O Level Combined Physics Structured

Forces Test 1.0

Q1

Pail A is filled with sand and is hung on a long string close to the surface of the Earth. An identical pail B is filled with the same mass of sand and hung in the same way, with the same length of string, close to the surface of the Moon.

To start each pail moving, both pails are given a sideways push with forces F_E and F_M as shown in Fig. 2.1.

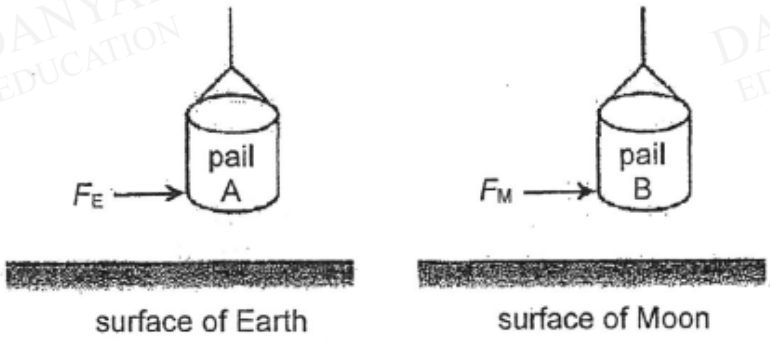


Fig. 2.1

(a) State which pail moves more easily when pushed.

.....[1]

(b) Hence, explain whether there will be any difference in the magnitudes of F_E and F_M.

.....

.....

.....

.....[2]

Q2

A man pushes a bobsleigh with some occupants along an ice track at a constant speed of 5.0 ms^{-1} for 30 s. The forces acting on the bobsleigh are shown in Fig. 10.1. The frictional force is constant throughout the entire ice track. When the man stops pushing, the bobsleigh decelerates uniformly and comes to a rest after 20 s.

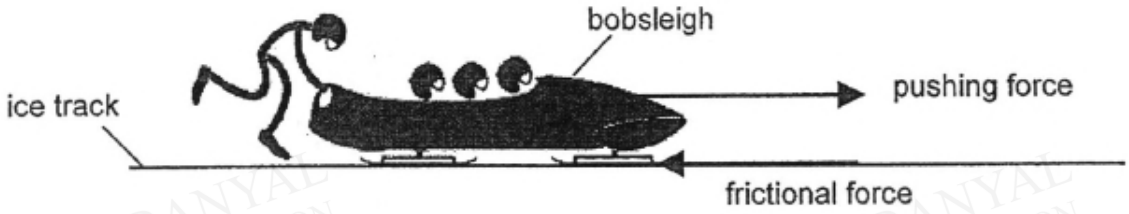


Fig. 10.1

(a) Explain, in terms of forces, why the bobsleigh is travelling at a constant speed initially.

.....

.....

.....

.....[2]

(b) Explain why the bobsleigh comes to a stop after some time.

.....

.....

.....

.....[2]

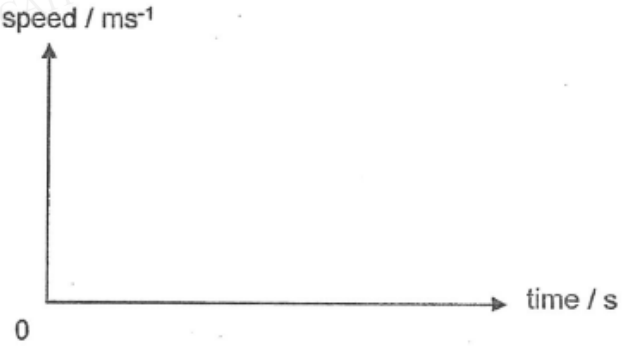
(c) Calculate the deceleration of the bobsleigh.

deceleration = ...[2]

(d) Hence, calculate the magnitude of the frictional force. The total mass of the bobsleigh and its occupants is 250 kg.

frictional force = ...[2]

(e) On the axes below, sketch the speed-time graph of the bobsleigh for the entire 50 s period.



[2]

Q3

A car of mass 1.5 x 10^3 kg accelerates uniformly from rest to 20 m/s in 8.0 s.

(a) Calculate the resultant force on the car.

resultant force = _____ N [2]

(b) Calculate the distance travelled by the car.

distance = _____ m [2]

(c) Calculate the work done on the car by the resultant force in (a).

work done = _____ J [2]

Q4

Fig 3.1 shows a rocket that has just launched and the forces acting on it.

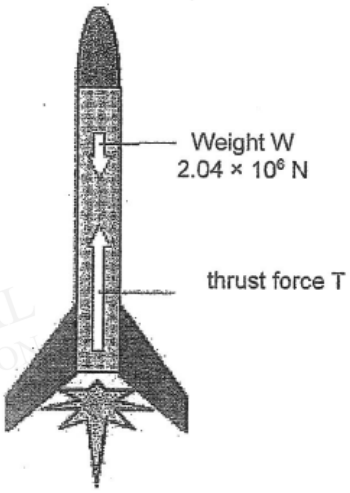


Fig 3.1

(a) The rocket has an acceleration of 15 m/s^2 at the instant shown. Calculate the net force acting on the rocket.

net force = ...N [1]

(b) Hence calculate the upward thrust T acting on the rocket at the instant shown.

T = ... N [2]

(c) As the rocket accelerates, the air resistance that opposes the rocket motion increases. Describe and explain the effect of this on the acceleration of the rocket.

.....

.....

.....

..... [2]

Q5

Fig. 2.1 shows the speed-time graph for the first 120 s of the journey of a lorry.

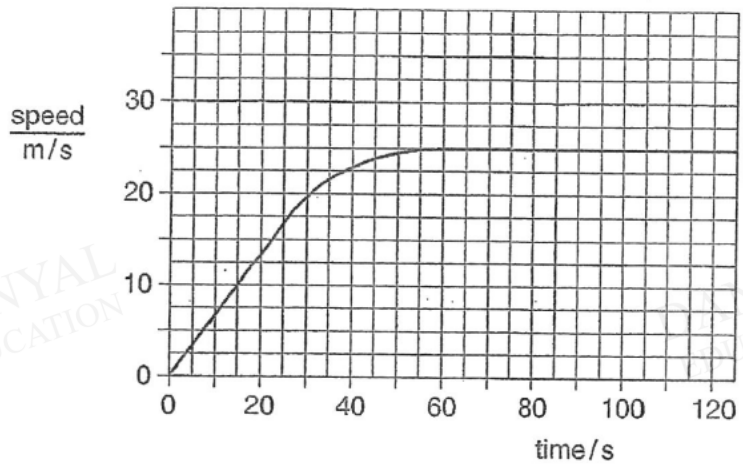


Fig. 2.1

(a) Describe the acceleration of the lorry during this period.

.....

.....

.....[2]

(b) The mass of the lorry is 5 000 kg. Calculate the resultant force on the lorry during the first 15 s.

resultant force = ... [2]

Answers

Forces Test 1.0

Q1

(a) Both pails move just as easily (or Both pails move equally easily). B1

(b) Both pails have the same mass and same inertia. B1

Hence both F_E and F_M have the same magnitude. B1

Or both pail needs the same amount of force to start moving.

Q2

(a) The pushing force is equal to the frictional force, B1

Hence the resultant force acting on the bobsleigh is zero. B1

(b) When the pushing force is removed, B1

and friction opposes motion of the bobsleigh. B1

Hence, it decelerates and comes to a stop after some time.

(c) $a = \frac{v - u}{t}$

$= \frac{0 - 5}{20}$ C1

$= -0.25\ m/s^2$

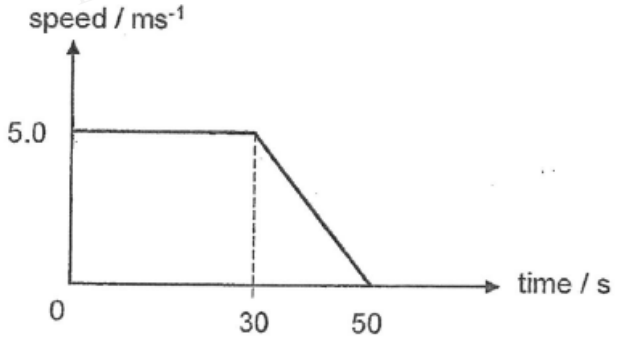
Deceleration = $0.25\ m/s^2$ A1

(d) $F = ma$

$= 250 \times 0.25$ Allow ECF from (c) C1

$= 62.5\ N$ A1

(e)



Award 1 mark for the correct shapes for both sections of the graph.

Award 1 mark for having the correct times and speeds.

Q3

A car of mass 1.5 x 10^3 kg accelerates uniformly from rest to 20 m/s in 8.0 s.

(a) Calculate the resultant force on the car.

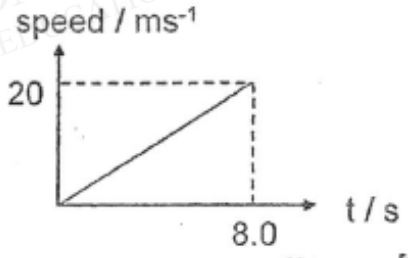
a = (v-u) / t
= (20 – 0) / 8
= 2.5 m/s² [M1]

F = ma
= 1.5 x 10^3 x 2.5
= **3750 N** [A1]

resultant force = _____ N [2]

(b) Calculate the distance travelled by the car.

distance = area under the speed-time graph
= ½ (v) (t)
= ½ x 20 x 8 [M1]
= **80 m** [A1]



distance = _____ m [2]

(c) Calculate the work done on the car by the resultant force in (a).

work done, W = force x distance
= 3750 x 80 [M1: force is from (a) / distance is from (b)]
= **300 000 J** [ECF1]

work done = _____ J [2]

Q4

a	Net force F_{net}= ma = (2.04 X 10^5)(15) = 3.06 X 10^6 N	1
b	T – W = F_{net} T = W + F_{net} = 2.04 X 10^6 + 3.06 X 10^6 = 5.1 X 10^6 N	1 1
c	Acceleration decreases As $\underline{F_{net}}$ = T – W – R And as R increases, $\underline{F_{net}}$ decreases	1 1

Q5

a Uniform/ constant acceleration at first and it decreases to zero

b a = (v-u)/t
= 10/ 15
= 0.667 m/s^2 or 0.67 m/s^2

F = ma
= 5 000 x 0.67
= 3 330 N or 3 300 N

Accept 3 350 N or 3 340 N