Name:_____

VCE UNIT 1/2 Physics Coursework Assessment

Name: SOLUTIONS.

VCE Study: Physics **Unit: 1** **Time allowed : 60 minutes**

Name of Task: Thermal Physics – Summary of practical reports

Grade/Score: _____ **Satisfactory Completion? S/N:** _____

Conditions:

Students are permitted to bring one single sided A4 page of notes

Thermodynamic pracs.

Formulae Sheet

Students may use a scientific calculator

Assessment Criteria

- convert temperature between degrees Celsius and kelvin
- describe the Zeroth Law of Thermodynamics as two bodies in contact with each other coming to a thermal equilibrium
- describe temperature with reference to the average kinetic energy of the atoms and molecules within a system
- distinguish between conduction, convection and radiation with reference to heat transfers within and between systems

analyse theoretically and practically the energy required to:

—raise the temperature of a substance: $Q = mc\Delta T$

—change the state of a substance: $Q = mL$

- explain why cooling results from evaporation using a simple kinetic energy model.
- describe power radiated by a body as being dependent on the temperature of the body according to the Stefan-Boltzmann Law, $P \propto T^4$

1. A pool blanket is used to trap heat within a pool to prevent the water from rapidly cooling down overnight. Four types of pool blanket were tested on identical pools. Each pool was heated to 28°C and at 5 p.m. each pool blanket was used to cover a pool. At 9 a.m. the following morning, the blankets were removed and the water temperature tested in each case. The results were as follows:

Pool blanket	**Silverline**	**Hot stuff**	**Luxury liner**	**Thermospecial**
Temperature at 9 a.m. (°C)	26	24	25.5	23.5

The four blankets listed in order from most effective insulator to least effective insulator are:

A Hot stuff, Silverline, Luxury liner, Thermospecial
B Silverline, Luxury liner, Hot stuff, Thermospecial
C Luxury liner, Thermospecial, Hot stuff, Silverline
D Thermospecial, Hot stuff, Luxury liner, Silverline

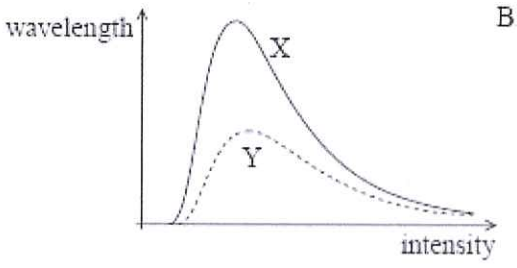
(1 mark)

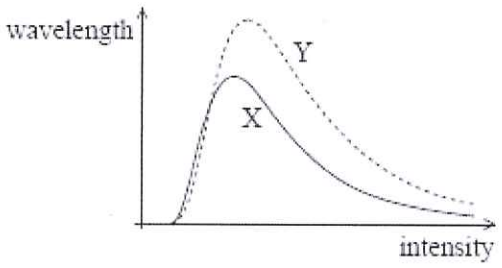
2. Convert 35°C into Kelvin.

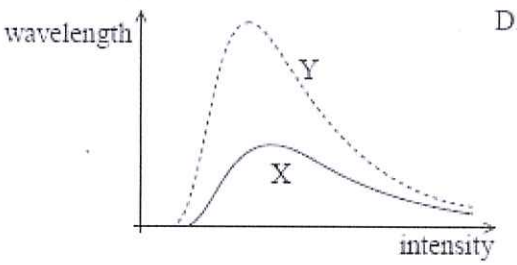
A 238 K
B 308 K
C 238°K
D 308°K

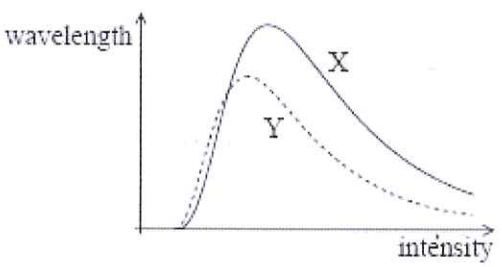
(1 mark)

3. Two black bodies X and Y are at different temperatures. The temperature of body Y is higher than that of body X. Which of the following shows the black body spectra for the two bodies?

A.


B.


C.


D.


(1 mark)

4. Which of the following will affect the rate at which an object radiates thermal energy?

A its temperature

B its colour

C its surface nature (shiny or dull)

D All of the above

(1 mark)

5. The natural greenhouse effect is caused mainly by the

A. direct trapping of solar radiation as it moves down through the atmosphere.

B. trapping by the atmosphere of radiation re-emitted by the earth's surface.

C. inability of solar radiation to penetrate the atmosphere.

D. increase in greenhouse gases due to human activity.

(1 mark)

6. Which of the following is the most likely effect of the enhanced greenhouse effect?

A. cooler nights

B. higher sea level

C. a significant reduction in atmospheric oxygen concentrations

D. lower levels of ultraviolet radiation reaching the earth's surface

(1 mark)

7. Which of the following is a greenhouse gas?

A. helium

B. oxygen

C. nitrogen

D. methane

(1 mark)

8. The enhanced greenhouse effect is due to

A. increased trapping of infrared radiation emitted from the Earth's surface and oceans.

B. decreased trapping of infrared radiation emitted from the Earth's surface and oceans.

C. increased trapping of visible and ultraviolet radiation emitted from the Earth's surface and oceans.

D. decreased trapping of visible and ultraviolet radiation emitted from the Earth's surface and oceans.

(1 mark)

9. A student does 100 J of work on a pot of cold water by stirring vigorously, the water also gains 30 J of thermal energy from its surroundings. What is the change in internal energy of the water?

$\Delta U = Q - W$

$= 30 - (-100)$

$= 130\ J$

(2 marks)

10. **Classify** each situation of heat transfer listed below as primarily being an example of conduction, convection or radiation.

a) Aiden feels his arms getting warm as he plays cricket on a summer day.

Radiation

b) Mika touches a tray that has just come out of the oven and burns her hand.

Conduction

c) The interior of a car warms up soon after the heater has been turned on.

Convection

(1 mark)

11. Energy must be supplied to ice in order for it to melt. The temperature of the resulting water is no higher than that of the original ice. Explain.

During a change in state the energy is used in overcoming the intermolecular bonds in the substance. Therefore no change in temperature.

(2 marks)

12. With reference to the particle model and heat transfer, explain why drying yourself quickly after a shower helps you keep warm.

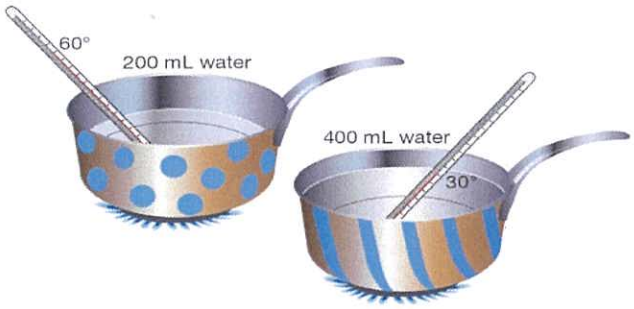
Conduction and/or evaporation.

← Not sure

(2 marks)

7

13. 200 mL of cold water is heated in a spotted saucepan, and 400 mL of cold water is heated in an identical striped saucepan.



a Explain why the base of each saucepan is metal, but the handles are made from a tough plastic.

The base of the saucepan is made from metal because it is a good conductor of heat and allows food to cook quicker. The handles are tough plastic because it is an insulator and prevents the handle heating up. Safe for people to pick up.

(2 marks)

b Explain why the water in the spotty saucepan heats up faster.

The spotty saucepan contains half the number of water particles. Since the energy supplied to both saucepans is the same, the spotty pan molecules will heat twice as fast.

(1 mark)

c Compare the average kinetic energy of particles in each saucepan.

The particles in the spotted pan have greater kinetic energy as it's temperature is higher.

(1 mark)

14. An immersion heater supplies energy to a lump of solid wax with a mass of 100g. The temperature of the wax is 20 °C. The melting point of the wax is 56 °C. The immersion heater has a potential difference of 6V and a current of 1.2 A and supplies the wax with energy at a constant rate for 15 minutes.

(c_{wax} = 2,140 J kg^{-1} K^{-1} $L_{f\ wax}$ = 200,000 J kg^{-1})

a) Show that the immersion heater supplies 6480J of energy

$Q = E = VIt = 6 \times 1{\cdot}2 \times 15 \times 60$ (15 minutes in seconds).

$Q = 6480$ J **(1 marks)**

b) What temperature will the wax be after 15 minutes?

$Q = mc\Delta T$

$6480 = 0{\cdot}1 \times 2140 \times \Delta T$

$\Delta T = \frac{6480}{0{\cdot}1 \times 2140} = 30{\cdot}28°$ $T_f = 20 + 30{\cdot}28 = 50°C$ **(2 marks)**

c) How much of the wax melted? Explain why?

None, it didn't reach melting point.

(1 mark)

15. 100g of ice is taken straight out of the freezer at 0°C. It is added to 400g water at 26 °C. After all of the ice has melted it warms up until it reaches the same temperature as the water which is now nice and cool!

(c = 4 200 J kg^{-1} K^{-1} L_f = 334 000 J kg^{-1}). **Show your working clearly**

a) Determine the energy required to melt the ice.

$Q = mL_f = 0{\cdot}1 \times 334\,000$

$= 33\,400$ J **(2 marks)**

b) Hence determine the temperature of the final mixture. Give your answer to 2 dp.

(ice) $Q_{melting} + Q_{temp} \uparrow = Q_{temp} \downarrow$ (water)

$33\,400 + mc(T_E - 0) = mc(26 - T_E)$

$33\,400 + 0{\cdot}1 \times 4200(T_E) = 0{\cdot}4 \times 4200(26 - T_E)$

$33\,400 + 420T_E = 43\,680 - 1680T_E$

$2100T_E = 43\,680 - 33\,400$ **(3 marks)**

$T_E = 4{\cdot}90°C$

9

16. If many objects are at 'room temperature', explain why metal objects feel cooler to touch than wooden objects?

Metals are good conductors of heat, so heat will be transferred quickly from your hands so will feel cool. Wood is a good insulator, heat transferred more slowly.

(2 marks)

17. Describe in terms of heat transfer how closing the curtains in the evening will help to keep the inside of a house warm?

Reduces radiation loss by reflecting heat back into room. Reduces conduction by trapping an extra layer of air between the glass and curtains.

(1 mark)

18. By referring to one of your experiments describe how a convection current develops and give a real world example. You must include a diagram.

(2 marks)

273 + 4 = 277 K.

19. A can of pepsi, containing 375g of delicious liquid, which has a specific heat capacity of 4220 J Kg^{-1} K^{-1} is chilled to 4.0 °C (an ideal temperature to drink). The can is 13.0cm high and has a diameter of 6.0 cm. The surface area of the can is 0.0301 m^2. Unfortunately, it was left in a warm room at 30.0 °C for an hour. Work out the following:

273 + 30 = 303 K

a) Taking the emissivity between the can and the surroundings as 1.0 and assuming that the can only gains energy from radiation, what is the rate at which power is transferred to the can?

$P = e\sigma A(T^4 - T_s^4)$

$= 1 \times 5.67 \times 10^{-8} \times 0.0301 (277^4 - 303^4)$

$= -4.47$ W

or power gained from surroundings at rate of 4.47W.

(2 marks)

b) The energy that would be gained by the liquid in the can after 1 hour (assuming only radiation).

$E = P \times t$

$= 4.47 \times 1 \times 60 \times 60 = 16082$ J

(2 mark)

c) What would be the temperature of the contents after sitting there for an hour?

$Q = mc\Delta T$

$16.082 = 0.375 \times 4220 \times \Delta T$

$\Delta T = 10.2$ °C $T = 4 + 10 = 14$ °C

(2 marks)

d) Your answer to part (c) is unlikely to be realistic. Explain why.

Only taking into account heat loss by radiation, ignoring conduction and convection. Also the rate of power transfer will change as the temperature of liquid changes.

(1 mark)