Forces (F= ma/ Resultant forces)

Question Paper 2

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	General Physics
Sub-Topic	Forces F=m/a/ Resultant forces
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 2

Time Allowed: **82 minutes**

Score: **/68**

Percentage: **/100**

1 Fig. 3.1 shows an oil tank that has a rectangular base of dimensions 2.4 m by 1.5 m.

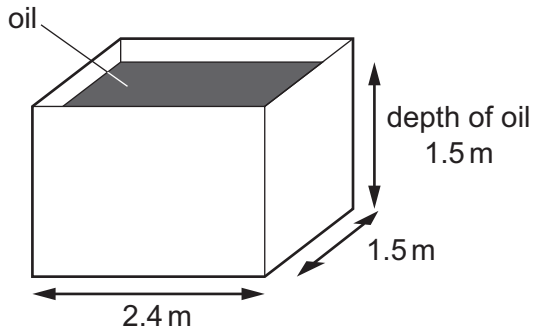

Fig. 3.1

The tank is filled with oil of density 850 kg / m^3 to a depth of 1.5 m.

(a) Calculate

(i) the pressure exerted by the oil on the base of the tank,

pressure = ... [2]

(ii) the force exerted by the oil on the base of the tank.

force = ... [2]

(b) The force calculated in **(a)(ii)** is the weight of the oil.

Calculate the mass of oil in the tank.

mass = ... [1]

(c) When he is checking the level of oil in the tank, a man drops a brass key into the oil and it sinks to the bottom of the oil.

(i) State what this shows about the density of brass.

..... [1]

(ii) Explain how attaching the key to a piece of wood could prevent the key from sinking.

.....

.....

..... [1]

[Total: 7]

2 **(a)** Figs. 1.1 and 1.2 show speed-time graphs for two objects, each moving in a straight line.

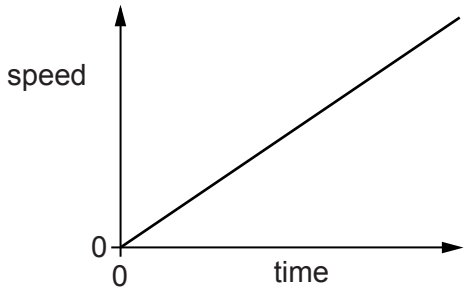

Fig. 1.1

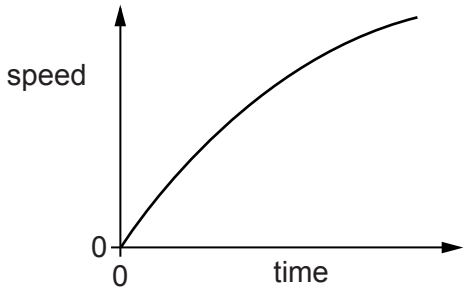

Fig. 1.2

(i) Describe the motion of the object shown by the graph in Fig. 1.1.

.....

.....

(ii) Describe the motion of the object shown by the graph in Fig. 1.2.

.....

.....

[3]

(b) On a day with no wind, a large object is dropped from a tall building. The object experiences air resistance during its fall to the ground.

State and explain, in terms of the forces acting, how the acceleration of the object varies during its fall.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

3 Fig. 1.1 shows a rocket-powered sled travelling along a straight track. The sled is used to test components before they are sent into space.

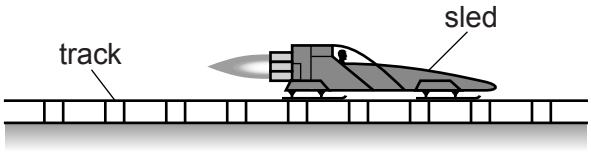

Fig. 1.1

Fig. 1.2 is the speed-time graph for the sled from time $t = 0$ s.

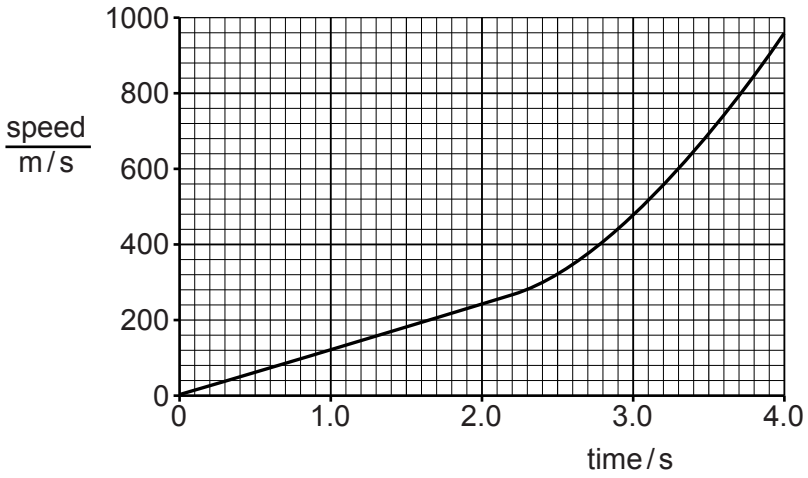

Fig. 1.2

(a) On Fig. 1.2, mark a point labelled P to indicate a time when the acceleration of the sled is not constant. [1]

(b) **(i)** Calculate the acceleration of the sled at $t = 1.0$ s.

acceleration = ...[2]

(ii) Determine the distance travelled by the sled between $t = 1.0$ s and $t = 2.0$ s.

distance = ...[2]

(c) The resultant force acting on the sled remains constant during the test.

Suggest why the acceleration of the sled is not constant.

.....

.....[1]

[Total: 6]

4 **(a)** **(i)** Mass is a scalar quantity.

State another scalar quantity.

.....

(ii) Force is a vector quantity.

State another vector quantity.

.....
[2]

(b) A boat is floating on still water.

The mass of the boat is 290 000 kg. A resultant force of 50 kN acts on the boat.

Calculate the acceleration of the boat.

acceleration = ...[3]

(c) Fig. 2.1, not to scale, shows the view from above of the boat, now on a fast-flowing river. The boat accelerates.

Two forces are shown acting on the boat. The resultant of these forces is at right angles to the river banks.

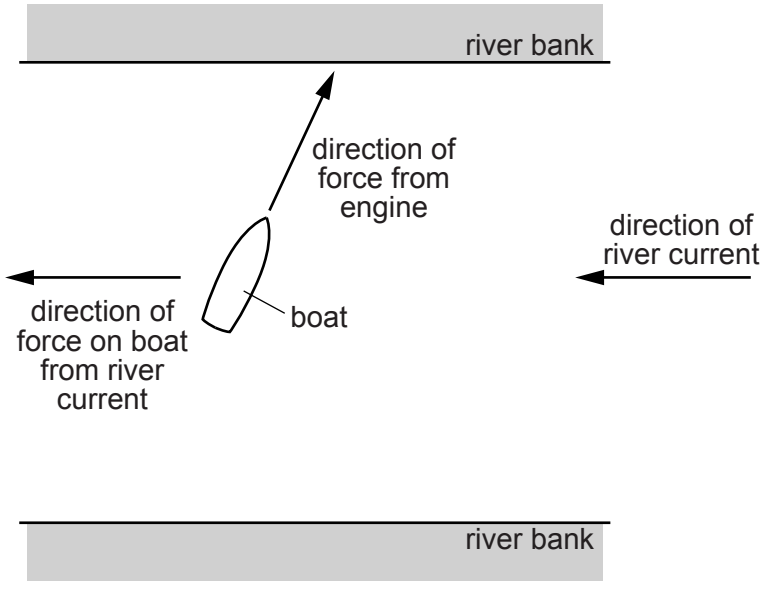

Fig. 2.1 (not to scale)

Fig. 2.2 is an incomplete vector diagram of the forces acting on the boat.

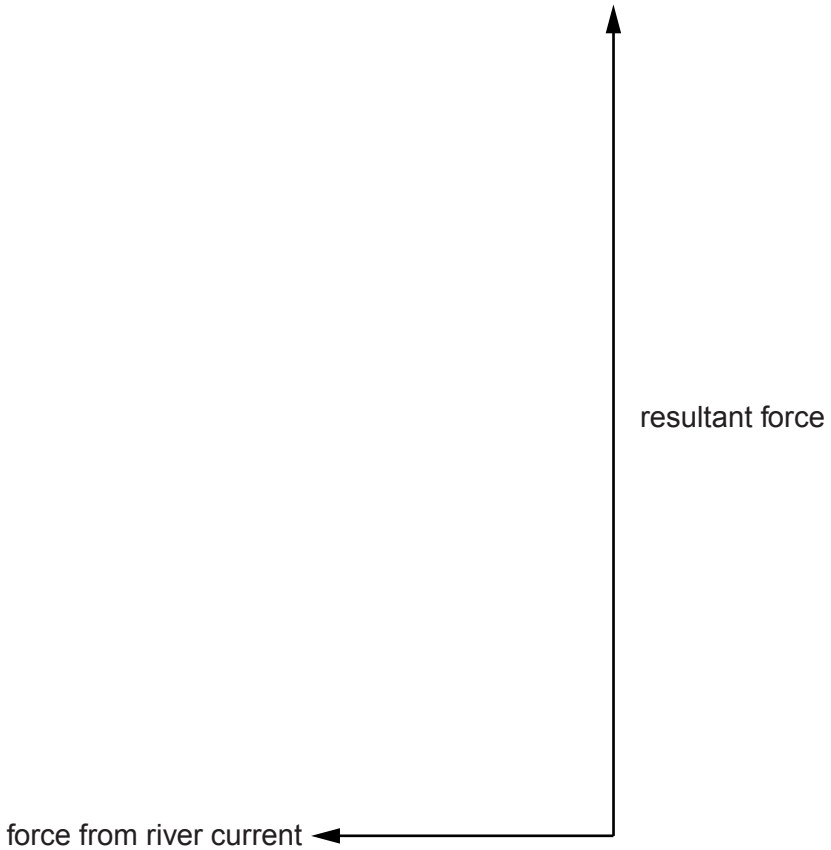

Fig. 2.2

The force from the river current is 80 kN.

(i) Determine the scale that has been used in the vector diagram.

scale is .....

(ii) On Fig. 2.2, complete the vector diagram to determine the magnitude and direction of the force from the engine. Measure the angle between the direction of the current and the force from the engine.

magnitude of force from engine = ...

angle = ...

[4]

[Total: 9]

5 Fig. 3.1 shows part of the extension-load graph for a spring.

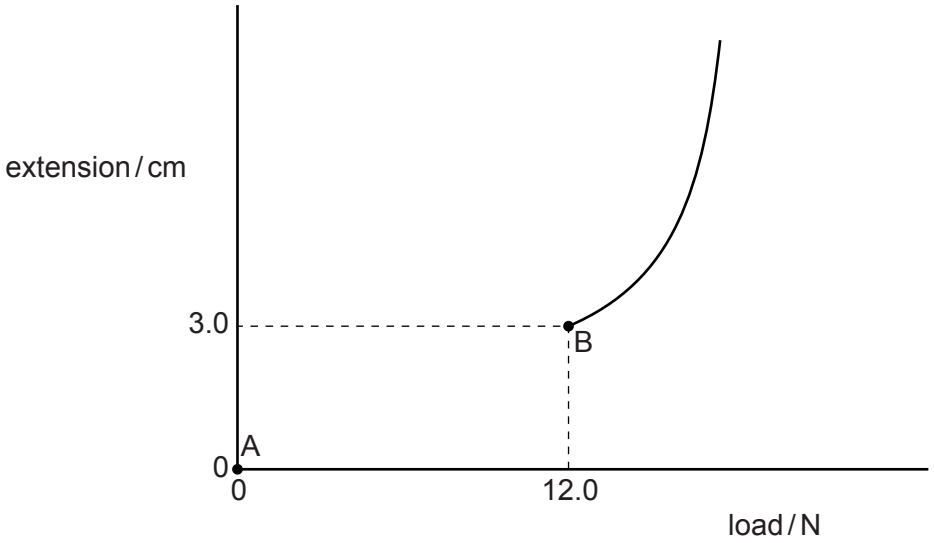

Fig. 3.1

The spring obeys Hooke's law between points A and B.

(a) (i) On Fig. 3.1, complete the graph between A and B. [1]

(ii) State the name of point B.

.....[1]

(b) The average value of the load between A and B is 6.0 N.

Calculate the work done in extending the spring from A to B.

work done = ...[2]

(c) The spring has an unstretched length of 4.0 cm.

An object is hung on the spring and the spring length increases from 4.0 cm to 6.0 cm.

(i) Calculate the mass of the object.

mass = ...[3]

(ii) The object is immersed in a liquid but remains suspended from the spring.

The liquid exerts an upward force on the object and the length of the spring decreases to 5.0 cm.

Calculate the upward force exerted on the object by the liquid.

upward force = ...[2]

[Total: 9]

6 **(a)** A solenoid connected to a battery produces a magnetic field. The wires are then connected to the battery terminals the other way round.

Tick **one** box in the table to indicate the effect on the magnetic field.

decreases but not to zero	
decreases to zero	
reverses direction	
increases	
stays the same	

[1]

(b) Fig. 7.1 shows a top view of two bar magnets and a vertical rigid conducting rod carrying a current. The direction of the current in the rod is coming **out of the paper**.

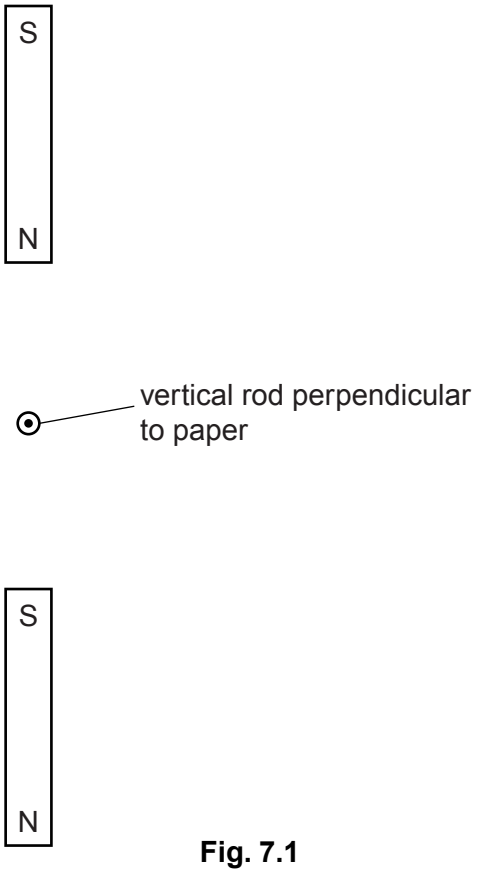

Fig. 7.1

(i) On Fig. 7.1, draw a single line with an arrow to show the direction of the magnetic field due to the bar magnets at the position of the rod. [2]

(ii) State the direction of the force exerted on the vertical rod.

..... [2]

(c) The rod has a mass of 350 g and the resultant force acting on the rod is 0.21 N. The rod is free to move.

Calculate the initial acceleration of the rod.

acceleration = ... [2]

[Total: 7]

7 Parachutes are used to slow down a certain racing car.

Fig. 1.1 shows the racing car, of total mass 750 kg, slowing down by using parachutes.

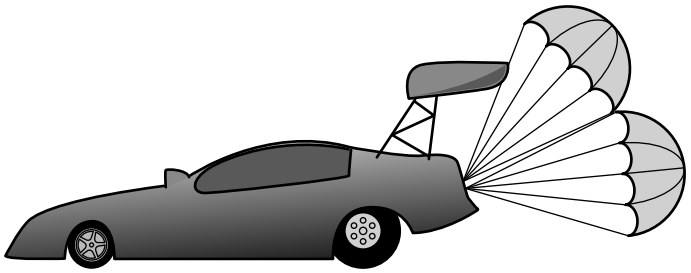

Fig. 1.1

Fig. 1.2 is the speed-time graph for 20 s after the car reaches full speed.

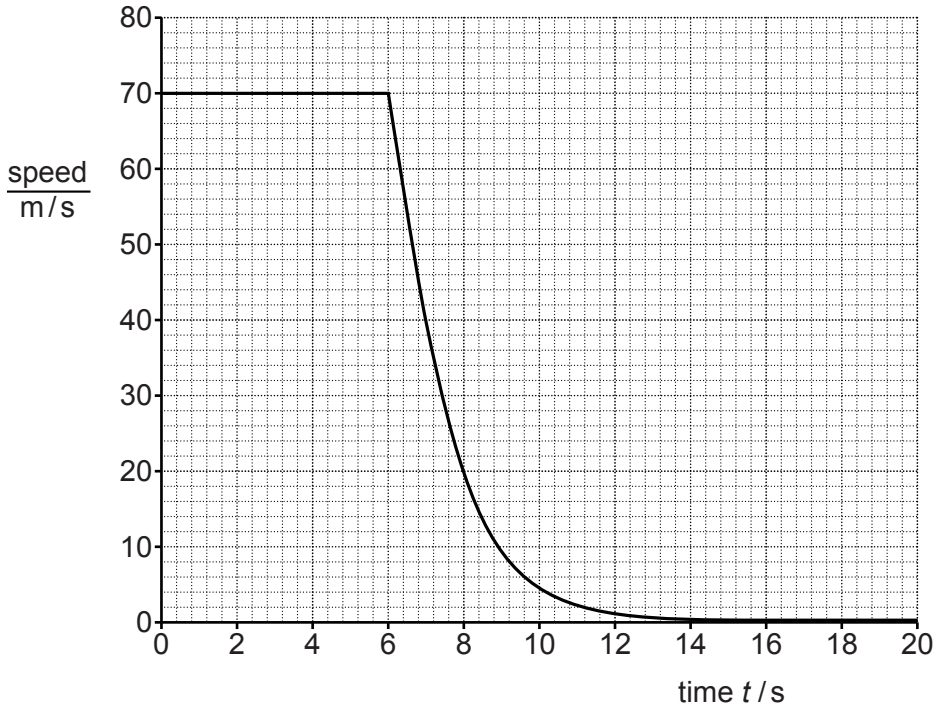

Fig. 1.2

At time t = 6.0 s, the parachutes open.

(a) On Fig. 1.2,

(i) mark a point, labelled A, where the car is moving at constant speed,

(ii) mark a point, labelled B, where the car is decelerating at a uniform rate,

(iii) mark a point, labelled C, where the car is decelerating at non-uniform rate.

[3]

(b) Calculate

(i) the deceleration of the car at time t = 6.5 s,

deceleration = ... [2]

(ii) the resultant force acting on the car at this time.

resultant force = ... [2]

(c) Explain why there is no resultant force acting on the car at time t = 4.0 s.

.....

..... [1]

[Total: 8]

8 A diver climbs some steps on to a fixed platform above the surface of the water in a swimming-pool. He dives into the pool. Fig. 2.1 shows the diver about to enter the water.

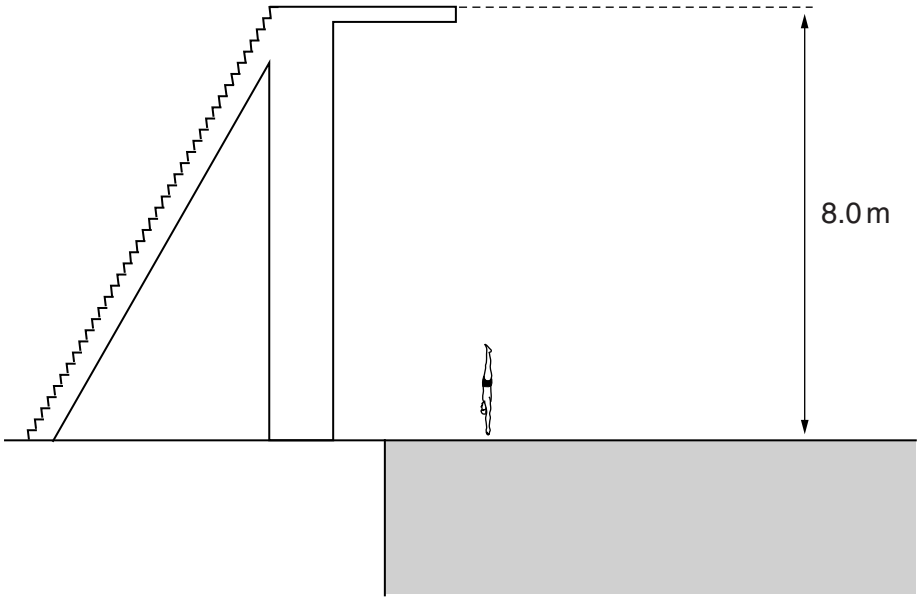

Fig. 2.1

The mass of the diver is 65 kg. The platform is 8.0 m above the surface of the water.

(a) Calculate

(i) the increase in the gravitational potential energy of the diver when he climbs up to the platform.

increase in gravitational potential energy = ...[1]

(ii) the speed with which the diver hits the surface of the water. Ignore any effects of air resistance.

speed = ...[4]

(b) In another dive from the same platform, the diver performs a somersault during the descent. He straightens, and again enters the water as shown in Fig. 2.1.

Discuss whether the speed of entry into the water is greater than, less than or equal to the speed calculated in **(a)(ii)**. Ignore any effects of air resistance.

.....

.....

.....

.....[3]

[Total: 8]

9 A train has a total mass of 7.5×10^5 kg.

(a) The train accelerates from rest at a constant rate along a straight, horizontal track. It reaches a speed of 24 m/s in 60 s.

Calculate

(i) the train's acceleration,

acceleration = ... [2]

(ii) the resultant force acting on the train.

force = ... [2]

(b) The train now travels with a constant speed of 24 m/s along a straight, horizontal track. The total force opposing the motion due to friction and air resistance is 7.2×10^4 N.

(i) By considering the work done by the train's engine in 1.0 s, calculate its output power.

power = ... [2]

(ii) The train begins to travel up a slope.

Explain why the power of the train's engine must be increased to maintain the speed of 24 m/s.

.....

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.....

.....

..... [3]

[Total: 9]