

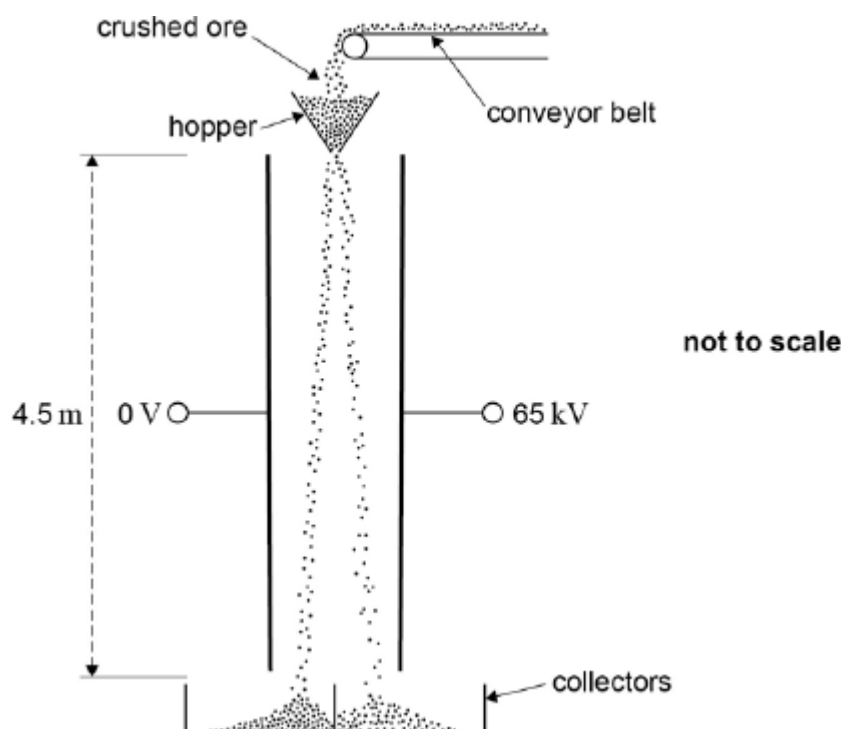
Name of the Student: _____

Max. Marks : 24 Marks

Time : 24 Minutes

Q1.

The figure below shows a system that separates two minerals from the ore containing them using an electric field.



The crushed particles of the two different minerals gain opposite charges due to friction as they travel along the conveyor belt and through the hopper. When they leave the hopper they fall 4.5 metres between two parallel plates that are separated by 0.35 m.

- (a) Assume that a particle has zero velocity when it leaves the hopper and enters the region between the plates.

Calculate the time taken for this particle to fall between the plates.

time taken = _____ s

(2)

- (b) A potential difference (pd) of 65 kV is applied between the plates.

Show that when a particle of specific charge $1.2 \times 10^{-6} \text{ C kg}^{-1}$ is between the plates its

horizontal acceleration is about 0.2 m s^{-2} .

(3)

- (c) Calculate the total horizontal deflection of the particle that occurs when falling between the plates.

horizontal deflection = _____m

(1)

- (d) Explain why the time to fall vertically between the plates is independent of the mass of a particle.

(2)

- (e) State and explain **two** reasons, why the horizontal acceleration of a particle is different for each particle.

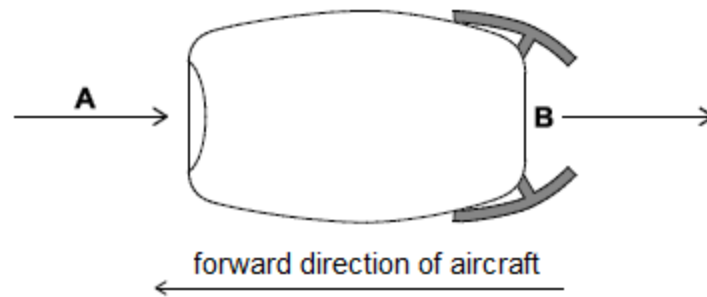
(4)

(Total 12 marks)

Q2.

Figure 1 shows a jet engine.

Figure 1



Air enters the engine at **A** and is heated before leaving **B** at a much higher speed.

- (a) State what happens to the momentum of the air as it passes through the engine.

(1)

- (b) Explain, using appropriate laws of motion, why the air exerts a force on the engine in the forward direction.

(3)

- (c) In one second a mass of 210 kg of air enters at **A**. The speed of this mass of air increases by 570 m s^{-1} as it passes through the engine.

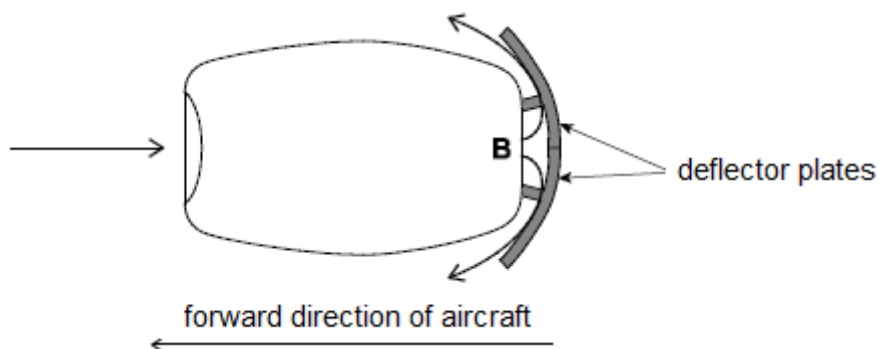
Calculate the force that the air exerts on the engine.

force = _____ N

(1)

- (d) When an aircraft lands, its jet engines exert a decelerating force on the aircraft by making use of deflector plates. These cause the air leaving the engines to be deflected at an angle to the direction the aircraft is travelling as shown in **Figure 2**.

Figure 2



The speed of the air leaving **B** is the same as the speed of the deflected air.

Explain why the momentum of the air changes.

(2)

- (e) The total horizontal decelerating force exerted on the deflector plates of the jet engines is 190 kN.

Calculate the deceleration of the aircraft when it has a mass of 7.0×10^4 kg.

deceleration = _____ m s^{-2}

(1)

- (f) The aircraft lands on the runway travelling at a speed of 68 m s^{-1} with the deflector plates acting.

Calculate the distance the aircraft travels along the runway until it comes to rest. You may assume that the decelerating force acting on the jet engines remains constant.

distance = _____ m

(2)

- (g) Suggest why in practice the decelerating force provided by the deflector plates may not remain constant.

(2)
(Total 12 marks)