Revision Sheet

A-Level Physics · Unit 4 Forces, density and pressure

10 vocabulary items · 28 marks of exam questions (11 questions)

Part 1 · Vocabulary review (10 items). The terms this unit is examined on most. Mark it yourself from the answer key.

Section A · English dictation

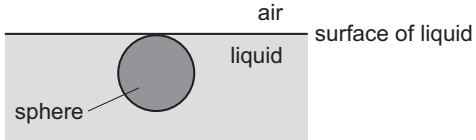
Listen to each word and write it in English. The teacher reads the numbered answer key aloud.

1. Dictation item 1. _____ [1]
2. Dictation item 2. _____ [1]
3. Dictation item 3. _____ [1]
4. Dictation item 4. _____ [1]
5. Dictation item 5. _____ [1]
6. Dictation item 6. _____ [1]
7. Dictation item 7. _____ [1]
8. Dictation item 8. _____ [1]
9. Dictation item 9. _____ [1]
10. Dictation item 10. _____ [1]

Part 2 · Exam questions (28 marks, 11 questions) begins on the next page. They are ordered easy to difficult and none of them has been set before.

11 The diagram shows a stationary sphere that is just fully submerged in a liquid. The radius of the sphere is r and the density of the liquid is ρ. The acceleration of free fall is g.

The air exerts pressure P_A on the surface of the liquid.



What is the pressure at the lowest point of the sphere?

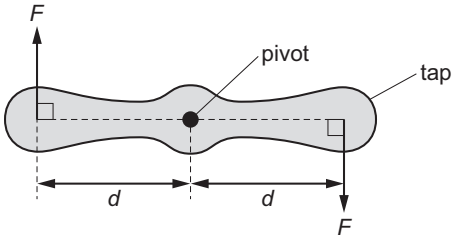
A $P_A + \frac{4}{3}\pi r^3 \rho g$

B $P_A - \frac{4}{3}\pi r^3 \rho g$

C $2r\rho g + P_A$

D $2r\rho g - P_A$

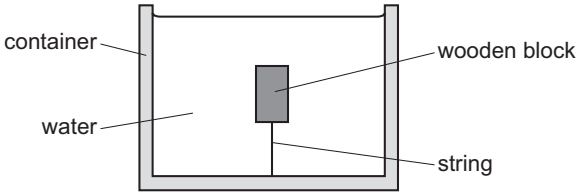
12 A couple is applied to a tap, as shown.



What is the torque of the couple?

A $\frac{Fd}{2}$ **B** Fd **C** $2Fd$ **D** $4Fd$

13 A wooden block is held stationary in a container of water using a string that is attached to both the wooden block and the bottom of the container.



The wooden block has mass m and volume V. The water has density ρ. The acceleration of free fall is g.

What is the magnitude of the force acting on the block due to the tension in the string?

A ρgV **B** $mg + \rho gV$ **C** mg **D** $\rho gV - mg$

14 An object is fully submerged in a liquid.

A student determines the ratio $\frac{\text{upthrust acting on the object}}{\text{weight of the object}}$.

Which single change would double the value of this ratio?

A Use a different liquid that has twice the density and the same volume as the original liquid.

B Use a different object that has half the volume and the same density as the original object.

C Use a different object that has twice the density and the same volume as the original object.

D Use a different object that has twice the volume and the same density as the original object.

15 Which single condition **must** apply for an object to be in equilibrium?

A The object has a constant non-zero acceleration.

B The object is stationary.

C There are no forces acting on the object.

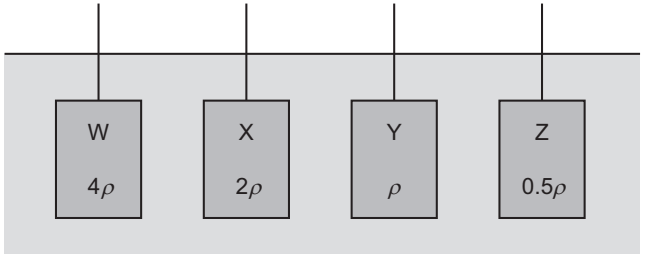
D The resultant force acting on the object is zero.

16 A rectangular block of lead of density $1.13 \times 10^4\,\text{kg m}^{-3}$ has sides of length 12.0 cm, 15.0 cm and 10.0 cm.

What is the maximum pressure the block can exert when resting on a table?

A 1.13 kPa **B** 1.70 kPa **C** 11.1 kPa **D** 16.6 kPa

17 Four cuboids with identical lengths, breadths and heights are immersed in water. The cuboids are held at the same depth and in identical orientations by vertical rods, as shown.



Water has density ρ.
Cuboid W is made of material of density 4ρ.
Cuboid X is made of material of density 2ρ.
Cuboid Y is made of material of density ρ.
Cuboid Z is made of material of density 0.5ρ.

Which statement is correct?

A The upthrust of the water on each of the cuboids is the same.

B The upthrust of the water on W is twice the upthrust of the water on X.

C The upthrust of the water on X is twice the upthrust of the water on W.

D The upthrust of the water on Y is zero.

18 A thin horizontal plate of area $0.036\,\text{m}^2$ is beneath the surface of a liquid of density $930\,\text{kg m}^{-3}$. The force on one side of the plate due to the pressure of the liquid is 290 N.

What is the depth of the plate beneath the surface of the liquid?

A 0.88 m **B** 1.1 m **C** 1.8 m **D** 8.7 m

19 Water has a density of $1.0\,\text{g cm}^{-3}$.

Glycerine has a density of $1.3\,\text{g cm}^{-3}$.

A student measures out a volume of $40\,\text{cm}^3$ of glycerine into a container.

The student adds water to the container to make a mixture of water and glycerine. Assume that the total volume of water and glycerine does not change when the two liquids are mixed.

Which volume of water needs to be added to make a mixture of density $1.1\,\text{g cm}^{-3}$?

A $4.0\,\text{cm}^3$ **B** $8.0\,\text{cm}^3$ **C** $34\,\text{cm}^3$ **D** $80\,\text{cm}^3$

20 **(a)** Define the moment of a force about a pivot.

.....

..... [1]

(b) Three objects A, B and C are placed on a horizontal beam. The beam is in equilibrium, as shown in Fig. 2.1.

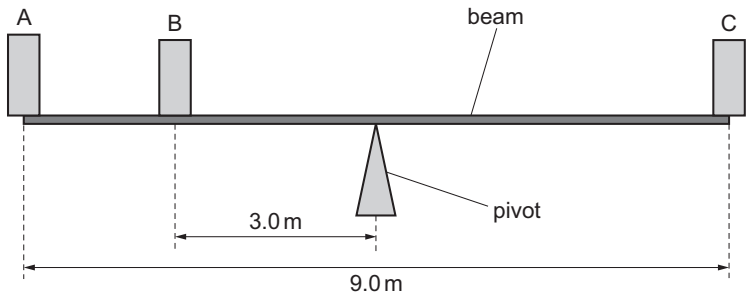


Fig. 2.1 (not to scale)

The beam is uniform and has length 9.0 m.
A pivot is at the midpoint of the beam.
Object A has mass 90 kg and is at one end of the beam.
Object B has mass *m* and is a distance of 3.0 m from the pivot.
Object C has mass 150 kg and is at the other end of the beam.

(i) Calculate *m*.

m = ... kg [3]

Name: A-Level Physics · Unit 4 revision: **s25 23**

(ii) Object A is removed and replaced by a wire fixed to the end of the beam and to the ground, as shown in Fig. 2.2.

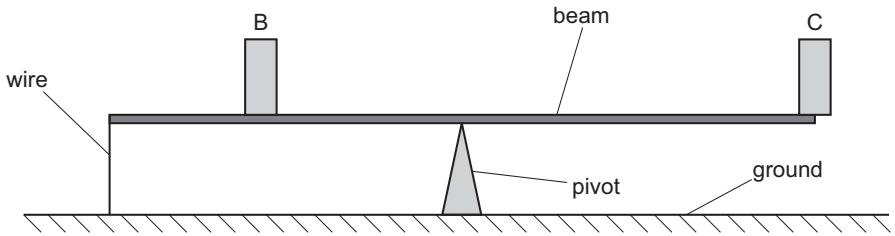


Fig. 2.2

After the change, the beam is again horizontal and in equilibrium. The positions of B and C are unchanged.

The wire has a diameter of 1.8×10^{-3} m and has a strain of 1.2×10^{-3}.
The wire is not extended beyond its limit of proportionality.

Calculate the Young modulus of the wire.

Young modulus = ... Pa [3]

(iii) Object B is now moved to a new position closer to the pivot without passing it. The beam is again horizontal and in equilibrium.

State and explain the effect, if any, that this has on the strain in the wire.

.....

.....

..... [2]

[Total: 9]

21 A pendulum consists of a solid sphere suspended by a string from a fixed point P, as shown in Fig. 3.1.

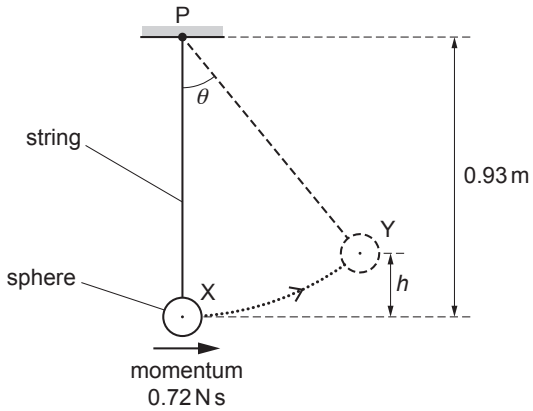


Fig. 3.1 (not to scale)

The sphere swings from side to side. At one instant the sphere is at its lowest position X, where it has kinetic energy 0.86 J and momentum 0.72 N s in a horizontal direction. A short time later the sphere is at position Y, where it is momentarily stationary at a maximum vertical height *h* above position X.

The string has a fixed length and negligible weight. Air resistance is also negligible.

(a) On Fig. 3.1, draw a solid line to represent the displacement of the centre of the sphere at position Y from position X. [1]

(b) Show that the mass of the sphere is 0.30 kg.

[3]

Name: A-Level Physics · Unit 4 revision: **s21 21**

(c) Calculate height *h*.

h = ... m [2]

(d) The distance between point P and the centre of the sphere is 0.93 m. When the sphere is at position Y, the string is at an angle θ to the vertical.

Show that θ is 47°.

[1]

(e) For the sphere at position Y, calculate the moment of its weight about point P.

moment = ... N m [2]

(f) State and explain whether the sphere is in equilibrium when it is stationary at position Y.

.....

..... [1]

[Total: 10]