FUKIEN SECONDARY SCHOOL

S4 First Term Uniform Test (2021-2022)

Physics

(1 hour)

Date: 8th November 2021 Name: _____

Time: 9:45a.m. – 10:45a.m. Class: _____ No.: _____

Instructions to students:

1. Write your name, class and class number on both the question paper and the answer sheets.
2. Answer ALL questions.
3. Write down all the answers on the answer sheets.
4. Hand in the question paper and the answer sheets at the end of the examination.
5. The total mark of the paper is 60.
6. The paper consists of two sections: Section A Multiple Choice Questions (20 marks) and Section B Structured Questions (40 marks).
7. You may use the following data and formulas.

   Specific heat capacity of water = 4200 J kg^{-1}°C^{-1}

   Specific heat capacity of ice = 2100 J kg^{-1} °C^{-1}

   Specific heat capacity of steam = 1900 J kg^{-1} °C^{-1}

   Specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1}

   Specific latent heat of vaporization of water = 2.26×10^6 J kg^{-1}

   Energy transfer during heating and cooling: $E = mc\,\Delta T$

   Energy transfer during change of state: $E = l\,\Delta m$

   For uniformly accelerated motion:

$$v = u + at$$
$$s = ut + \frac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Section A: Multiple Choice Questions (20 marks)

1. Which of the following statements about 0 °C are correct?

   (1) It is the lower fixed point of the Celsius temperature scale.

   (2) It represents the hotness of pure melting ice at normal atmospheric pressure.

   (3) It is the temperature at which the average kinetic energy of the particles in an object is zero.

   A. (1) and (2) only

   B. (1) and (3) only

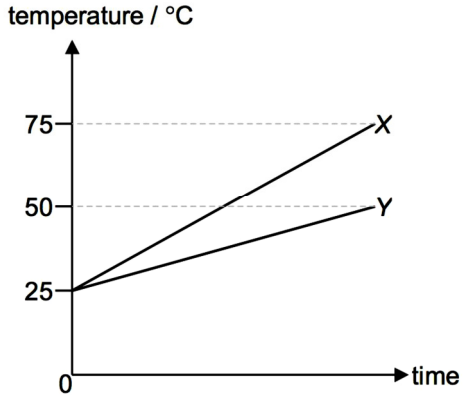
   C. (2) and (3) only

   D. (1), (2) and (3)

2. Gill uses a portable gas stove to prepare hot pot. The energy supplied by the stove in 1 hour is 1920 kcal. For how long does he need to wait if 5150 kJ is required to boil water?
(Given: 1 kcal = 4.19 kJ)

A. 0.320 hour
B. 0.640 hour
C. 1.56 hours
D. 11.2 hours

3. Energy is transferred to two copper blocks *X* and *Y* at the same rate. The graph below shows how the temperatures of the blocks change with time. What is the ratio of the heat capacity of block *X* to that of block *Y* ?



A. 4 : 1
B. 2 : 1
C. 1 : 2
D. 1 : 4

4. A heater is used to heat each of the following blocks for the same period of time. Which block has the highest specific heat capacity?

	Block	**Mass**	**Increase in temperature**
A.	*P*	$\frac{m}{2}$	$2T$
B.	*Q*	m	$2T$
C.	*R*	$2m$	$4T$
D.	*S*	$4m$	T

5. Two objects *X* and *Y* of different initial temperatures are placed inside a **well-insulated** container as shown in Figure (a). They are in good thermal contact. Figure (b) shows the variation of their temperatures with time.

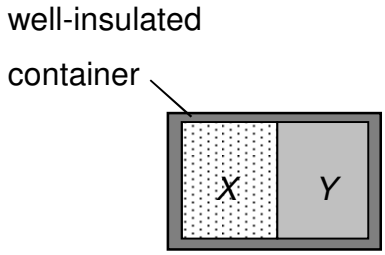


Figure (a)

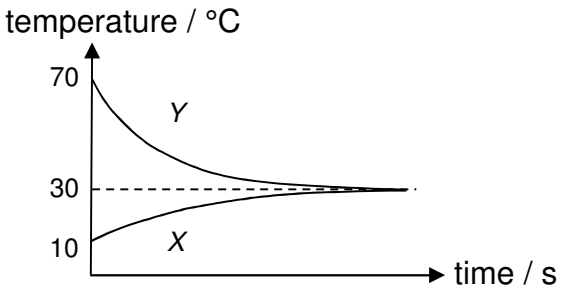


Figure (b)

Which of the following statements is/are correct?

(1) *X* and *Y* are in thermal equilibrium at 30 °C.

(2) The heat lost by *Y* is larger than the heat gained by *X* at the beginning.

(3) The ratio of the heat capacity of *X* to that of *Y* is 7:1.

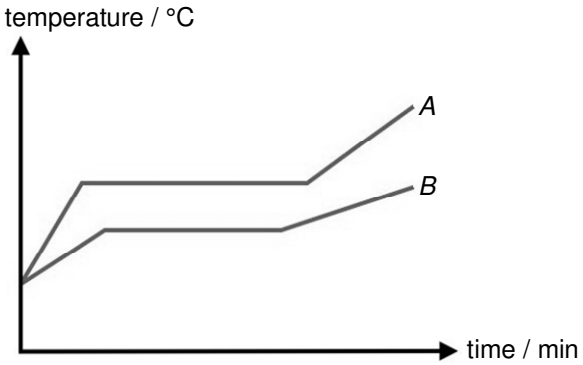
A. (1) only

B. (2) only

C. (1) and (2) only

D. (1) and (3) only

6. Two substances *A* and *B* of the same mass are heated from solid to liquid under the same condition. Energy is transferred to the substances at the same rate. Their temperatures vary with time as shown below.



Which of the following statements is/are correct?

(1) Substance *A* has a higher melting point than substance *B*.

(2) Substance *B* has a higher specific heat capacity in solid state than in liquid state.

(3) Substance *A* has a higher specific latent heat of fusion than substance *B*.

A. (2) only

B. (1) and (3) only

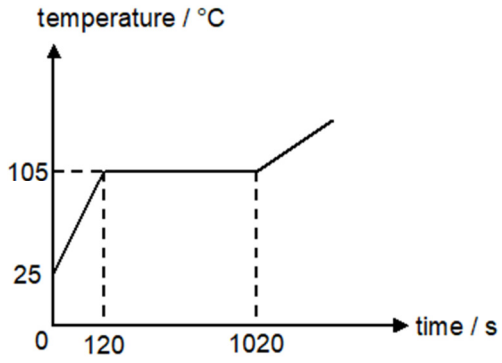
C. (2) and (3) only

D. (1), (2) and (3)

7. In an experiment, a beaker of liquid *X* is heated to boil using a 150 W heater. In 200 s, 0.02 kg of liquid *X* has boiled away. Suppose 20% of the energy has been lost to the surroundings, what is the specific latent heat of vaporization of liquid *X*?

   A. 3.34×10^5 J kg^{-1}
   B. 1.2×10^6 J kg^{-1}
   C. 1.5×10^6 J kg^{-1}
   D. 2.26×10^6 J kg^{-1}

8. A solid *X* of unknown mass is heated with a 100 W heater. It is known that the specific heat capacity of solid *X* is 500 J kg^{-1}°C^{-1}. The graph below shows how the temperature of *X* varies with time. Assume that all the energy given out by the heater is absorbed by the solid. Find the specific latent heat of fusion of solid *X*.



   A. 340 kJ kg^{-1}
   B. 30 kJ kg^{-1}
   C. 394 kJ kg^{-1}
   D. 300 kJ kg^{-1}

9. A car speeds up from rest at a uniform acceleration of 3 m s^{-2} for 3 seconds. Then, it slows down at a uniform deceleration of 3 m s^{-2} for 3 seconds. Which of the following statements is/are correct?

   (1) The displacement of the car is zero at 6 s.
   (2) The average velocity of the toy car is +3 m s^{-1}.
   (3) The velocity of the toy car is zero at 6 s.

   A. (1) only
   B. (2) only
   C. (3) only
   D. (2) and (3) only

10. In a 400 m race, a runner first accelerates uniformly from rest to a speed of $8\ \text{m s}^{-1}$. He then maintains this speed and finishes the race in 52 s. How long does the runner take to reach the speed of $8\ \text{m s}^{-1}$?
    A. 2 s
    B. 4 s
    C. 6 s
    D. 8 s

End of Section A

Section B: Structured Questions (40 marks)

1. Figure 1 shows an air thermometer.

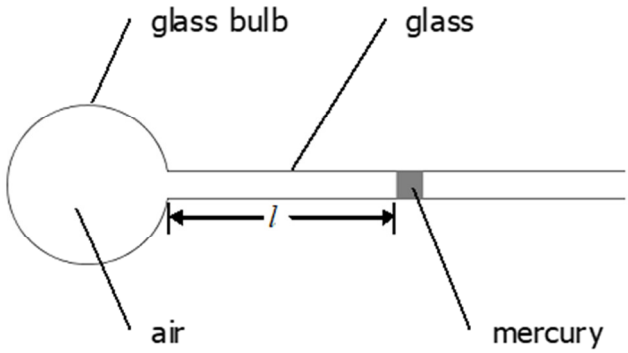


Figure 1

(a) Briefly describe how the thermometer works. (2 marks)

(b) The length l of the air column in the glass tube is 7 cm and 22 cm at 0 °C and 100 °C respectively. What is the temperature when the length l is 15 cm? State one assumption made in your calculations. (3 marks)

(c) Suggest one modification to the air thermometer such that

(i) the thermometer is more sensitive. It means that the change in length of the air column is more sensitive to the temperature change. (1 mark)

(ii) the thermometer shows a quicker response to temperature change. (1 mark)

2. Briefly explain how the following daily cases are related to heat transfer.

(a) The radiator of a refrigerator is usually painted black. (2 marks)

(b) A ventilation fan is usually installed at a high position in the kitchen. (2 marks)

(c) In Figure 2, the handle of a pan is made of wood. (2 marks)

Figure 2

3. A student uses the apparatus shown in Figure 3 to investigate the specific heat capacity of a liquid. The immersion heater has a power of 10 W.

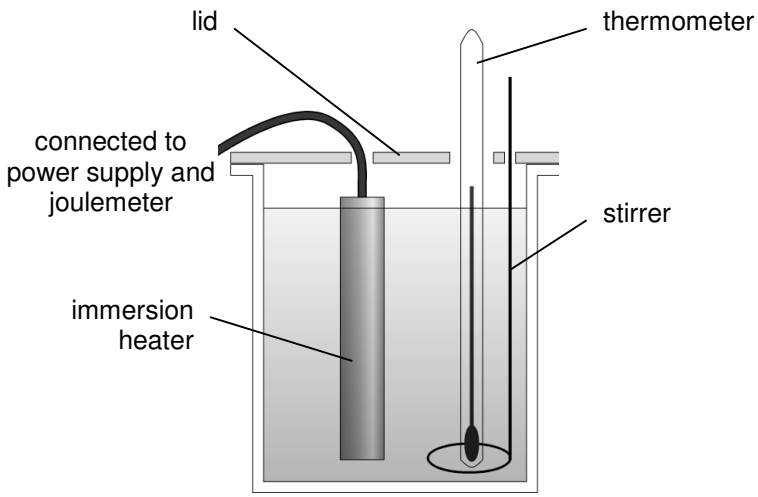


Figure 3

The heater is switched on for 5 minutes and the temperature of the liquid is recorded. The experiment is repeated with the liquid of different mass. The following results are obtained.

mass of liquid, m / kg	0.2	0.25	0.3	0.35	0.4
temperature rise of the liquid, ΔT / °C	5.1	4.0	3.2	2.7	2.4

(a) (i) Calculate the values of $\frac{1}{\Delta T}$ and plot a graph of $\frac{1}{\Delta T}$ against m. (4 marks)

(ii) Deduce the slope of the graph in (a) (i). Express the slope in terms of physical quantities. (1 mark)

(iii) Use the result of in (a) (ii) to find the specific heat capacity of the liquid. (3 marks)

(b) If the lid is removed, do you think the answer in (a) (iii) would be higher or lower? Briefly explain your answer. (2 marks)

4. A student adds some ice cubes having an initial temperature of −10 °C to liquid Z of mass 180 g and specific heat capacity of 3500 J $kg^{-1}°C^{-1}$ at 50 °C. When the mixture reaches thermal equilibrium, 45 g of ice cubes is not melted. Find the initial mass of the ice cubes. Neglect the heat loss to the surroundings. (3 marks)

5. A liquid of mass 2.5 kg is heated by a 500 W heater. Figure 4 shows how the temperature of the liquid varies with time.

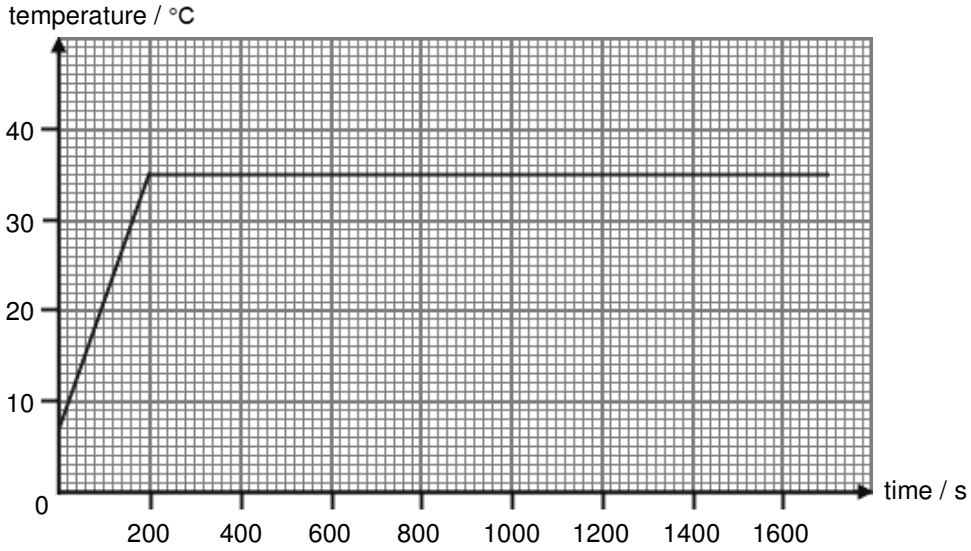


Figure 4

(a) Find the specific heat capacity of the liquid. (2 marks)

(b) At 1700 s, the mass of liquid that remains is 0.6 kg.

(i) State the definition of specific latent heat of vaporization of a substance. (1 mark)

(ii) Find the specific latent heat of vaporization of the liquid. (2 marks)

(c) A student thinks that the internal energy of the substance remains unchanged from 200 s to 1700 s. Do you argee with the student? Explain your answer. (2 marks)

6. The velocity–time graph of a car travelling along a straight line is shown in Figure 5.

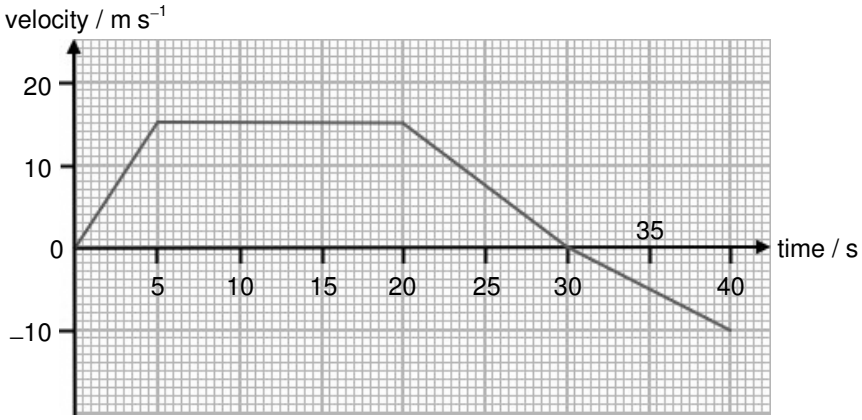


Figure 5

(a) Draw the corresponding acceleration–time graph of the car. Label the values of acceleration at different time periods. (3 marks)

(b) When will the car be furthest from the starting point? Find the car's distance from the starting point at this moment. (2 marks)

(c) Find the magnitude of the average velocity of the car during the first 40 s. (2 marks)

End of Section B

END OF PAPER