Neap:

PHYSICS VCE UNITS 1&2
DIAGNOSTIC TOPIC TESTS 2016

TEST 1: HOW CAN THERMAL EFFECTS BE EXPLAINED? (I)

TOTAL 45 MARKS (45 MINUTES)

Student's Name: _____ Teacher's Name: _____

Directions to students

Write your name and your teacher's name in the spaces provided above.
Answer all questions in the spaces provided.

Question 1 (1 mark)

There are various scales used to measure temperature. Two important ones are based on the Celsius and Kelvin scales.

Which one of the following statements gives the correct formula for converting the temperature in Celsius to the temperature in Kelvin?

A. $T_{(K)} = T_{(°C)} + 273.15$

B. $T_{(°K)} = T_{(°C)} + 273.15$

C. $T_{(K)} = T_{(°C)} - 273.15$

D. $T_{(°K)} = T_{(°C)} - 273.15$

Question 2 (2 marks)

On a cold winter's night the room temperature in Monis' bedroom is 10°C. To keep warm, Monis puts two blankets on top of him when he goes to bed.

Explain how the blankets keep Monis warm.

_____

_____

_____

_____

d. What is the melting point of compound X-1? 2 marks

°C

e. What is the boiling point of compound X-1? 2 marks

°C

Question 9 (6 marks)

A thermos flask (Figure 4) is used to keep liquids very hot for a long time (for example, hot coffee taken in a thermos flask on a cold winter's day to an outside sporting event).

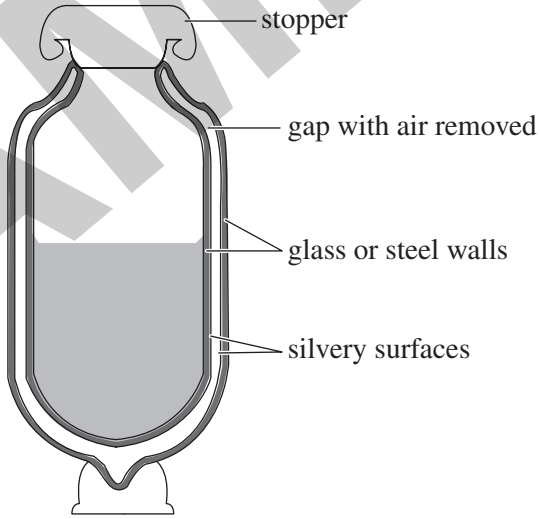

Figure 4

Explain, using the principles of conduction, convection and radiation, why the thermos flask can keep hot liquids hot for a long time. You should refer to Figure 4 in your answer.

Question 10 (10 marks)

The table below gives some specific heat capacities for various substances.

Substance	Specific heat capacity ($J\ kg^{-1}\ K^{-1}$)
water	4200
human body (average)	3500
air	1003
desert sand	830
glass (various)	660–720
steel	460
copper	380
lead	129

a. Explain why the specific heat capacity of the human body is so high. 2 marks

_____

_____

_____

_____

b. Explain why the water temperature does not change as quickly as the air temperature for the same mass of air and water. 2 marks

_____

_____

_____

_____

c. Explain why many steel saucepans used on conventional hotplate stoves have copper bottoms. 2 marks

_____

_____

_____

_____

d. Explain why glass has a range of possible values for its specific heat capacity. 2 marks

_____

_____

_____

_____

Neap:

PHYSICS VCE UNITS 1&2
DIAGNOSTIC TOPIC TESTS 2016

TEST 1: HOW CAN THERMAL EFFECTS BE EXPLAINED? (I)

SUGGESTED SOLUTIONS AND MARKING SCHEME

Question 1 (1 mark)

The correct answer is **A.** 1 mark

$T_{(K)} = T_{(°C)} + 273.15$

Question 2 (2 marks)

The blankets allow Monis' body heat to keep him warm. Cold air will carry his body heat away. Blankets form a barrier between his body and the cold air. 1 mark

Heat does not transfer through blankets very well as they are good insulators, so most of the heat generated by Monis' body is kept in the tiny air space between him and the blankets. 1 mark

Question 3 (6 marks)

a. $Q = 1200$ J 1 mark

$W = 400$ J 1 mark

$\Delta U = 1200 - 400 = 800$ J 1 mark

Therefore the change in the internal amount of energy of the balloon as it expands is an increase of 800 J.

b. $Q = mc\Delta T$ 1 mark

$800 = m(5193)(10)$ 1 mark

$m = 1.5 \times 10^{-2}$ kg 1 mark

Note: Consequential on answer to ***Question 3a.***

Question 4 (3 marks)

The total internal energy of a body is present as the random kinetic energy of the molecules (for example, molecular vibration) and the potential energy of the molecules (for example, bond energies). Temperature is a measure of the average random kinetic energy per molecule. 1 mark

The human body per molecule has a greater average of kinetic energy than the ocean does per molecule which means it has a higher temperature. 1 mark

However, the ocean has a much greater mass than Ed's body and therefore has a much greater total internal energy. 1 mark

Question 5 (2 marks)

The gas in the gas bottle is under high pressure. 1 mark

When the valve is opened the gas coming out expands rapidly. This expansion in volume causes the temperature to drop. 1 mark

Question 6 (3 marks)

Let the final temperature of the bolt–water system be T. As the system is in thermal equilibrium, the heat lost by the steel bolt cooling down has gone into heating the water up.

Using $Q = mc\Delta T$ gives $(460)(0.2)(100 - T) = (4200)(1.0)(T - 20)$ 1 mark

$$92(100 - T) = (4200)(T - 20)$$ 1 mark

$$93\,200 = 4292T$$

$$T = 21.7\,^{\circ}\text{C}$$ 1 mark

Question 7 (2 marks)

A small layer of air which is in contact with your body is heated up beyond the ambient temperature of the air in the room. The electric fan blows this heated air layer away and replaces it with room temperature air, which is cooler. Thus heat from the warmer body passes to the cooler air, drawing away more heat. 1 mark

The electric fan also increases the rate of evaporation of moisture from your skin, which decreases the skin temperature as the moist air is replaced by dry air, even at the same temperature as the skin. Latent heat would be drawn by the dry, warm air. 1 mark

Question 8 (10 marks)

a. The solid form of compound X-1 begins to melt at time $t \approx 7$ minutes. 2 marks

b. Compound X-1 is in the solid form until $t \approx 7$ minutes. . 2 marks

c. Compound X-1 takes approximately 10 minutes to change from a liquid form to gas (27 – 17 m). 2 marks

d. The melting point of compound X-1 is approximately –18°C. 2 marks

e. The boiling point of compound X-1 is approximately 66°C. 2 marks