[1. Motion]

3 Fig. 1.1 is a distance / time graph showing the motion of an object.

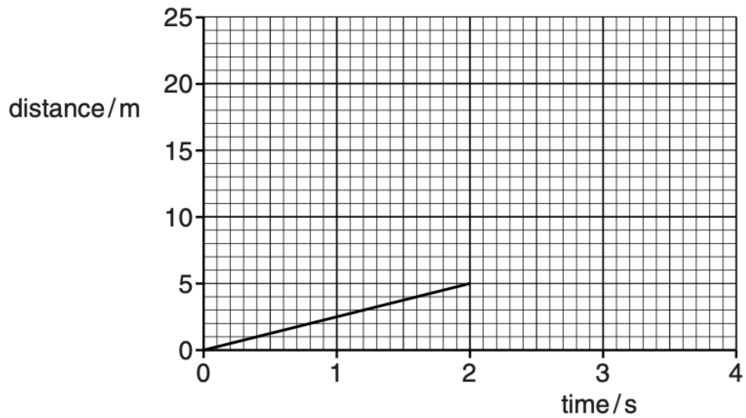

Fig. 1.1

(a) **(i)** Describe the motion shown for the first 2 s, calculating any relevant quantity.

....

.... [2]

(ii) After 2 s the object accelerates.

On Fig. 1.1, sketch a possible shape of the graph for the next 2 s. [1]

(b) Describe how a distance / time graph shows an object that is stationary.

....

.... [1]

(c) Fig. 1.2 shows the axes for a speed/time graph.

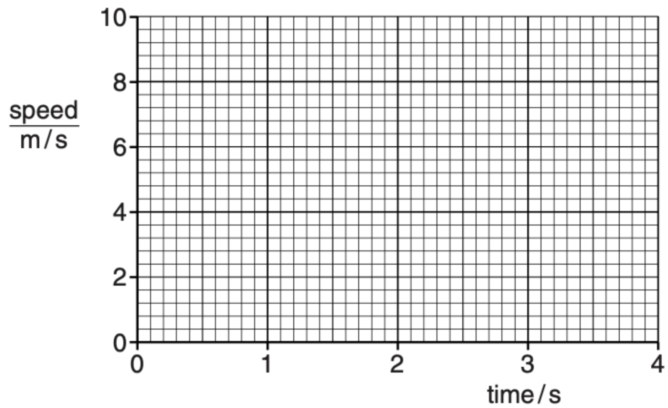

Fig. 1.2

On Fig. 1.2, draw

(i) the graph of the motion for the first 2 s as shown in Fig. 1.1,

(ii) an extension of the graph for the next 2 s, showing the object accelerating at 2 m/s^2.
[3]

(d) Describe how a speed/time graph shows an object that is stationary.

....

.... [2]

[Total: 9]

[2. Momentum]

14 Fig. 2.1 shows a dummy of mass 70 kg used in a crash test to investigate the safety of a new car.

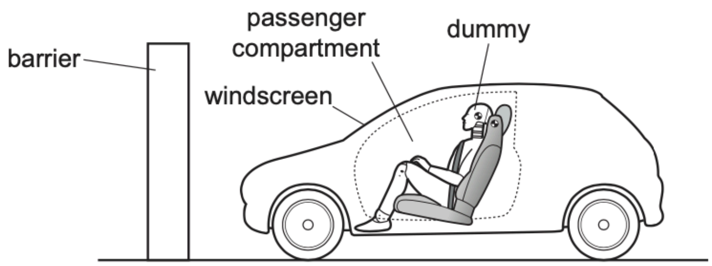

Fig. 2.1

The car approaches a solid barrier at 50 km/hr. It crashes into the barrier and stops suddenly.

(a) **(i)** Calculate the momentum of the dummy immediately before the crash.

momentum = ... [2]

(ii) Determine the impulse that must be applied to the dummy to bring it to rest.

impulse = ... [1]

(b) In the crash test, the passenger compartment comes to rest in 0.30s.

Calculate the deceleration of the passenger compartment.

deceleration = ... [2]

(c) The seat belt and air bag bring the dummy to rest so that it does not hit the windscreen. The dummy has an average deceleration of 25 m/s^2.

Calculate the average resultant force applied to the dummy, of mass 70 kg.

force = ... [2]

(d) The deceleration of the dummy is less than the deceleration of the passenger compartment.

Explain why this is of benefit for the safety of a passenger.

....

....

....

....

....

.... [2]

[Total: 9]

[3.Moment]

2. Fig. 2.1 shows apparatus for investigating moments of forces.

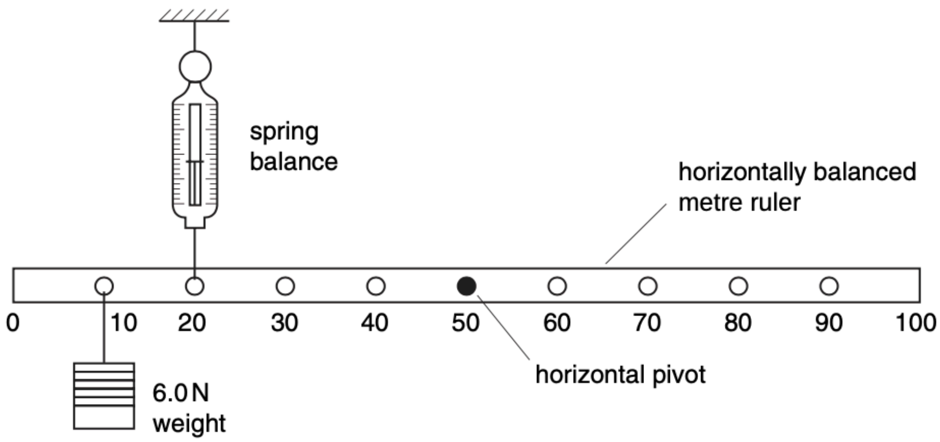

Fig. 2.1

The uniform metre ruler shown in Fig. 2.1 is in equilibrium.

(a) Write down two conditions for the metre ruler to be in equilibrium.

condition 1 ....

....

....

condition 2 ....

....

.... [2]

(b) Show that the value of the reading on the spring balance is 8.0 N. [2]

(c) The weight of the uniform metre ruler is 1.5N.

Calculate the force exerted by the pivot on the metre ruler.

magnitude of force = ...

direction of force .... [2]

[4. Hooke's Law]

5 **(a)** State Hooke's law.

....

.... [1]

(b) Fig. 5.1 shows the extension–load graph for a spring.

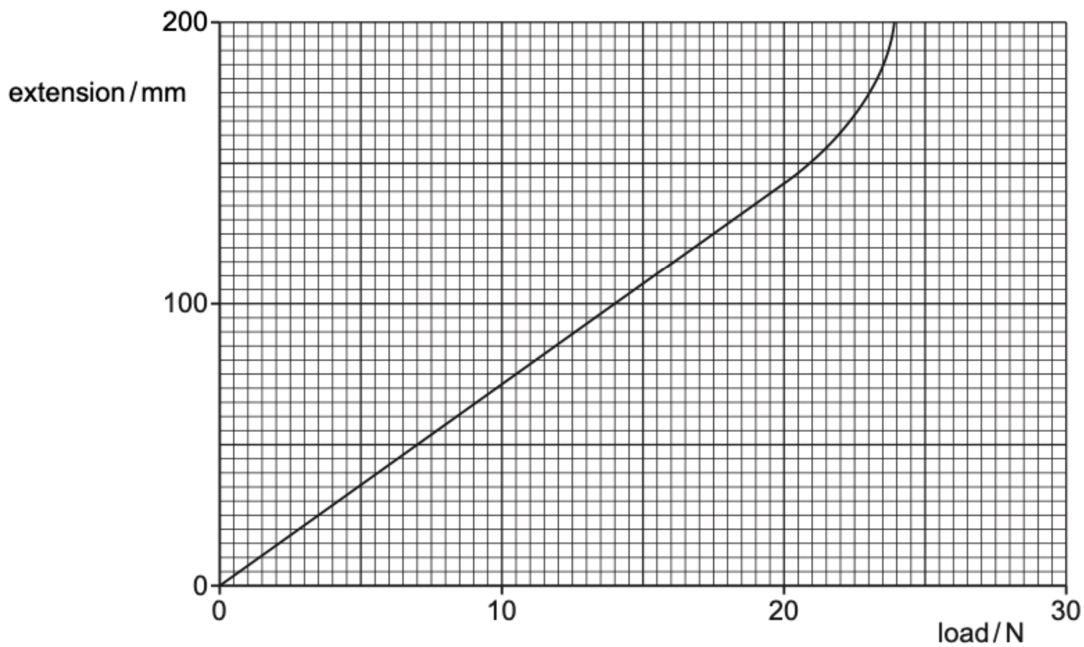

Fig. 5.1

(i) On Fig. 5.1, mark and label the region where the spring obeys Hooke's law. [1]

(ii) Calculate the spring constant k.

k = ... [2]

(iii) The original length of the spring is 120 mm.

Calculate the length of the spring when a load of 8.5 N is applied to the spring.

length = ... [2]

(c) The weight of an object is 4.0 N on a planet where the acceleration of free fall is 8.7 m/s^2.

Calculate the mass of the object.

mass = ... [2]

[Total: 8]

[5. Pressure]

3 **(a)** A submarine descends to a depth of 70 m below the surface of water.

The density of the water is 1050 kg/m^3. Atmospheric pressure is 100 kPa.

Calculate

(i) the increase in pressure as it descends from the surface to a depth of 70 m,

increase in pressure = ... [2]

(ii) the total pressure on the submarine at a depth of 70 m.

total pressure = ... [1]

(b) On another dive, the submarine experiences a total pressure of 6.5×10^5 Pa. A hatch cover on the submarine has an area of 2.5 m^2.

Calculate the force on the outside of the cover.

force = ... [2]

(c) The submarine undergoes tests in fresh water of density 1000 kg/m^3.

Explain why the pressure on the submarine is less at the same depth.

....

.... [1]

[Total: 6]

[6. Energy and Work]

1 **(a)** State what is meant by *kinetic energy*.

....

....[1]

(b) A cannon fires a shell vertically upwards. The shell leaves the cannon with a speed of 80 m s^{-1} and a kinetic energy of 480 J. The shell then rises to a maximum height of 210 m. The effect of air resistance is significant.

(i) Show that the mass of the shell is 0.15 kg.

[2]

(ii) For the movement of the shell from the cannon to its maximum height, calculate

1. the gain in gravitational potential energy,

gain in gravitational potential energy = ... J [2]

2. the work done against air resistance.

work done = ... J [1]

(iii) Determine the average force due to the air resistance acting on the shell as it moves from the cannon to its maximum height.

force = ... N [2]

[Total: 8]

[7. Thermal]

2 Fig. 2.1 shows a cold plastic spoon that has just been placed in hot liquid in a cup.

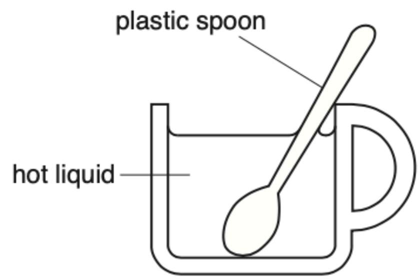

Fig. 4.1

(a) Describe, in terms of molecules, why the temperature of the whole of the spoon increases.

....

....

....

....

.... [3]

(b) The plastic spoon is replaced by a metal spoon.

Describe an additional process by which the temperature of the whole of this spoon increases.

....

....

.... [2]

(c) The cup contains 150 g of liquid of specific heat capacity 4.2 J / (g °C). When the cold spoon is placed into the hot liquid, the temperature of the liquid decreases from 80 °C to 56 °C.

Calculate the loss of thermal energy from the liquid.

energy loss = ... [3]

[Total: 8]