3.10 Density, Pressure in Liquids and Change of State: 30-minute Pack

EDEXCEL 4PH1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

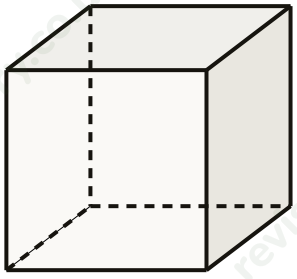
1 State a typical value for atmospheric pressure at sea level and give its units.

(Total for Question 1 is 1 mark)

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2 A cube of plastic has edge length 6.0 cm and density 950 kg/m^3. Calculate the mass of the cube in grams. Show equation, substitution and final answer with units.

Diagram NOT accurately drawn



6.0 cm

(Total for Question 2 is 2 marks)

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3 Define pressure in a liquid at a depth and state the equation linking pressure, depth, fluid density and gravitational field strength, naming symbols.

(Total for Question 3 is 2 marks)

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4 Ice of mass 0.25 kg at 0°C is melted to water at 0°C. The specific latent heat of fusion of ice is 3.34×10^5 J/kg. Calculate the energy required. Show equation, substitution and final answer with units.

(Total for Question 4 is 3 marks)

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5 A small sample of an unknown metal has volume 15.0 cm^3 and mass 120 g. Calculate its density in kg/m^3 and suggest which metal it could be from this list: aluminium (2700 kg/m^3), copper (8900 kg/m^3), iron (7800 kg/m^3), zinc (7100 kg/m^3). Show your working and final answer.

(Total for Question 5 is 3 marks)

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6 Using $p = h \rho g$, calculate how much the pressure increases per metre depth in freshwater (ρ = 1000 kg/m^3). Give your answer in Pa per metre. Use g = 9.8 N/kg.

(Total for Question 6 is 2 marks)

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7 A diver swims at a depth of 12 m in seawater with density 1025 kg/m^3. Calculate the increase in pressure due to the water at that depth. Use g = 9.8 N/kg. Give your answer in Pa.

(Total for Question 7 is 3 marks)

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8 Explain why the pressure at the base of a tall tank of mercury is greater than at the base of a tall tank of water of the same depth, using the $p = h \rho g$ equation and particle ideas.

(Total for Question 8 is 3 marks)

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9 A sealed container has two immiscible liquid layers of equal depth 0.20 m. The upper layer is oil with density 850 kg/m^3 and the lower layer is water with density 1000 kg/m^3. Calculate the pressure at the interface between the oil and water due to the oil alone. Use g = 9.8 N/kg. Give your answer in Pa.

(Total for Question 9 is 2 marks)

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10 A block of aluminium of mass 270 g is heated, and its temperature rises from 20°C to 80°C. The specific heat capacity of aluminium is 900 J/kg °C. Calculate the energy required to heat the block. Show equation, substitution and final answer with units.

(Total for Question 10 is 3 marks)

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11 A student uses 500 g of water at 20°C and supplies 9,000 J of energy. Calculate the final temperature of the water. Use specific heat capacity of water as 4200 J/kg °C. Show equation, substitution and final answer with units.

(Total for Question 11 is 4 marks)

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Mark scheme · 3.10 Density, Pressure in Liquids and Change of State: 30-minute Pack

Question 1

1.01 x 10^5 Pa or 101,325 Pa **B1**

Answer: 1.01 x 10^5 Pa (approximately 101,325 Pa)

Question 2

calculates volume = 6.0^3 cm^3 = 216 cm^3 = 216 x 10^{-6} m^3 **M1**

mass = density x volume = 950 x 216e-6 = 0.2052 kg = 205.2 g cao **A1**

Answer: Mass = 205.2 g

Question 3

p = h x ρ x g with p = pressure, h = depth, ρ = fluid density, g = gravitational field strength **B1**

pressure is the normal force exerted per unit area **B1**

Answer: Pressure is the normal force exerted per unit area. p = h ρ g, where p is pressure, h is depth, ρ is fluid density and g is gravitational field strength.

Question 4

writes E = m L **M1**

substitutes m = 0.25, L = 3.34 x 10^5 so E = 0.25 x 3.34 x 10^5 **M1**

E = 8.35 x 10^4 J cao **A1**

Answer: E = 8.35 x 10^4 J (83,500 J)

Question 5

converts mass to kg and volume to m^3: m = 0.120 kg, V = 15.0 x 10^{-6} m^3 **M1**

computes density = m / V = 0.120 / 15.0e-6 = 8000 kg/m^3 **M1**

identifies closest metal as iron (7800 kg/m^3) or states value 8000 kg/m^3 and suggests iron as reasonable match **A1**

Answer: Density = 8.00 x 10^3 kg/m^3, suggests iron as the closest match

Question 6

uses p/h = ρ g = 1000 x 9.8 **M1**

pressure increases by 9,800 Pa per metre cao **A1**

Answer: Pressure increases by 9,800 Pa per metre

Question 7

writes p = h ρ g **M1**

substitutes p = 12 x 1025 x 9.8 **M1**

p = 120,540 Pa (give or take rounding) cao **A1**

Answer: 1.21 x 10^5 Pa (120540 Pa)

Question 8

states p = h ρ g and that h and g are same so difference is ρ **B1**

mercury has higher density (more mass per unit volume) than water **B1**

therefore weight of column above base is greater, so pressure at base is greater **B1**

Answer: Because mercury has a larger density, the term ρ is bigger so p = h ρ g is larger; a denser fluid means more mass in the same column and therefore more weight on the base

Question 9

uses p = h ρ g with h = 0.20, ρ = 850, g = 9.8 **M1**

p = 0.20 x 850 x 9.8 = 1666 Pa (rounding acceptable) cao **A1**

Answer: Approximately 1.67 x 10^3 Pa (1666 Pa)

Question 10

writes E = m c DeltaT **M1**

substitutes m = 0.270 kg, c = 900, DeltaT = 60 so E = 0.270 x 900 x 60 **M1**

E = 14,580 J cao with units **A1**

Answer: E = 1.46 x 10^4 J (14,580 J)

Question 11

writes E = m c DeltaT **M1**

substitutes E = 9000, m = 0.500 kg, c = 4200 so 9000 = 0.500 x 4200 x DeltaT **M1**

rearranges to DeltaT = 9000 / (0.500 x 4200) **M1**

DeltaT = 4.29°C so final temperature = 24.29°C cao **A1**

Answer: Final temperature = about 24.3°C

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