Q1.

* The approximate age of an egg can be determined by placing it in a bowl of water. Two eggs of different ages are placed in water and come to rest as shown.

1 day   1 month
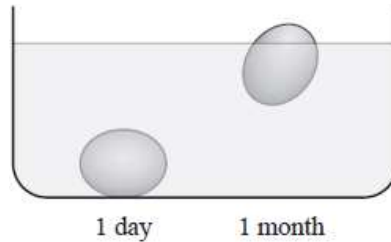
The internal structure of an egg is shown below.

air cell

egg white

yolk

shell
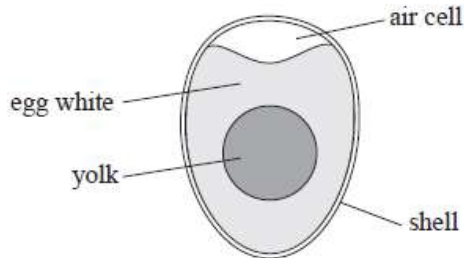
A student searched on the internet to find the reason why old eggs float.

He found the following statements on different websites.

Statement 1

Old eggs float because as the egg ages it starts to decompose. As it decomposes gases are produced that escape through the eggshell.

Statement 2

As the egg ages, air enters the egg through the eggshell and increases the size of the air cell. The larger air cell acts as a flotation device and hence old eggs float.

Assess which of these two statements is correct.

(6)

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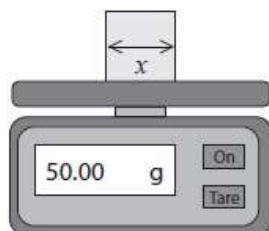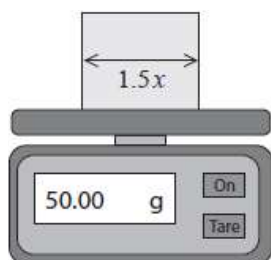
(Total for question = 6 marks)

Q2.

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** $\rho_L = 0.30\ \rho_S$
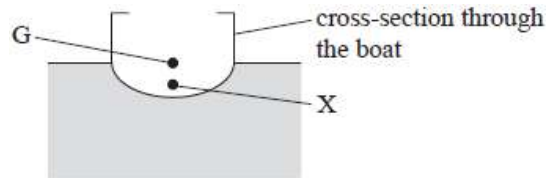
(Total for question = 1 mark)

Q3.

For a boat to maintain a constant upright position in the water, the weight W and upthrust U should have the same line of action.

W acts through G, the centre of gravity of the boat.

U acts through X, the centre of gravity of the volume of water displaced by the boat.

G and X are shown on the diagram.

(a)   A sudden gust of wind applies a force to the side of the boat, causing it to tilt.

The lines of action of W and U move apart a distance d, as shown below.
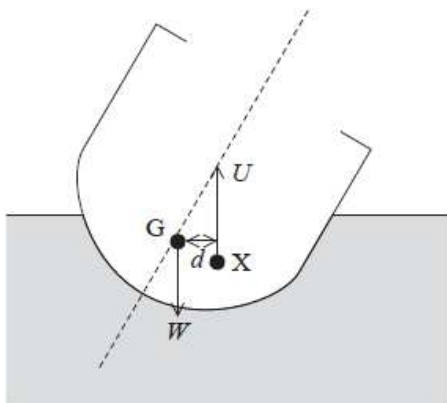
(i)   Explain the effect of the moment Ud.

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(ii) Explain what would happen to the boat in windy weather if the centre of gravity G were higher.

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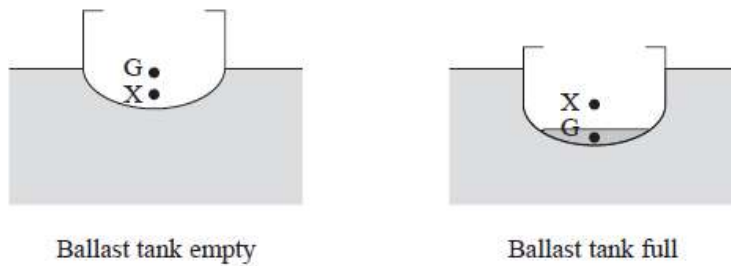
(b) Some boats use a ballast tank, which is a refillable tank of water in the base of the boat, to improve stability.

Ballast tank empty   Ballast tank full

(i) Explain why the position of X for the ship when it has a full ballast tank is lower than when the ship has an empty ballast tank.

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(ii) Explain a disadvantage of using a full ballast tank when the boat is moving through the water.

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(Total for question = 11 marks)

Q4.

Answer the question with a cross in the box you think is correct ⊠. If you change your mind about an answer, put a line through the box ⊠ and then mark your new answer with a cross ⊠.

A sphere of weight 2.5 N floats in water with ½ of its volume beneath the surface.

A force F is applied to the sphere, completely immersing it in the water as shown.

Which of the following is the minimum value of F?

☒ **A** 2×2.5 N

☒ **B** 1×2.5 N

☒ **C** $½ \times 2.5$ N

☒ **D** $¼ \times 2.5$ N

(Total for question = 1 mark)