

# REVIEW QUESTIONS

The following questions come from recent examination papers and, as such, are good examples of the type of question that will appear on your examination appear. The marks allocated also indicate, in minutes, the amount of time available under exam conditions to do the questions.

- 1 Describe two methods of increasing the total internal energy of a metal bar.

4 marks

- 2 State in words the first law of thermodynamics.

If a system does 1000 joules of external work on its surroundings and 300 joules of heat flows into the system from the surroundings, does the internal energy of the system increase or decrease? By how much?

6 marks

- 3 Estimate the efficiency of photosynthetic conversion of radiant solar energy into the internal energy of agricultural produce from the following data:

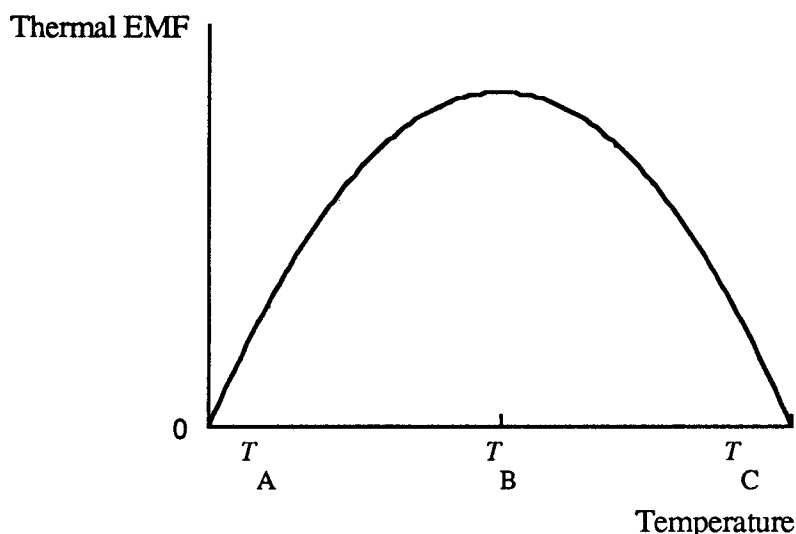
CORNFIELD

Growing season:	100 days.
Plot size:	1.0 hectare ( $10^4 \text{ m}^2$ ).
Number of plants per plot:	$2.0 \times 10^4$ .
Average mass of plant:	0.50 kg.
24-hour average radiant power intensity on earth's surface:	$0.20 \text{ kW.m}^{-2}$ .
Energy content of 1.0 kg of plant material:	20 MJ.

6 marks

- 4 What is a thermometric property?

The diagram shows the thermal EMF for a thermocouple as a function of temperature difference. Comment on the suitability of the thermocouple for use as a thermometer in the temperature range  $T_A$  to  $T_C$ .



6 marks

- 5 (a) Name two convenient fixed points for checking the calibration of a thermometer in the temperature range 250 K to 400 K.

- (b) In each of the following thermometers, what is the thermometric property used to measure temperature?

Mercury-in-glass thermometer.

Thermistor thermometer.

Constant volume gas thermometer.

Thermocouple thermometer.

6 marks

- 6 How could you measure the temperature of a bathful of water?  
How could you measure the temperature of a thimbleful of water?  
Give reasons for your answers.  
*6 marks*
- 
- 7 Consider two mercury-in-glass thermometers, one placed in the shade, the other in direct sunlight.  
Which of the thermometers gives a better estimate of the temperature of the surrounding air? Discuss.  
*7 marks*
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- 8 (a) Explain the significance of the zeroth law of thermodynamics.  
*2 marks*
- (b) With the aid of a labeled diagram describe the construction of a triple point cell.  
*4 marks*
- (c) Write down the conventional definition of the ideal gas temperature scale. Describe how the triple point temperature is used in that definition.  
*2 marks*
- (d) Explain why the triple point of water is such a convenient fixed point for use in this definition.  
*2 marks*
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- 9 Suggest suitable forms of thermometer for the following applications.  
(a) Measuring the temperature of a horse's blood.  
(b) Measuring the temperature of boiling liquid oxygen.  
(c) Measuring the temperature of molten iron in a blast furnace.  
(d) Measuring the temperature of an incandescent lamp filament.  
In each case give a reason for your choice.  
*8 marks*
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- 10 A thermocouple was calibrated against an accurate thermometer. The following data were obtained.
- | TEMPERATURE MEASURED BY THERMOMETER / °C | THERMOCOUPLE METER READING / mV |
|--|---------------------------------|
| 0  | 0                               |
| 10.5                                     | 0.67                            |
| 24.0                                     | 1.47                            |
| 34.0                                     | 2.02                            |
- (a) On the graph paper provided, draw a calibration curve for the thermocouple.  
(b) Estimate the temperature corresponding to a reading of 1.00 mV.  
*8 marks*
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- 11 Suppose that as a result of eating breakfast a person's internal chemical energy increases by 3 MJ. Suppose that the person then commences to work and that for each joule of external work performed the body generates 9 joules of heat. When the internal chemical energy of the body has reached its pre-breakfast value again, how much external work will the person have done?  
Using the data below determine:  
(a) by how much the person's body temperature would rise if the body could not lose the heat generated;  
(b) how much perspiration the body must secrete if all the heat is lost evaporatively.
- Data.** Mass of person: 70 kg.  
Specific heat of person:  $3.5 \text{ kJ.kg}^{-1}.\text{K}^{-1}$ .  
Latent heat of vaporization of water at body temperature:  $2.4 \text{ MJ.kg}^{-1}$ .  
*9 marks*
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- 12 Is the specific heat of water greater than or less than the specific heat of most other substances?  
When 1 kg of water is mixed with 1 kg of another substance at a different temperature, which suffers the greater temperature change? Explain.  
*3 marks*