This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 02

19DEC2022

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level : Physics 1 : RB
Class :	11A and 12A
Teacher :	Dr Ruth Brett
Duration :	30 minutes

You should have a physics formula booklet. Write all your answers in this exam paper in black pen. You may use a pencil for diagrams.

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Q1. A student is investigating a material in the form of a wire.

Which of the following properties of the wire will change if a longer wire is used?

☐ **A** breaking stress

☐ **B** density

☐ **C** stiffness

☐ **D** Young modulus

(Total for question = 1 mark)

Q3. A student used a balance to measure the mass of a small cube with sides of length x.



The student also measured the mass of a larger cube with sides of length 1.5 x.



Which of the following is the density ρ_L of the larger cube in terms of the density ρ_S of the smaller cube?

☐ **A** $\rho_L = 3.4\ \rho_S$

☐ **B** $\rho_L = 1.5\ \rho_S$

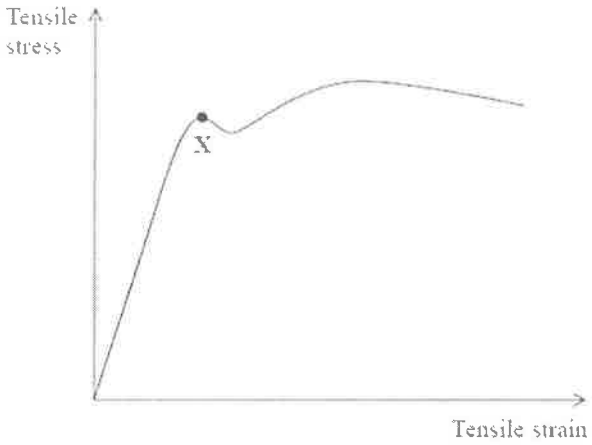
☐ **C** $\rho_L = 0.67\ \rho_S$

☐ **D** $\rho_L = 0.30\ \rho_S$

(Total for question = 1 mark)

Q3.
A copper rod was placed under tensile stress and the tensile strain in the rod was measured.

The graph shows how the tensile stress required to cause a tensile strain in the rod depends upon the tensile strain.



What does point X represent?

- ☐ **A** the fracture point of the rod
- ☐ **B** the limit of proportionality for copper
- ☐ **C** the maximum tensile stress in the rod
- ☐ **D** the yield point of copper

(Total for question = 1 mark)

Q4.

A steadily increasing tensile force was applied to a sample of a titanium alloy.

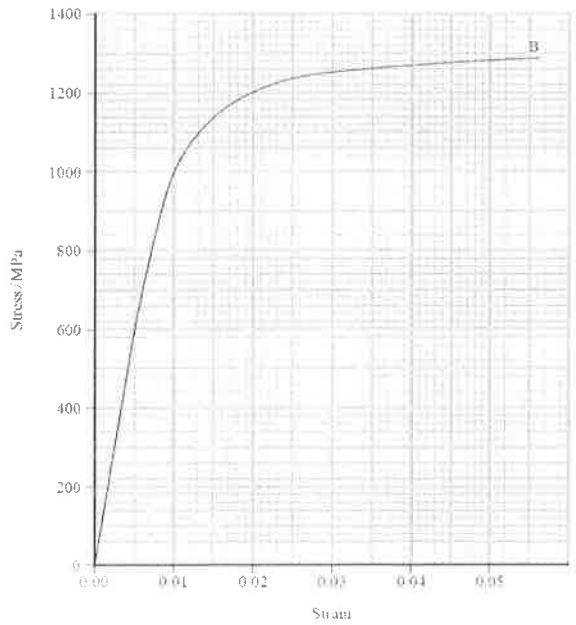
The sample had an original length of 40.0 cm and diameter of 5.05 mm.

(a) State a suitable measuring instrument to measure the diameter of the sample.

(1)

.....

(b) The graph shows how stress varied with strain for the sample.



(i) Determine the Young modulus of the sample.

(3)

.....

.....

.....

.....

.....

Young modulus = ...

(ii) The sample broke at point B.
Determine the force required to break the sample.

(4)

.....

.....

.....

.....

.....

.....

Force = ...

(Total for question = 8 marks)

Q6. A spherical polystyrene bead is immersed in oil. The bead has diameter 4.00×10^{-3} m. The bead is released and moves upwards through the oil at a constant velocity.

(a) Complete the free body force diagram below to show all the forces acting on the polystyrene bead.

(2)



(b) Show that the upthrust the oil exerts on the bead is about 3.1×10^{-4} N.

density of oil = 930 kg m^{-3}

(3)

.....

.....

.....

.....

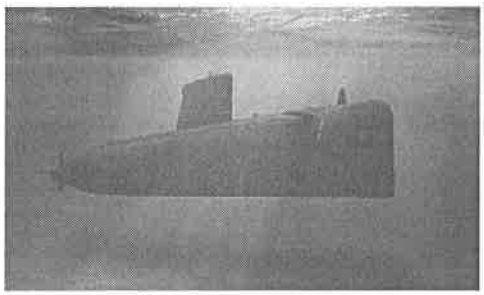
.....

.....

(Total for question = 5 marks)

Q7.

The photograph shows a submarine below the surface of the sea.



(Source: noraismail/Shutterstock)

(a) The submarine has a volume of 5.83×10^3 m^3 .

The submarine is stationary in a region of the sea where the density of the seawater is 1.03×10^3 kg m^{-3} .

(i) Calculate the upthrust exerted on the submarine by the seawater.

(2)

.....

.....

.....

.....

.....

.....

Upthrust = ...

(ii) Explain why the mass of the submarine must be 6.0×10^6 kg.

(2)

.....

.....

.....

.....

(b) The submarine now moves into a region of the sea where the water is less salty, and the density of the water reduces to 1.01×10^3 kg m^{-3} .

(i) Explain what would happen to the submarine as it moves into this region of lower density seawater.

(3)

.....

.....

.....

.....

(ii) The submarine alters its weight by pumping water in or out of its internal tanks. Determine the mass of water that the submarine should pump, in or out of its tanks, to maintain its depth below the surface of the sea.

(2)

.....

.....

.....

.....

Mass of water = ...

(Total for question = 9 marks)

This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 02

19DEC2022

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level : Physics 1 : RB
Class :	11A and 12A
Teacher :	Dr Ruth Brett
Duration :	30 minutes

You should have a physics formula booklet. Write all your answers in this exam paper in black pen. You may use a pencil for diagrams.

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Q1. A student is investigating a material in the form of a wire.

Which of the following properties of the wire will change if a longer wire is used?

☐ **A** breaking stress

☐ **B** density

(1) ☒ **C** stiffness

☐ **D** Young modulus

(Total for question = 1 mark)

Q3. A student used a balance to measure the mass of a small cube with sides of length x.



The student also measured the mass of a larger cube with sides of length 1.5 x.



Which of the following is the density ρ_L of the larger cube in terms of the density ρ_S of the smaller cube?

☐ **A** $\rho_L = 3.4\ \rho_S$

☐ **B** $\rho_L = 1.5\ \rho_S$

☐ **C** $\rho_L = 0.67\ \rho_S$

(1) ☒ **D** $\rho_L = 0.30\ \rho_S$

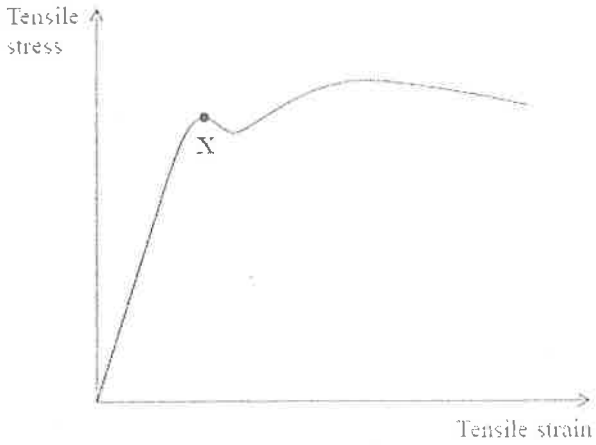
$\rho = \frac{m}{V}$ $\quad \rho_S = \frac{50}{x^3}$

$\rho_L = \frac{50}{(1.5x)^3} = \frac{50}{1.5^3 x^3} = \frac{\rho_S}{1.5^3} = 0.296\rho_S$

(Total for question = 1 mark)

Q3.
A copper rod was placed under tensile stress and the tensile strain in the rod was measured.

The graph shows how the tensile stress required to cause a tensile strain in the rod depends upon the tensile strain.



What does point X represent?

- ☐ **A** the fracture point of the rod
- ☐ **B** the limit of proportionality for copper
- ☐ **C** the maximum tensile stress in the rod
- (1) ☒ **D** the yield point of copper

(Total for question = 1 mark)

Q4.

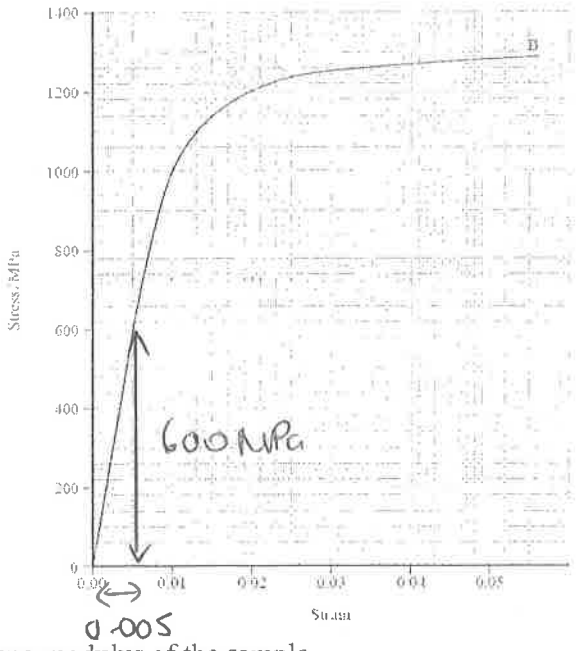
A steadily increasing tensile force was applied to a sample of a titanium alloy.

The sample had an original length of 40.0 cm and diameter of 5.05 mm.

(a) State a suitable measuring instrument to measure the diameter of the sample.

Micrometer (1)

(b) The graph shows how stress varied with strain for the sample.



(i) Determine the Young modulus of the sample.

(1)

Gradient of straight line = Young modulus

$E = \frac{600 \times 10^6}{0.005} = 1.2 \times 10^{11}$ (1)

Young modulus = 120 GPa (1)

(ii) The sample broke at point B.
Determine the force required to break the sample.

Breaking stress = 1280 MPa ①

$A = \pi r^2 = \pi \left(\frac{5.05 \times 10^{-3}}{2}\right)^2$ ① $= 2.003 \times 10^{-5}\ m^2$

①

$\sigma = \frac{F}{A}$ $F = \sigma A = 1280 \times 10^6 \times 2.003 \times 10^{-5}$

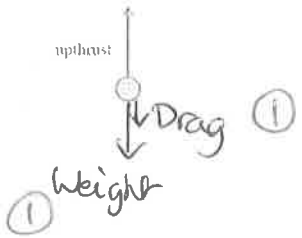
$F = 25637\ N$

Force = 25.6kN ①

(Total for question = 8 marks)

Q6. A spherical polystyrene bead is immersed in oil. The bead has diameter 4.00×10^{-3} m. The bead is released and moves upwards through the oil at a constant velocity.

(a) Complete the free body force diagram below to show all the forces acting on the polystyrene bead.



(b) Show that the upthrust the oil exerts on the bead is about 3.1×10^{-4} N.

density of oil = 930 kg m^{-3}

$U = V_B \rho_o g$

(1)

$V_B = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{4\times10^{-3}}{2}\right)^3 = 3.35\times10^{-8}\ m^3$

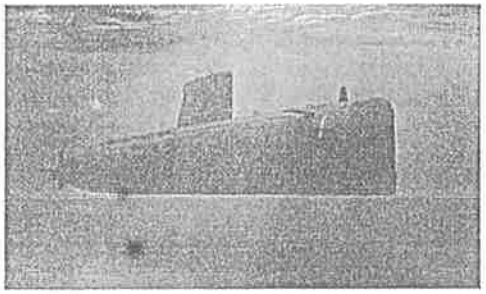
$U = 3.35\times10^{-8} \times 930 \times 9.81 = 3.06\times10^{-4}\ N$

(1) (1)

(Total for question = 5 marks)

Q7.

The photograph shows a submarine below the surface of the sea.



(Source: norasismail/Shutterstock)

(a) The submarine has a volume of 5.83×10^3 m^3 .

The submarine is stationary in a region of the sea where the density of the seawater is 1.03×10^3 kg m^{-3} .

(i) Calculate the upthrust exerted on the submarine by the seawater.

(2)

$U = V_s \rho_w g = 5.83 \times 10^3 \times 1.03 \times 10^3 \times 9.81$ (1)

$U = 5.891 \times 10^7$

(1)

Upthrust = 5.89×10^7 N

(ii) Explain why the mass of the submarine must be 6.0×10^6 kg.

(2)

If the submarine is stationary, the forces are balanced so the weight of the submarine = upthrust. (1)

Since $W = mg$ $m = \frac{U}{g} = \frac{5.89 \times 10^7}{9.81} = 6.00 \times 10^6$ kg (1)

(b) The submarine now moves into a region of the sea where the water is less salty, and the density of the water reduces to 1.01×10^3 kg m^{-3}.

(i) Explain what would happen to the submarine as it moves into this region of lower density seawater.

(3)

The upthrust will now be smaller (1) than the weight of the submarine, so a resultant force acts downwards (1) causing the submarine to sink. (1)

must score first mark to be given this

(ii) The submarine alters its weight by pumping water in or out of its internal tanks. Determine the mass of water that the submarine should pump, in or out of its tanks, to maintain its depth below the surface of the sea.

(2)

New $U = 5.83 \times 10^3 \times 1.01 \times 10^3 \times 9.81 = 5.776 \times 10^7$ N (1)

Net downward force $= 5.89 \times 10^7 - 5.78 \times 10^7 = 0.11 \times 10^7$ N

∴ mass difference needed to balance this is $0.11 \times 10^7 / 9.81$

$\Delta m = 1.12 \times 10^5$ kg. This needs to be a mass DECREASE

Mass of water = 1.12×10^5 kg (1)

OUT of the tank

(Total for question = 9 marks)

if using 5.891×10^7 N

and 5.776×10^7 N

then $F = 1.15 \times 10^6$ N

and $m = 1.17 \times 10^5$ kg