2 **(a)** Define acceleration.

.....

..... [1]

(b) A train has a total mass of 520 000 kg. The train accelerates at 1.1 m/s^2.

(i) Calculate the time taken for the train to increase its speed from 15 m/s to 28 m/s.

time = ... [2]

(ii) Calculate the force required to produce an acceleration of 1.1 m/s^2 for this train.

force = ... [2]

(iii) The train uses electric motors.

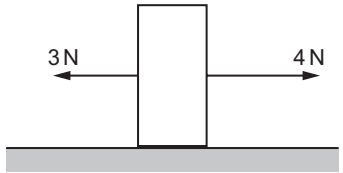
Explain why the force on the train due to the motors is greater than the value calculated in **(ii)**.

.....

..... [1]

[Total: 6]

2 The diagram shows a solid object on a flat surface, with two forces acting on the object.



What is the resultant force on the object?

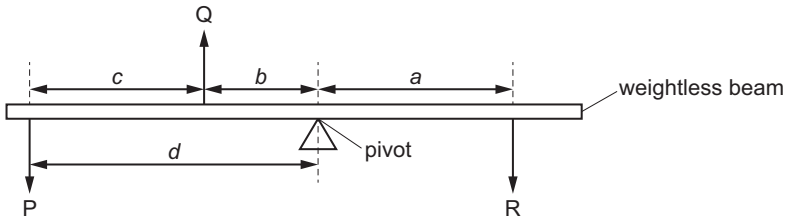
A 1 N to the left

B 1 N to the right

C 7 N to the left

D 7 N to the right

6 A weightless beam is balanced on a pivot as shown. Forces P, Q and R act on the beam.



Which equation is correct?

A $(P \times c) + (Q \times b) = (R \times a)$

B $(P \times c) - (Q \times b) = (R \times a)$

C $(P \times d) + (Q \times b) = (R \times a)$

D $(P \times d) - (Q \times b) = (R \times a)$

1 **(a)** Fig. 1.1. is a speed–time graph for the first 5 minutes of a bus journey.

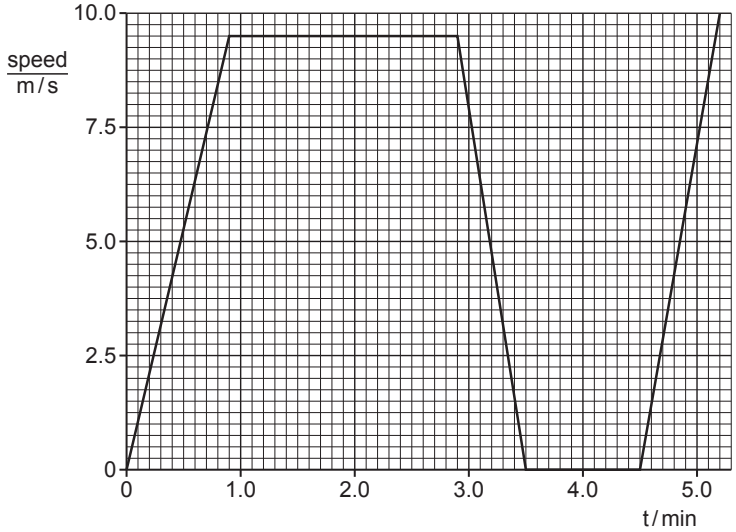


Fig. 1.1

Describe the motion between:

1. t = 0.90 min and t = 2.9 min .....

2. t = 2.9 min and t = 3.5 min .....

3. t = 3.5 min and t = 4.5 min .....

[3]

(b) Another bus travels at a speed of 8.9 m/s. The brakes apply a constant force and the bus stops in a distance of 23 m. This bus has a mass of 18 000 kg.

(i) Calculate the kinetic energy of the bus before the brakes are applied.

kinetic energy = ... [2]

(ii) Calculate the force applied to stop the bus.

force = ... [3]

[Total: 8]

2 **(a)** Define impulse.

.....

..... [1]

(b) Fig. 2.1 shows a rocket and its exhaust gases.

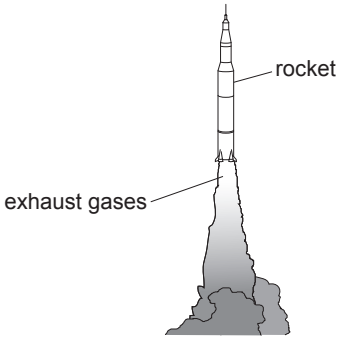


Fig. 2.1

The exhaust gases are emitted from the rocket with a velocity of 1400 m / s and at a rate of 2800 kg / s.

(i) Show that the force exerted on the rocket by the exhaust gases is 3900 kN.

State the equation you use.

[2]

(ii) Calculate the maximum mass that this force can lift from the ground. Ignore air resistance.

maximum mass = ... [3]

5

[Total: 6]