Forces

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Forces, Density & Pressure
Sub Topic	Forces
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **74 minutes**

Score: **/61**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** The Young modulus of the metal of a wire is 1.8×10^{11} Pa. The wire is extended and the

strain

produced is 8.2×10^{-4}.
Calculate the stress in GPa.

stress = ...GPa [2]

(b) An electromagnetic wave has frequency 12 THz.

(i) Calculate the wavelength in μm.

wavelength = ...μm [2]

(ii) State the name of the region of the electromagnetic spectrum for this frequency.

....[1]

(c) An object B is on a horizontal surface. Two forces act on B in this horizontal plane. A vector diagram for these forces is shown to scale in Fig. 1.1.

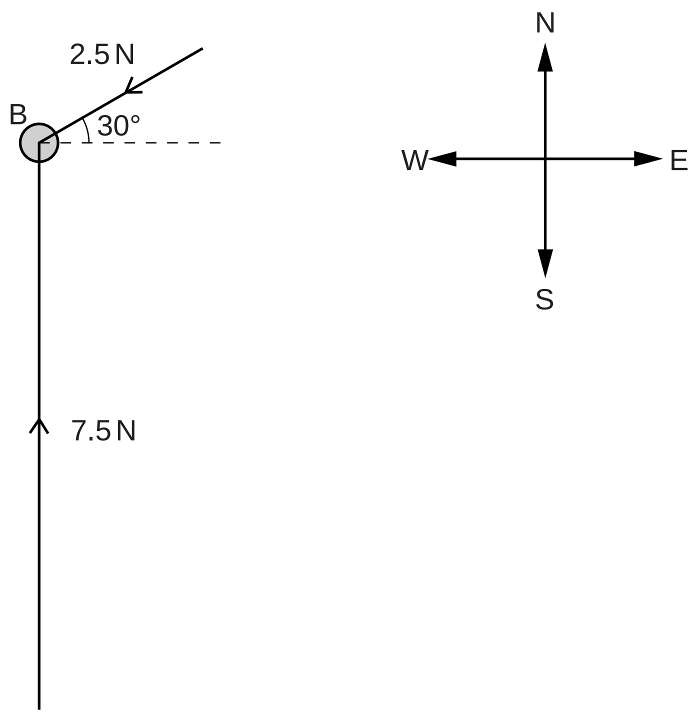

Fig. 1.1

A force of 7.5 N towards north and a force of 2.5 N from 30° north of east act on B.
The mass of B is 750 g.

(i) On Fig. 1.1, draw an arrow to show the approximate direction of the resultant of these two forces. [1]

(ii) **1.** Show that the magnitude of the resultant force on B is 6.6 N.

[1]

2. Calculate the magnitude of the acceleration of B produced by this resultant force.

magnitude = ... $m\,s^{-2}$ [2]

(iii) Determine the angle between the direction of the acceleration and the direction of the 7.5 N force.

angle = ... ° [1]

2 A uniform plank AB of length 5.0 m and weight 200 N is placed across a stream, as shown in Fig. 3.1.

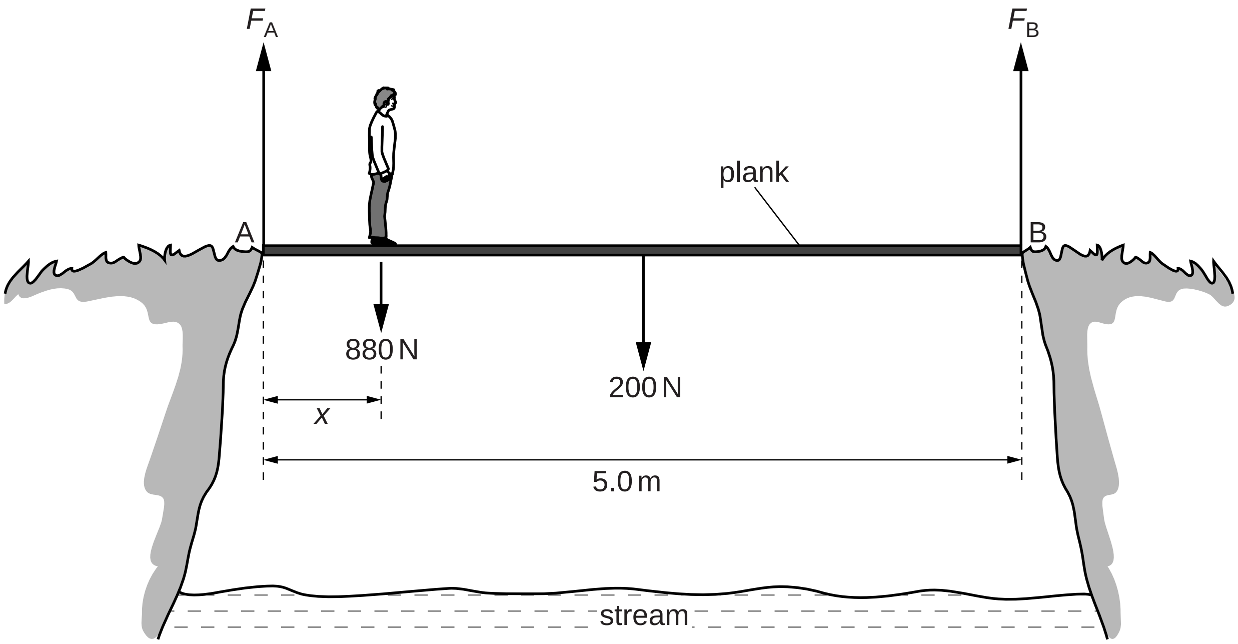

Fig. 3.1

A man of weight 880 N stands a distance x from end A. The ground exerts a vertical force F_A on the plank at end A and a vertical force F_B on the plank at end B.
As the man moves along the plank, the plank is always in equilibrium.

(a) (i) Explain why the sum of the forces F_A and F_B is constant no matter where the man stands on the plank.

....

....

.... [2]

(ii) The man stands a distance x = 0.50 m from end A. Use the principle of moments to calculate the magnitude of F_B.

F_B = ... N [4]

(b) The variation with distance x of force F_A is shown in Fig. 3.2.

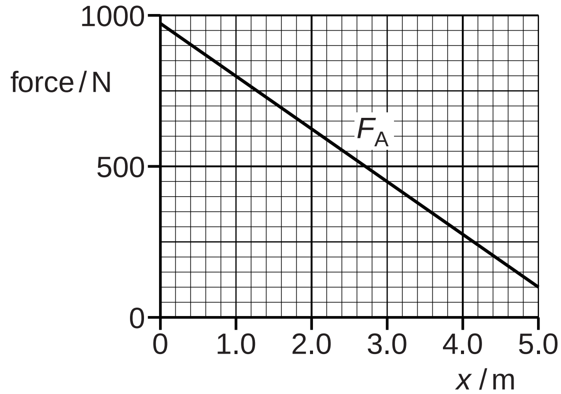

Fig. 3.2

On the axes of Fig. 3.2, sketch a graph to show the variation with x of force F_B. [3]

3 **(a)** Distinguish between *mass and weight*.

mass: ....

....

weight: ....

....
[2]

(b) An object O of mass 4.9 kg is suspended by a rope A that is fixed at point P. The object is pulled to one side and held in equilibrium by a second rope B, as shown in Fig. 2.1.

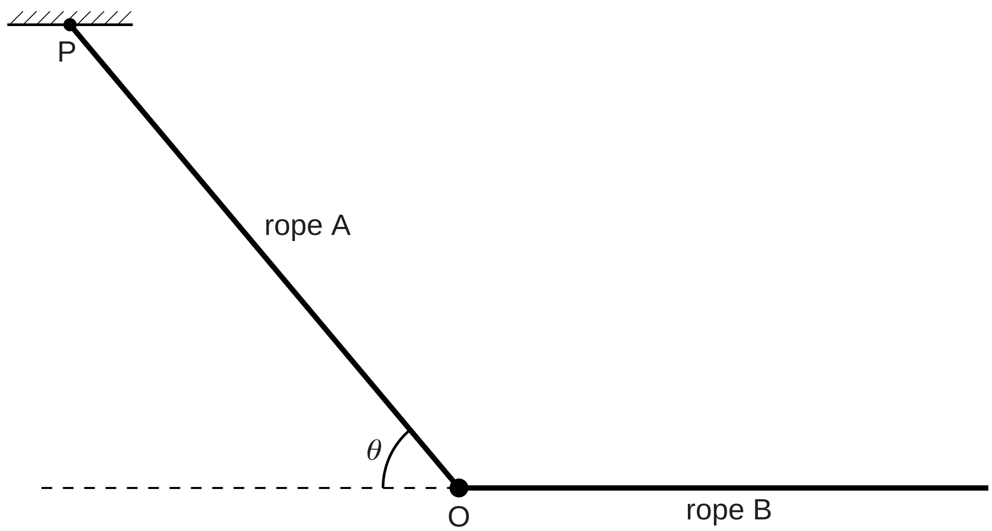

Fig. 2.1

Rope A is at an angle θ to the horizontal and rope B is horizontal. The tension in rope A is 69 N and the tension in rope B is T.

(i) On Fig. 2.1, draw arrows to represent the directions of all the forces acting on object O. [2]

(ii) Calculate

1. the angle θ,

θ = ... ° [3]

2. the tension T.

T = ... N [2]

4 **(a)** Define *centre of gravity*.

....

....[2]

(b) A uniform rod AB is attached to a vertical wall at A. The rod is held horizontally by a string attached at B and to point C, as shown in Fig. 3.1.

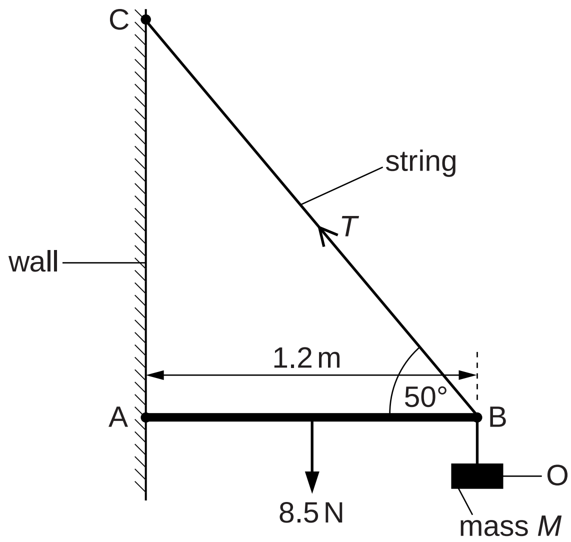

Fig. 3.1

The angle between the rod and the string at B is 50°. The rod has length 1.2 m and weight 8.5 N. An object O of mass *M* is hung from the rod at B. The tension *T* in the string is 30 N.

(i) Use the resolution of forces to calculate the vertical component of *T*.

vertical component of *T* = ... N [1]

(ii) State the *principle of moments*.

....

....[1]

(iii) Use the principle of moments and take moments about A to show that the weight of the object O is 19 N.

[3]

(iv) Hence determine the mass *M* of the object O.

M = ... kg [1]

(c) Use the concept of equilibrium to explain why a force must act on the rod at A.

....

....

....[2]

5 **(a)** Define *power*.

....

.... [1]

(b) A cyclist travels along a horizontal road. The variation with time t of speed v is shown in Fig. 3.1.

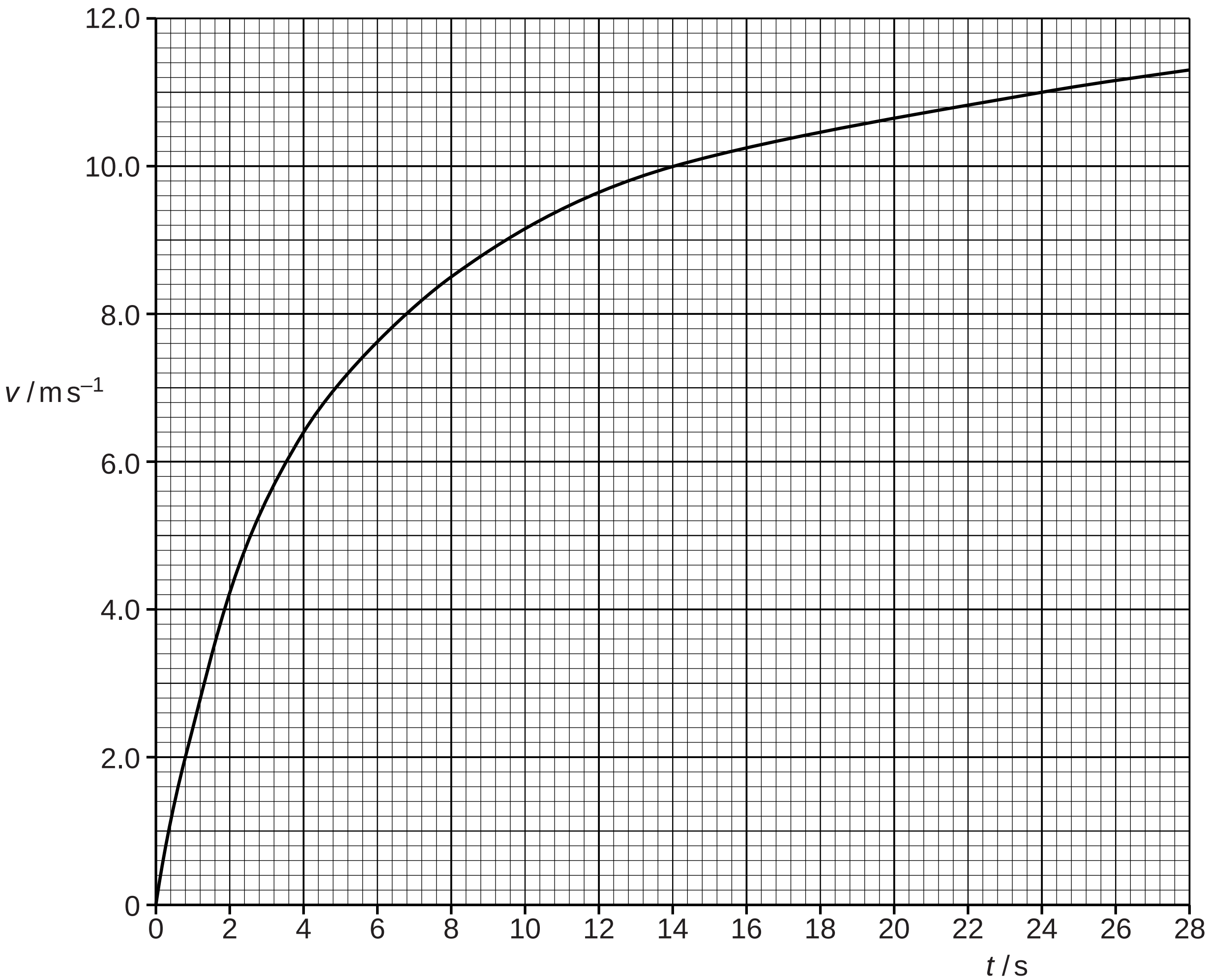

Fig. 3.1

The cyclist maintains a constant power and after some time reaches a constant speed of 12 m s^{-1}.

(i) Describe and explain the motion of the cyclist.

....

....

....

....

.... [3]

(ii) When the cyclist is moving at a constant speed of $12\,m\,s^{-1}$ the resistive force is 48 N. Show that the power of the cyclist is about 600 W. Explain your working.

[2]

(iii) Use Fig. 3.1 to show that the acceleration of the cyclist when his speed is $8.0\,m\,s^{-1}$ is about $0.5\,m\,s^{-2}$.

[2]

(iv) The total mass of the cyclist and bicycle is 80 kg. Calculate the resistive force *R* acting on the cyclist when his speed is $8.0\,m\,s^{-1}$. Use the value for the acceleration given in **(iii)**.

R = ... N [3]

(v) Use the information given in **(ii)** and your answer to **(iv)** to show that, in this situation, the resistive force *R* is proportional to the speed *v* of the cyclist.

[1]

6 A motor drags a log of mass 452 kg up a slope by means of a cable, as shown in Fig. 2.1.

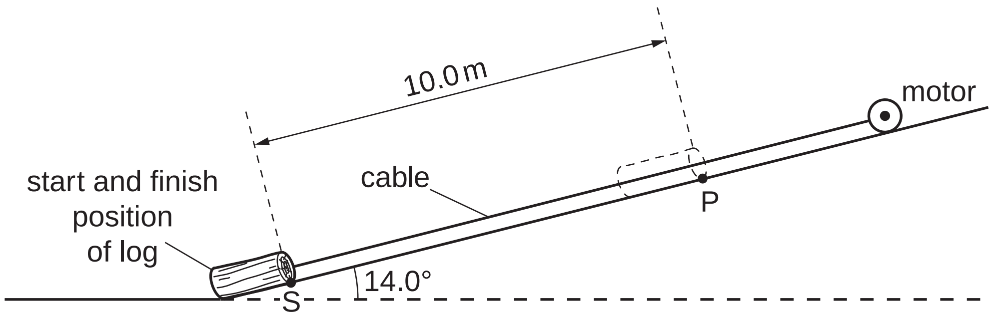

Fig. 2.1

The slope is inclined at 14.0° to the horizontal.

(a) Show that the component of the weight of the log acting down the slope is 1070 N.

[1]

(b) The log starts from rest. A constant frictional force of 525 N acts on the log. The log accelerates up the slope at 0.130 m s^{-2}.

(i) Calculate the tension in the cable.

tension = ... N [3]

(ii) The log is initially at rest at point S. It is pulled through a distance of 10.0 m to point P.

Calculate, for the log,

1. the time taken to move from S to P,

time = ... s [2]

2. the magnitude of the velocity at P.

velocity = ... m s^{-1} [1]

(c) The cable breaks when the log reaches point P. On Fig. 2.2, sketch the variation with time t of the velocity v of the log. The graph should show v from the start at S until the log returns to S. [4]

Fig. 2.2