O Level Combined Physics Structured

Forces Test 2.0

Q1

A skydiver, of mass 80 kg, jumps off from an air plane and falls towards the Earth at a constant speed for some time. He opens his parachute only at 12 s.
The speed time graph of the parachutist is shown in **Fig. 1**.

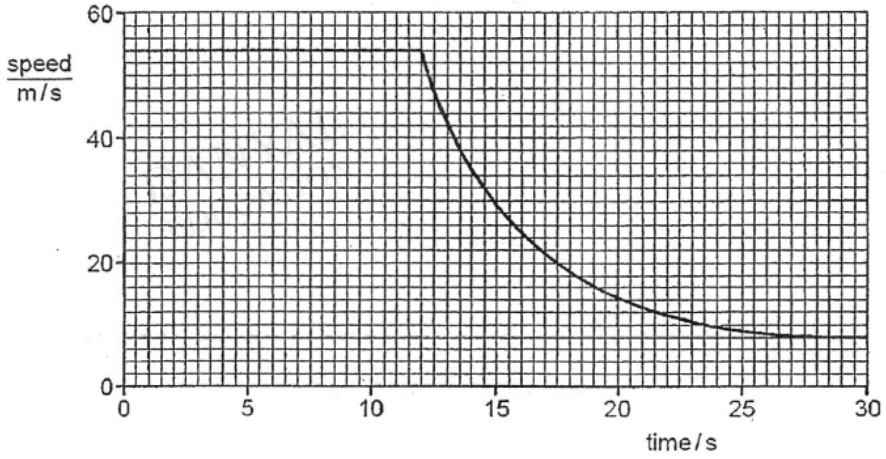


Fig. 1

a) The gravitational field strength g is 10 N/kg. Calculate the weight of the skydiver. [1]

weight = ... N

b) Calculate the height he falls from the plane before he opens his parachute. [2]

height = ... m

c) Determine the air resistance acting on the skydiver for the first 12 seconds. Explain your answer. [2]

.....

.....

.....

d) Describe his motion after he opens his parachute. [1]

.....

Q2

A hovercraft moves on a cushion of air which is trapped underneath it, as shown in Fig. 2. The trapped air reduces friction.

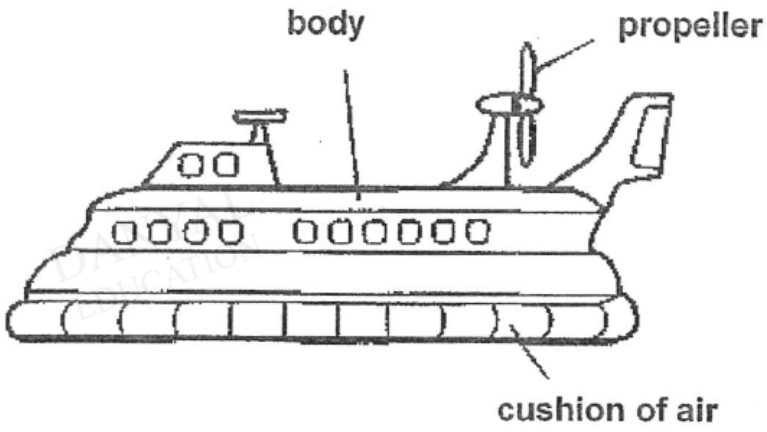


Fig. 2

(a) The hovercraft starts from rest and, as it starts, the propeller produces a forward force F of 22 000 N. The mass of the hovercraft is 25 000 kg.

Calculate the initial acceleration of the hovercraft. You may assume there is no friction.

acceleration = ...[2]

(b) Some time later, the hovercraft reaches a steady speed, even though the force **F** is unchanged.

Suggest in terms of the forces acting on the hovercraft, why the speed is now constant.

.....

.....

.....[2]

Q3

Fig. 3.1 shows the total forces acting forward and backward on a car at different times **X**, **Y** and **Z** during a journey. In each case, the car is moving forward. The mass of the car is 1000 kg.

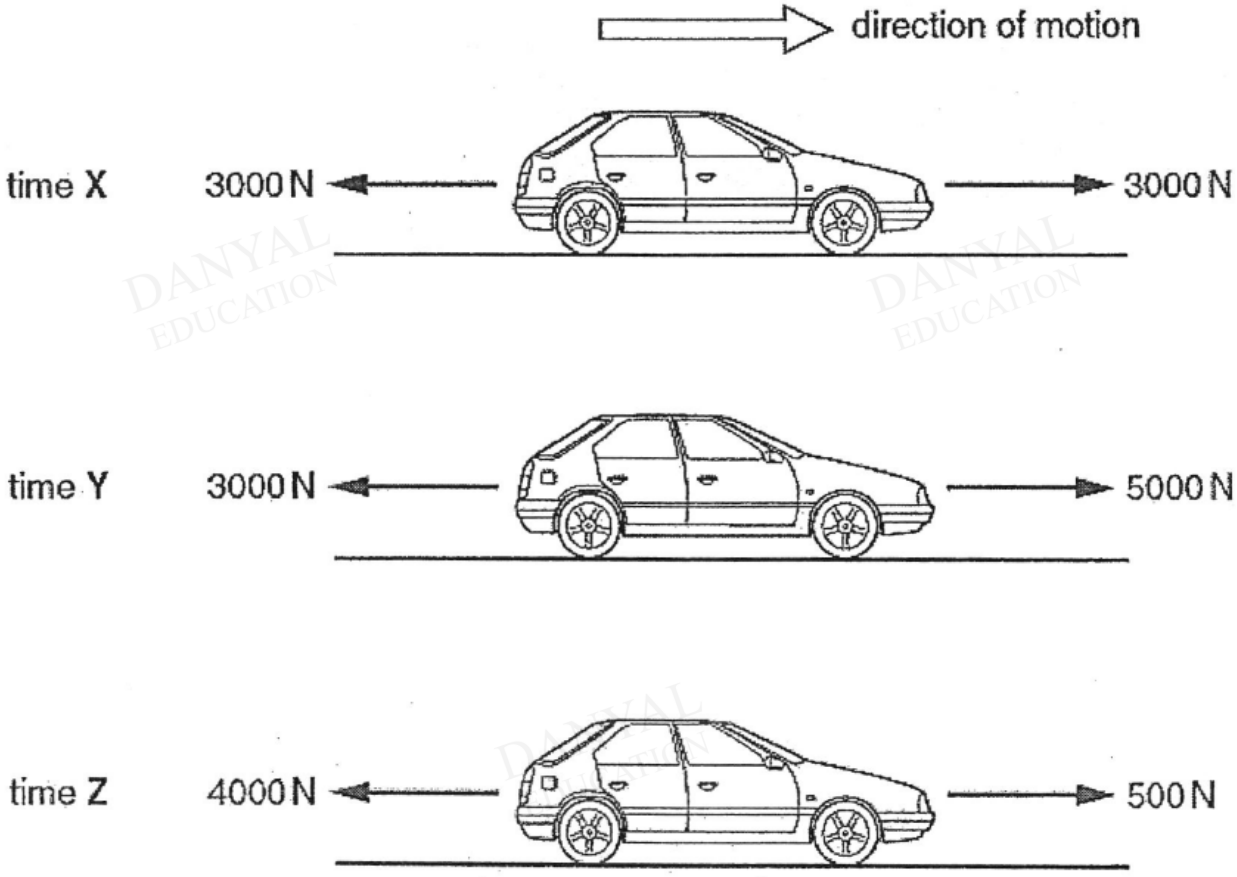


Fig. 3.1

(a) State the name of **one** of the forces that is acting in the opposite direction to the motion of the car.

..... [1]

(b) State whether the speed of the car is changing at time **X**. Explain your answer.

.....

.....

..... [2]

(c) State whether the speed of the car at time **Z** is increasing, decreasing or constant. Explain your answer.

.....

.....

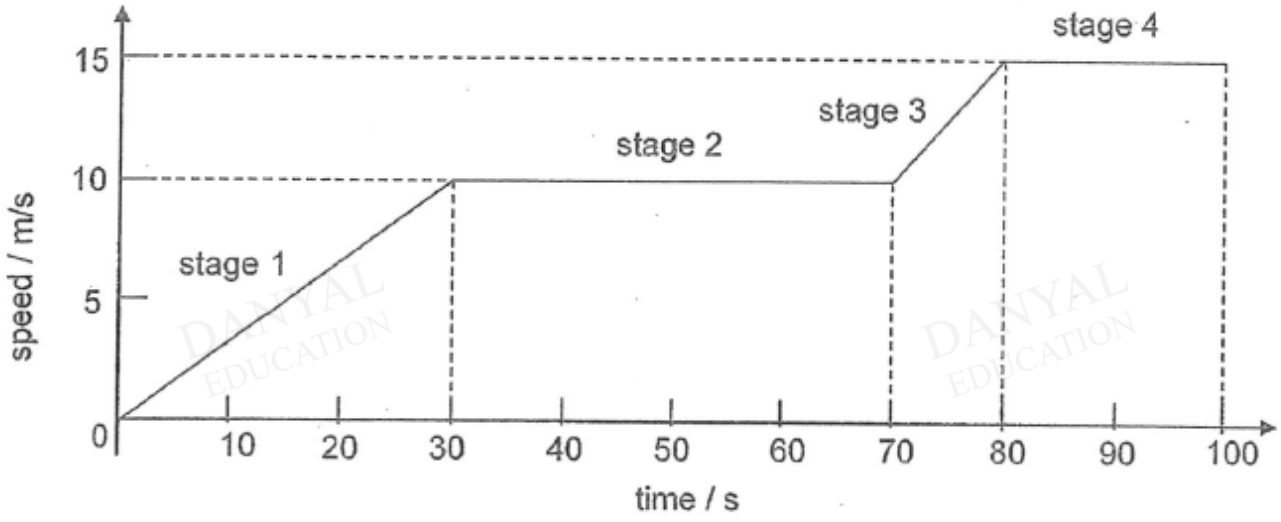
..... [2]

(d) Calculate the acceleration of the car at time Y.

acceleration = ... m/s^2 [2]

Q4

A motor car of mass 500 kg travels along a straight level road. The speed-time graph of its motion is shown below.



(a) Calculate the greatest acceleration of the car.

greatest acceleration = ... [2]

(b) What is the resultant force acting on the car when it was at its greatest acceleration?

resultant force = ... [2]

(c) Calculate the greatest kinetic energy of the car.

greatest kinetic energy = ... [2]

(d) What is the resultant force acting on the car in stage 2?

..... [1]

(e) While travelling at its greatest speed, the driver applies the brakes in an emergency stop. The average braking force on the car is 2 000 N. Calculate the stopping distance.

stopping distance = ... [2]

(f) If the car was full of passengers, so that its mass was doubled, how would this affect the stopping distance of the car if the braking force remained constant at 2000 N? You can assume that the driver applied the brakes while it was travelling at the same greatest speed as in part **(e)**.

..... [1]

Q5

Richard wants to find out how much frictional force his 1500 kg truck experiences while travelling on a level road.

He drives his truck along the level road and turns off his engine when the truck reaches the speed of 8.0 m / s, and finds that the truck was able to slow down to 7.0 m / s over a distance of 15 m.

(a) Find the time taken for the truck to slow down from 8.0 m / s to 7.0 m / s.

time taken = ... s [2]

(b) Calculate the deceleration of the truck.

deceleration = ... m / s^2 [2]

(c) Find the frictional force acting on the truck.

frictional force = ... N [2]

Answers

Forces Test 2.0

Q1

a) W = mg = 80 x 10 = 800 N [1]

b) Height = area under the graph = 54 x 12[1] = 648 m [1]

c) Air resistance = 800N. [1]
Since the speed is constant means the acceleration is zero and the resultant force is zero. So weight acting downwards = air resistance. [1]

d) The diver experience decreasing deceleration. [1]

Q2

(a)	F = ma 22 000 = 25 000 x a a = 0.88 m/s^2	[1] [1]
(b)	As the speed of the hovercraft increases, the air resistance also increases. When the magnitude of the air resistance is equal to the applied force, there will be no resultant force acting on the hovercraft and it will move with constant speed.	[1] [1]

Q3

(a) Either air resistance or friction between the tyres and the ground	1
(b) The net or resultant force is zero. Since F = m x a, acceleration = 0 and the speed is constant	1 1
(c) The net or resultant force opposes the motion. So, the car is decelerating or speed is decreasing.	1 1
(d) F = m x a (5000 – 3000) = 1000 x a a = 2 m/s^2	1 1

Q4

(a)	Greatest acceleration = (v-u)/t = (15 – 10) / 10 = 0.5 m/s^2	 1 1
(b)	Resultant force = ma = 500 x 0.5 = 250 N	 1 1
(c)	Greatest K.E. = ½ mv^2 = ½ (500)(15)^2 = 56300 J	 1 1
(d)	0 N	
(e)	Work Done = F x d 56250 = 2 000 x d d = 28.1 m	 1 1
(f)	The stopping distance of the car will be **doubled.** (do not accept increase)	1
		1

Q5

a	Distance Travelled = Area under graph (award mark if student is able to state formula for area) 15 m = ½ x (7.0 m / s + 8.0 m / s) x t t = 2.0 s	[1] [1]
b	a = △v / △ t (do not accept d = – △v / △ t) a = (7.0 m / s - 8.0 m / s) / 2.0 s a = - 1.0 m / s / 2.0 s a = - 0.50 m / s^2 deceleration = 0.50 m / s^2	[1] [1]
c	Frictional Force = mass x deceleration (accept F = m x a) F = m x a F = 1500 kg x 0.5 m / s^2 F = 750 N	[1] [1]