1 **(a)** Fig. 3.1 shows the stress against strain graph for a metal **X** up to its breaking point.

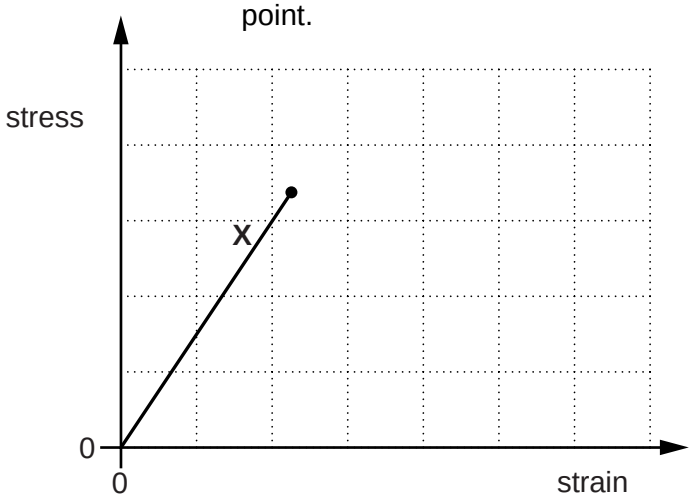

Fig. 3.1

(i) Use Fig. 3.1 to state the physical properties of this metal.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

.....

.....

..... **[2]**

(ii) On the axes of Fig. 3.1, sketch a graph for a ductile material, having a larger Young modulus value than the metal **X**, up to its breaking point. **[2]**

(b) Fig. 3.2 shows a stationary cable car.

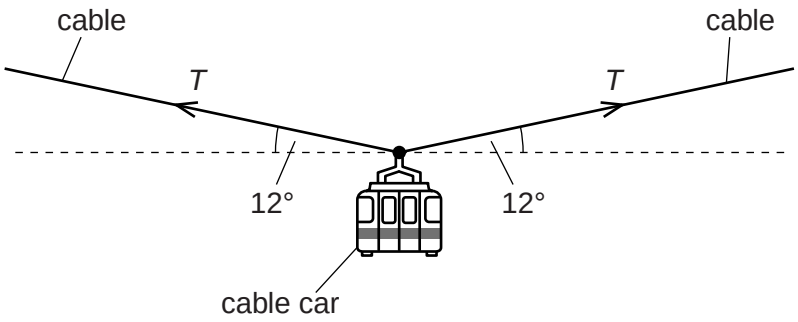

Fig. 3.2

The cable on both sides of the car is at an angle of 12° to the horizontal. The radius of the cable is 2.6×10^{-2} m. The stress in the cable is 1.8×10^{7} Pa. The Young modulus of the material of the cable is 2.0×10^{11} Pa.

(i) Calculate the strain experienced by the cable.

strain = ... **[2]**

(ii) Calculate the tension T in the cable.

T = ... N **[2]**

(iii) Calculate the weight of the cable car.

weight = ... N **[3]**

[Total: 11]

2 **(a)** A student holds a golf ball and a table tennis ball out of an upper window of a tall building. The balls are released at the same time. Both balls have the same size. The golf ball has a **greater mass** than the tennis ball. One of the balls reaches a greater terminal velocity.

(i) State and explain the acceleration of the golf ball immediately after it is released.

.....

.....

..... **[2]**

(ii) By referring to the forces acting on the golf ball, explain what is meant by *terminal velocity*.

.....

..... **[1]**

(iii) Explain which of the two balls reaches the greater terminal velocity.

.....

.....

.....

.....

.....

..... **[3]**

(b) Fig. 5.1 shows a graph of drag D against speed v for a lorry.

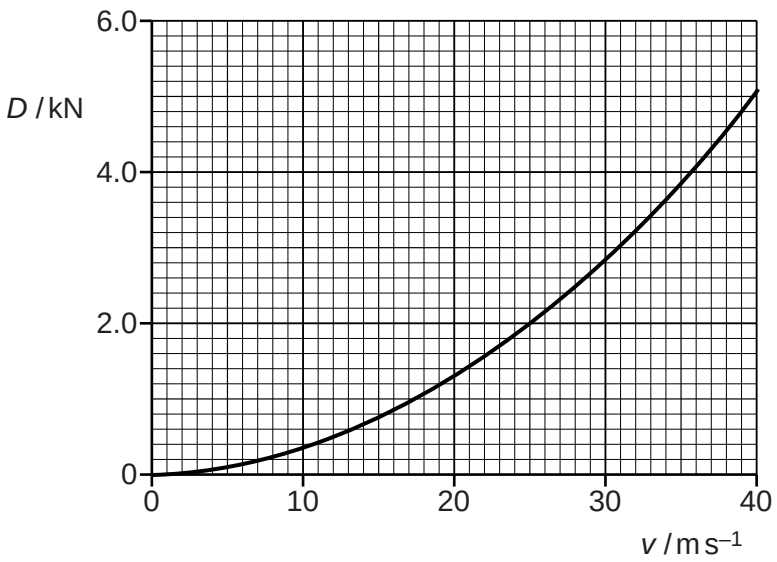

Fig. 5.1

The lorry has mass 8000 kg. Its engine provides a **constant** forward force of 3200 N.

(i) Calculate the instantaneous acceleration of the lorry when travelling on a level road at a speed of 25 m s^{-1}.

acceleration = ... m s^{-2} **[3]**

(ii) Explain why this lorry cannot travel at a speed of 40 m s^{-1} on a level road.

.....

..... **[1]**

(c) The lorry driver wears a seat belt. Describe and explain how a seat belt reduces the force on a driver during the impact in an accident.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

[Total: 13]

3 Fig. 2.1 shows the path of a metal ball fired at a velocity of $24\,m\,s^{-1}$ at an angle of 30° to the horizontal.

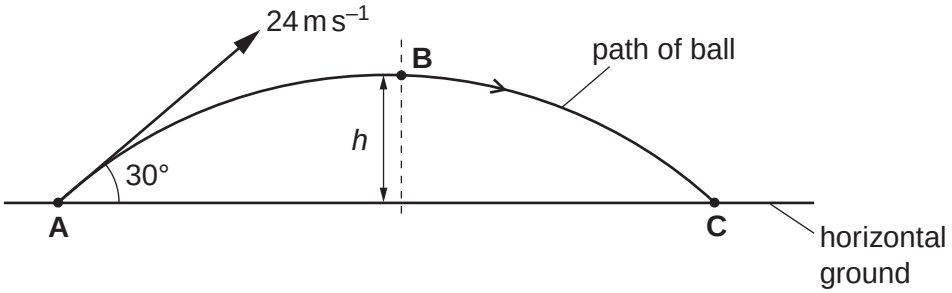

Fig. 2.1

Air resistance has negligible effect on the motion of the metal ball. The ball is fired from point **A** and it reaches its maximum height at point **B**. The mass of the ball is 450 g.

(a) State the direction of the acceleration of the ball during its flight.

..... **[1]**

(b) Calculate the horizontal and vertical components of the velocity of the ball at **A**.

horizontal velocity = ... $m\,s^{-1}$

vertical velocity = ... $m\,s^{-1}$ **[2]**

(c) Explain why the gravitational potential energy gained by the ball as it moves from **A** to **B** is not equal to its initial kinetic energy at **A**.

.....

.....

..... **[1]**

(d) Calculate the maximum vertical height *h* of the ball.

h = ... m **[3]**

[Total: 7]

4 **(a)** Define *velocity*.

.....

..... **[1]**

(b) Define *work done* by a force.

.....

..... **[2]**

(c) Fig. 3.1 shows a rider on a sledge sliding down an icy slope.

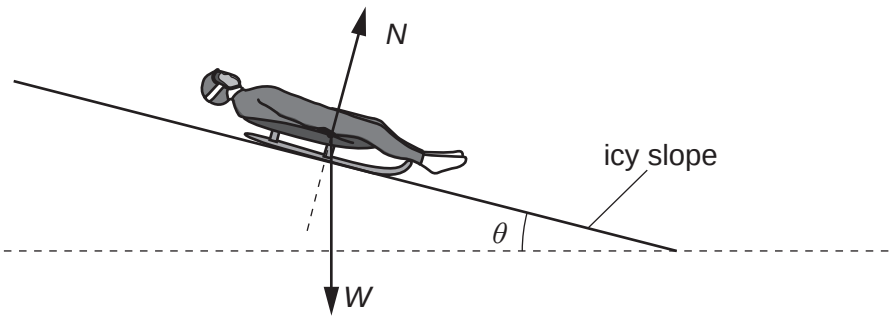

Fig. 3.1

The frictional forces acting on the sledge and the rider are negligible. The normal contact force *N* and the total weight *W* of the sledge and rider are shown.

(i) Explain why the force *N* does no work on the sledge as it slides down the slope.

.....

..... **[1]**

(ii) State and explain the force that causes the sledge and rider to accelerate down the slope.

.....

..... **[1]**

(d) Fig. 3.2 shows the velocity against time graph for the sledge and rider in **(c)** sliding down the icy slope.

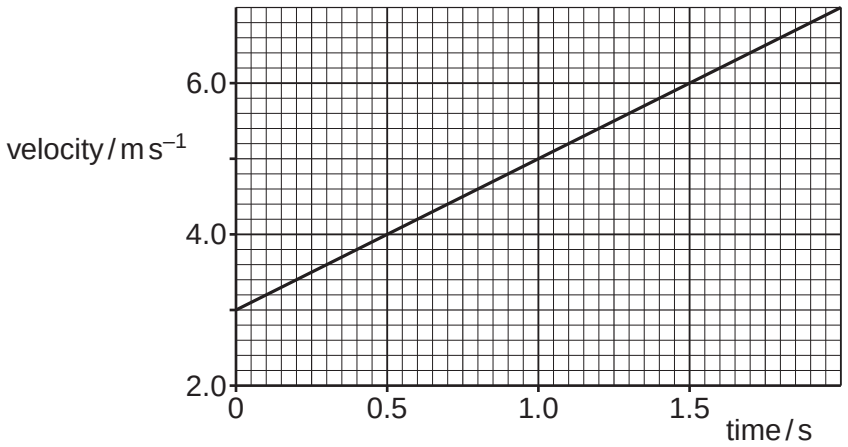

Fig. 3.2

(i) Use Fig. 3.2 to determine

1 the acceleration of the sledge and rider down the slope

acceleration = ... m s^{-2} **[2]**

2 the angle made by the slope to the horizontal.

angle = ...° **[2]**

(ii) The sledge crashes into a foam barrier at the bottom of the slope.

The velocity of the sledge just before the impact is $15\,m\,s^{-1}$. The sledge and rider take 3.5 s to stop. The average decelerating force on the sledge and rider is 510 N.

Calculate the total mass of the sledge and rider.

mass = ... kg **[3]**

[Total: 12]

5 **(a)** Define the following terms:

(i) *couple*

.....

..... **[1]**

(ii) *torque of a couple*.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

..... **[1]**

(b) Fig. 4.1 shows a satellite in space moving from left to right.

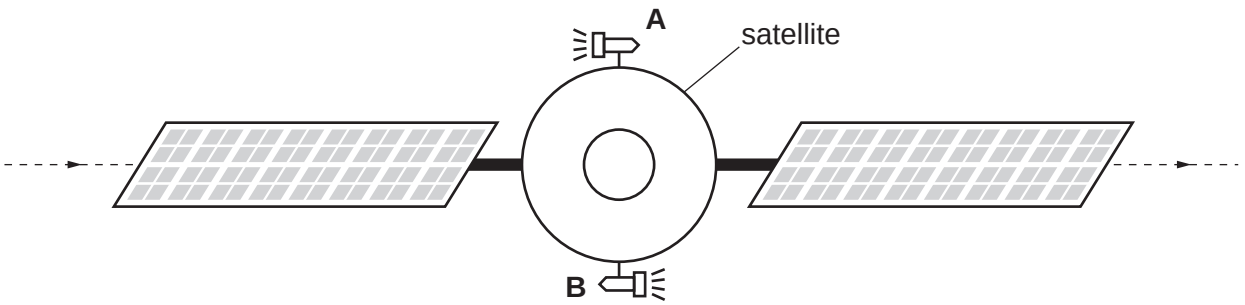

Fig. 4.1

The satellite has two small rockets **A** and **B** mounted at opposite ends of a diameter. When fired, each rocket motor provides the **same** constant force, but in **opposite** directions.

Describe the change in the motion of the satellite when

(i) both rocket motors are fired

.....

.....

..... **[2]**

(ii) only rocket motor **A** is fired.

.....

.....

..... **[2]**

[Total: 6]