rocket has changed speed from standing on the launch pad to accelerating skyward so we know that a force is acting on it.



- 5) Consider the 5 stages of a model rocket flight shown below.

- i. Shading the bar to show the intensity of each force during each stage of flight.
- ii. At which stage during flight is drag an unwanted force? Explain

During launch, stage 2, when the rocket is travelling at maximum speed, drag is a force that must be minimised. Drag is acting against thrust and preventing the rocket from achieving maximum speed and therefore altitude.

- iii. At which stage during flight is drag a welcomed and necessary force? Explain
- Stage 5. During descent when we need to slow the rocket down drag is a handy force to have. That is why parachutes are used, the bigger the parachute the greater the drag force created.*

