Revision Questions Thermal + Material Physics

1. Fig. 1 shows a pond that is kept at a constant depth by a pressure-operated valve in the base.

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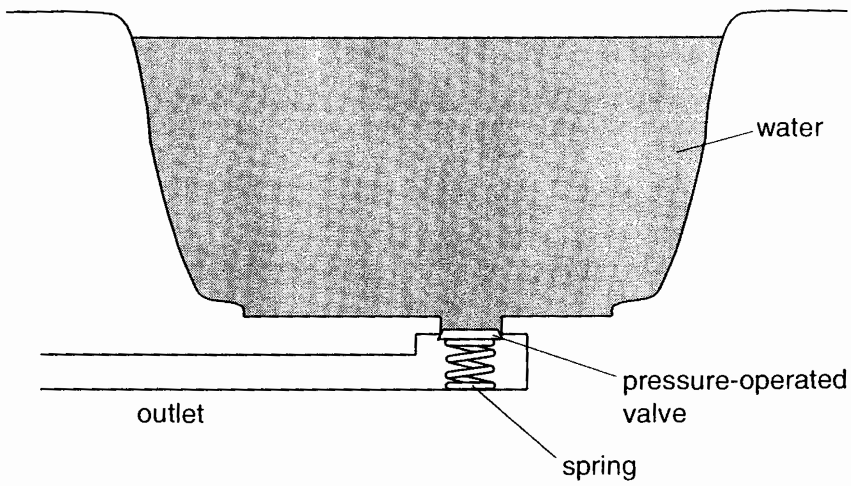

Fig. 1

(a) The pond is kept at a depth of 2.0 m. The density of water is 1000 kg/m^3.

Calculate the water pressure on the valve.

pressure =.......................... [2]

(b) The force required to open the valve is 50 N. The valve will open when the water depth reaches 2.0 m.

Calculate the area of the valve.

area = ... [2]

(c) The water supply is turned off and the valve is held open so that water drains out through the valve.

State the energy changes of the water that occur as the depth of the water drops from 2.0 m to zero.

....

.... [2]

2 Fig. 2. shows a reservoir that stores water.

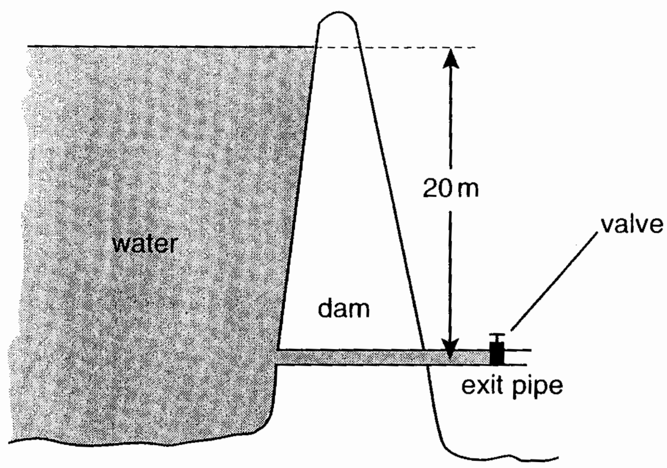

Fig. 2

(a) The valve in the exit pipe is closed. The density of water is 1000 kg/m^3 and the acceleration of free fall is 10 m/s^2.
Calculate the pressure of the water acting on the closed valve in the exit pipe.

pressure = ...[2]

(b) The cross-sectional area of the pipe is 0.5 m^2.
Calculate the force exerted by the water on the closed valve.

force = ...[2]

(c) The valve is then opened and water, originally at the surface of the reservoir, finally flows out of the exit pipe. State the energy transformation of this water between the surface of the reservoir and the open end of the pipe.

....

....[2]

For Examiner's Use

3. **(a)** Fig. 3 shows a sealed box.

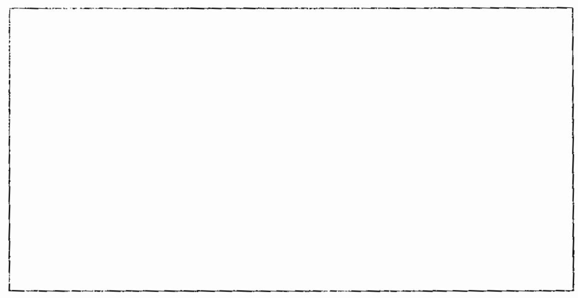

Fig. 3

(i) The box contains a large number of air molecules. On Fig. 5.1, draw a possible path of **one** of the air molecules, as it moves inside the box.

(ii) Explain

1 how air molecules in the box create a pressure on the inside walls,

....

....

....

2 why this pressure rises as the temperature of the air in the box increases.

....

....

....

[5]

(b) Air in a cylinder is compressed slowly, so that the temperature does not rise. The pressure changes from 2.0×10^5 Pa to 5.0×10^5 Pa. The original volume was $0.35\,m^3$. Calculate the new volume.

volume = ...[3]

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4 **(a)** Fig. 4 shows the paths of a few air molecules and a single dust particle. The actual air molecules are too small to show on the diagram.

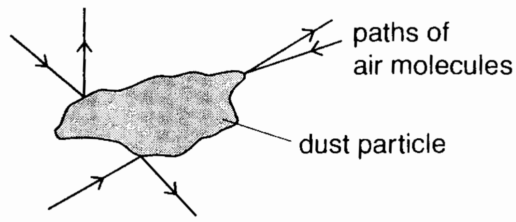

Fig. 4

Explain why the dust particle undergoes small random movements.

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....

....

.... [4]

(b) Fig. 5 shows the paths of a few molecules leaving the surface of a liquid. The liquid is below its boiling point.

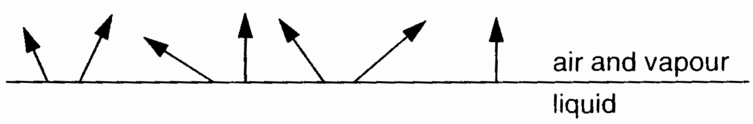

Fig. 5

(i) State which liquid molecules are most likely to leave the surface.

....

.... [1]

(ii) Explain your answer to **(i)**.

....

....

.... [2]

For Examiner's Use

5 **(a)** Two identical open boxes originally contain the same volume of water. One is kept at 15 °C and the other at 85 °C for the same length of time.

Fig. 6 shows the final water levels.

Fig. 6

With reference to the energies of the water molecules, explain why the levels are different.

....

....

....

....[3]

(b) In an experiment to find the specific latent heat of vaporisation of water, it took 34 500 J of energy to evaporate 15 g of water that was originally at 100 °C.

A second experiment showed that 600 J of energy was lost to the atmosphere from the apparatus during the time it took to evaporate 15 g of water.

Calculate the specific latent heat of vaporisation of water that would be obtained from this experiment.

specific latent heat = ... [3]

6. Fig. 7 shows apparatus that could be used to measure the specific latent heat of ice.

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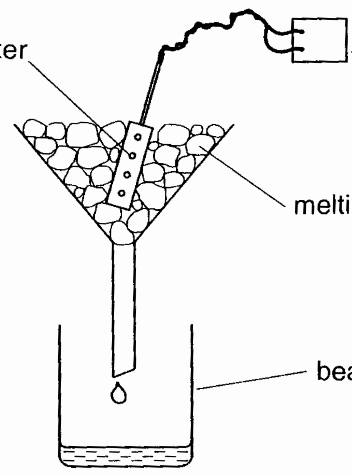

Fig. 7

(a) Describe how you would use the apparatus. You may assume that ice at 0 °C and a stopwatch are available. State all the readings that would be needed at each stage.

....

....

....

....

.... [4]

(b) In an experiment, 120 g of ice at 0 °C is to be melted. The specific latent heat of ice is 340 J/g. Assume that all the energy from the heater will be used to melt the ice.

Calculate the expected time for which the 60 W heater is switched on.

expected time = ... [2]

(c) When the experiment is carried out, the ice melts in slightly less time than the expected time.

(i) State one reason why this happens.

....

.... [1]

(ii) Suggest one modification to the experiment that would reduce the difference between the experimental time and the expected time.

....

.... [1]

For Examiner's Use

7. **(a)** In an experiment to find the specific latent heat of water, the following readings were taken.

m_1	mass of water at 100 °C, before boiling starts	120 g
m_2	mass of water at 100 °C, after boiling finishes	80 g
V	voltage across the heater	12 V
I	current through the heater	2.0 A
t	time that the heater was supplying energy	3750 s

(i) Using the symbols above, write down the equation that must be used to find the value of the specific latent heat L of water.

(ii) Use the equation to calculate the specific latent heat of water from the readings above.

specific latent heat = ...

[4]

(b) Explain, in terms of the energy of molecules, why the specific latent heat of water has a high value.

....

....

....[2]

8. **(a)** Fig. 8 shows a simple type of thermocouple that has been calibrated to measure temperature.

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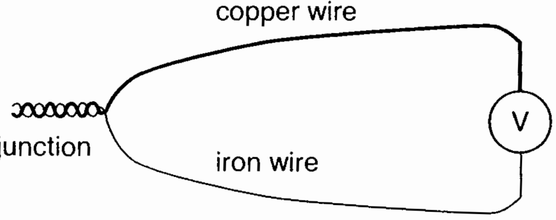

Fig. 8

(i) Describe how the thermocouple could be used to measure the temperature of a beaker of hot water.

....

....

....

(ii) State two situations where a thermocouple would be a good choice of thermometer to measure temperature.

1. ....

....

2. ....

....

[4]

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(b) A mercury-in-glass thermometer is placed in an insulated beaker of water at 60 °C. The water is heated at a constant rate. The temperature of the water is measured and recorded on the graph shown in Fig. 9

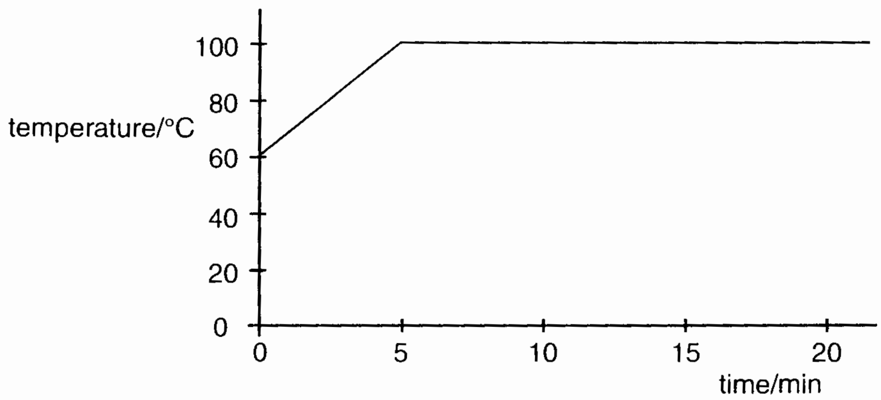

Fig. 9

State the effect of the heat supplied

(i) during the period 0 to 5 minutes,

....

....

(ii) during the period 10 to 15 minutes.

....

.... [2]

[Turn over

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9. Fig. 10 shows a thermocouple set up to measure the temperature at a point on a solar panel.

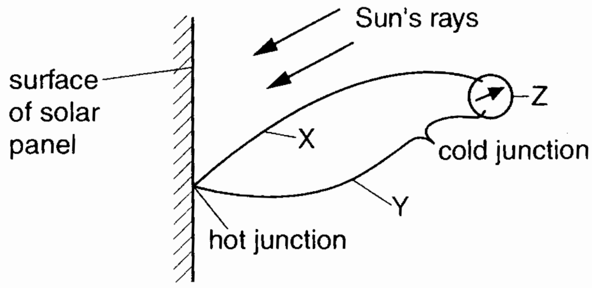

Fig. 10

(a) X is a copper wire.

(i) Suggest a material for Y.

....

(ii) Name the component Z.

....
[2]

(b) Explain how a thermocouple is used to measure temperature.

....

....

....[3]

(c) Experiment shows that the temperature of the surface depends upon the type of surface used.

Describe the nature of the surface that will cause the temperature to rise most.

....

....[1]

For Examiner's Use

1a (a) Fig. 1.1 shows two identical metal plates. The front surface of one is dull black and the front surface of the other is shiny silver.
The plates are fitted with heaters that keep the surfaces of the plates at the same temperature.

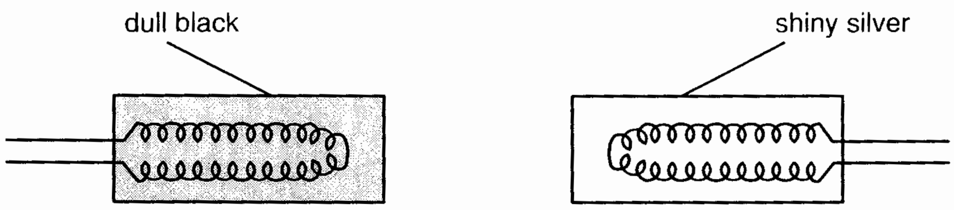

Fig. 1.1

(i) State the additional apparatus needed to test which surface is the best emitter of heat radiation.

....

(ii) State one precaution that is needed to ensure a fair comparison.

....

....

(iii) State the result that you expect.

....

(iv) Write down another name for heat radiation.

....
[4]

(b) In the space below, draw a labelled diagram of an everyday situation in which a convection current occurs.

Mark the path of the current with a line and show its direction with arrows. [3]

For Examiner's Use

11. Fig. 12 shows a rock that is falling from the top of a cliff into the river below.

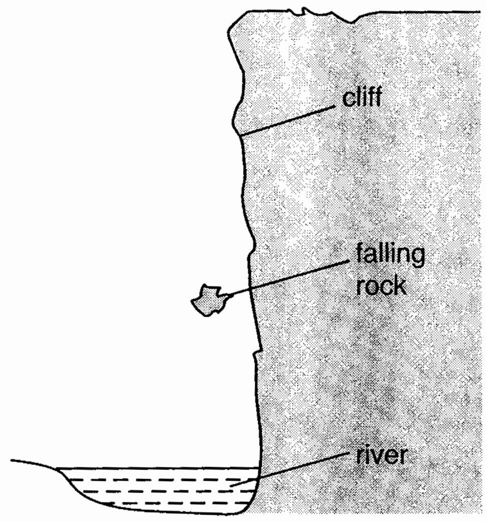

Fig. 12

(a) The mass of the rock is 75 kg. The acceleration of free fall is 10 m/s^2.
Calculate the weight of the rock.

weight = ...[1]

(b) The rock falls from rest through a distance of 15 m before it hits the water.
Calculate its kinetic energy just before hitting the water. Show your working.

kinetic energy = ...[3]

(c) The rock hits the water. Suggest what happens to the kinetic energy of the rock during the impact.

....

....

....[3]