Stretching, Compression and Fluids

Total marks:25

Q1.

A weight of 4.0 N is used to extend a spring.
The extension of the spring is 0.06 m.

(i) Calculate the spring constant, *k*, of the spring.

Use the equation

$$F = k \times x$$

(3)

spring constant = ... N/m

(ii) State what measurements should be made to determine the extension of the spring produced by the 4.0 N weight.

(2)

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(Total for question = 5 marks)

Q2.

A spring is extended.

A force of 0.50 N gives an extension of 13 mm.

Calculate the spring constant *k* in N/m.

(3)

spring constant *k* = ... N/m

(Total for question = 3 marks)

Q3.

Figure 8 shows some water in a tank.

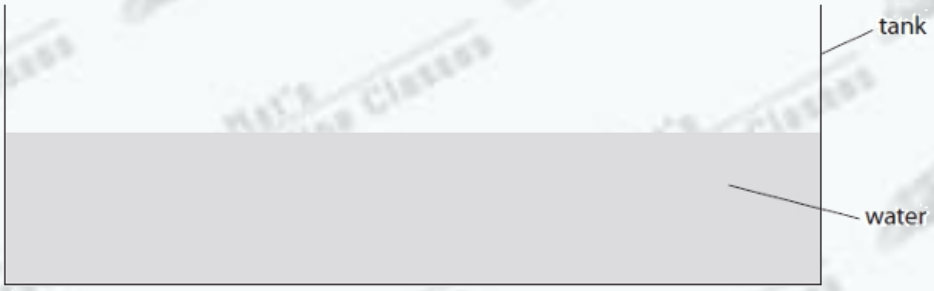

Figure 8

(i) The bottom of the tank has an area of 0.80 m^2. The force on the bottom of the tank, due to the water, is 2400 N. Calculate the pressure, due to the water, on the bottom of the tank.

(3)

pressure = ... Pa

(ii) More water is added to the tank.

Explain how the pressure on the bottom of the tank changes when more water is added to the tank.

(2)

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(iii) Figure 9 shows an object on the bottom of the tank of water.

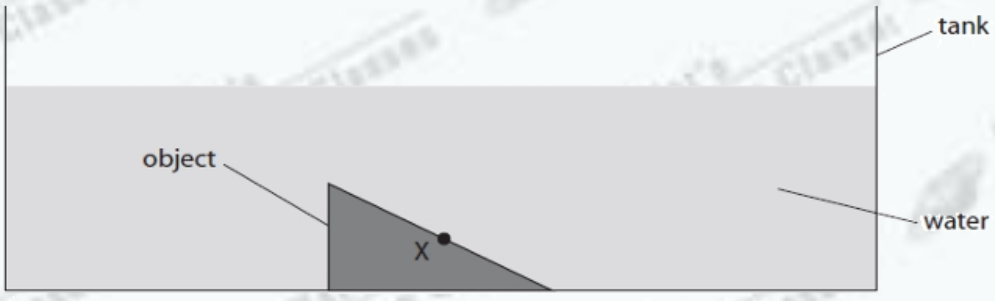

Figure 9

Draw an arrow on Figure 9 to show the direction of the force exerted by the water on the surface of the object at point X.

(1)

(Total for question = 6 marks)

Q4.

* Figure 16 illustrates an effect that can be explained using the ideas of pressure, force and area.

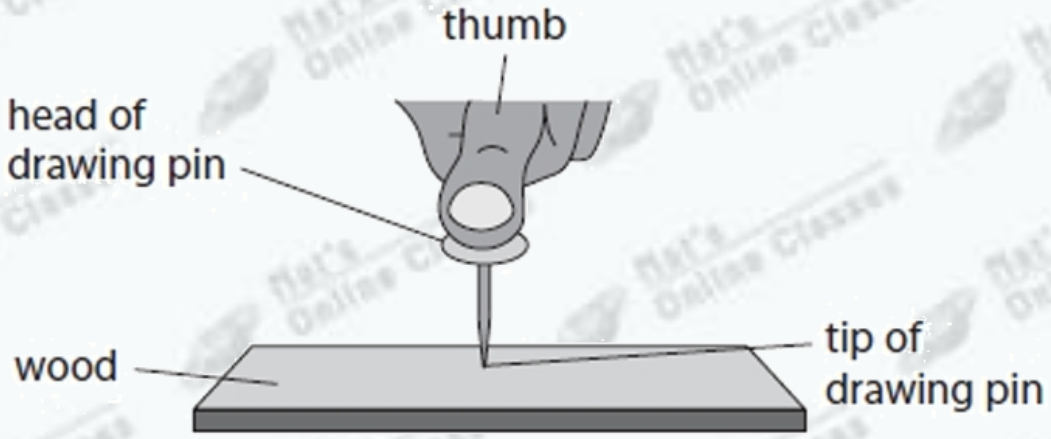

Figure 16

Explain why the tip of the drawing pin goes into the wood but the head of the drawing pin does not go into the thumb.

(6)

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(Total for question = 6 marks)

Q5.

Figure 26 shows a glass U-tube containing water of density 1000 kg/m^3.

The water levels are the same on both sides of the U-tube.

Both ends of the U-tube are open to the atmosphere.

Atmospheric pressure is 101 000 N/m^2.

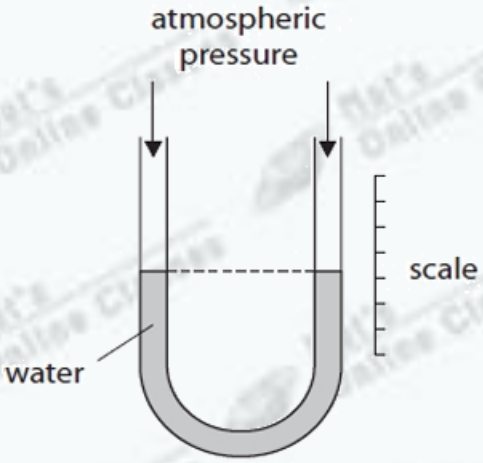

Figure 26

Figure 27 shows the U-tube with one side connected to a gas supply.

The difference in the levels of water, *h*, is 0.200 m.

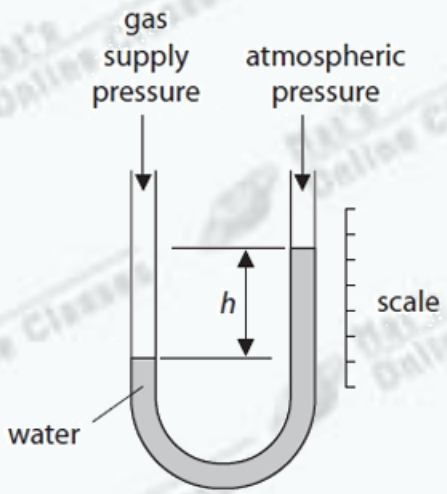

Figure 27

(i) Calculate the gas supply pressure.
Use an equation selected from the list of equations at the end of the paper.

(3)

pressure of gas supply = ... N/m^2

(ii) The measurement is repeated using a U-tube of larger cross-sectional area.
Explain why the value of *h* does not change.

(2)

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(Total for question = 5 marks)

Mark scheme:

Q1.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) 4.0=k x 0.06 rearrangement (1) 4.0 (=k) 0.06 evaluation (1) 67 (N/m)	allow substitution and rearrangement in either order (k=) $\frac{F}{x}$ allow values that round to 67 (N/m) award full marks for the correct answer without working POT error 2 marks maximum	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	(measurement of) original length (1) (measurement of) final length (1)	Accept measure length of spring for 1 mark	(2)

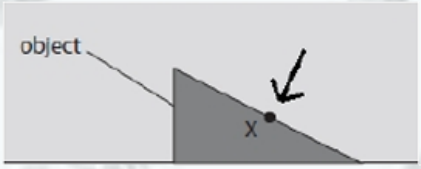
Q2.

Question number	Answer	Additional guidance	Mark
	recall and substitution (1) $0.5 = k \times 13 (\times 10^{-3})$ rearrangement (1) $\frac{0.5}{13(\times 10^{-3})}$ evaluation (1) 38 (N/m)	 $k = \frac{F}{x}$ allow 38.5 (N/m) or 38.46 (N/m) or 39 (N/m) 0.04/0.038 (N/m) gains 2 marks 2958 (N/m) gains 1 mark (x^2 used in equation) award full marks for the correct answer without working	**(3)**

Q3.

Question number	Answer	Additional guidance	Mark
i	recall (1) $P = \frac{F}{A}$ substitution (1) $(p) = \frac{2400}{0.8}$ evaluation (P) = 3000 (Pa) (1)	may be implied by a correct substitution award full marks for the correct answer without working	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
ii	an explanation linking greater pressure (on bottom of tank) (1) with greater force **due to water** (above bottom of tank) (1)	more weight of water more depth/height of water ignore simply 'more water' or 'greater amount of water'	**(2)** **AO1**

Question number	Answer	Additional guidance	Mark
iii	 an arrow perpendicular to the sloping side **and** pointing towards X	judge by eye	**(1)** **AO1**

Q4.

Question Number:	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative (example) content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • same force at tip and head of the thumb tack • flat end has a large surface area • pointed end has a very small surface area • using pressure =force /area • at pointed end the pressure is large • large pressure , tip goes into wood • at flat end the pressure is much less • the flat end does not damage the thumb	**(1)** AO 1 2

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) (p) = 1000 x 10 x 0.200 evaluation of pressure difference (1) 2000 final evaluation (1) 103000 (Pa)	 accept e.c.f for addition of atmospheric pressure seen for 1mark award 1 mark for selecting correct equation if no other mark awarded award full marks for correct answer without working.	(3)

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking use of $P = h \times \rho \times g$ (1) no area in the equation (1)	 P /pressure, ρ /density (and g /gravitational field strength) are constant/the same Area does not affect result h /height of water is independent of area P, ρ, and g are all constant gains 2 marks	(2)