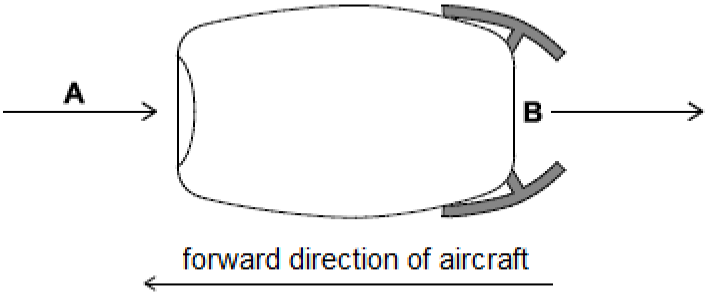
Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Measurement And Their Errors

Name of the Student:____
Max. Marks : 21 Marks **Time : 21 Minutes**

Q1.

Figure 1 shows a jet engine.

Figure 1



Air enters the engine at **A** and is heated before leaving **B** at a much higher speed.

(a) State what happens to the momentum of the air as it passes through the engine.

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(1)

(b) Explain, using appropriate laws of motion, why the air exerts a force on the engine in the forward direction.

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(3)

(c) In one second a mass of 210 kg of air enters at **A**. The speed of this mass of air increases by 570 m s^{-1} as it passes through the engine.

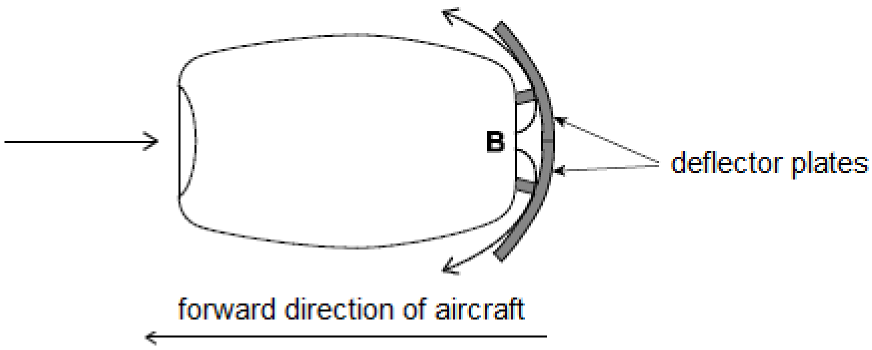
Calculate the force that the air exerts on the engine.

force = ____________________ N

(1)

(d) When an aircraft lands, its jet engines exert a decelerating force on the aircraft by making use of deflector plates. These cause the air leaving the engines to be deflected at an angle to the direction the aircraft is travelling as shown in **Figure 2**.

Figure 2



The speed of the air leaving **B** is the same as the speed of the deflected air.

Explain why the momentum of the air changes.

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(2)

(e) The total horizontal decelerating force exerted on the deflector plates of the jet engines is 190 kN.

Calculate the deceleration of the aircraft when it has a mass of 7.0×10^4 kg.

deceleration = ____________________ $m\ s^{-2}$

(1)

(f) The aircraft lands on the runway travelling at a speed of 68 $m\ s^{-1}$ with the deflector plates acting.

Calculate the distance the aircraft travels along the runway until it comes to rest. You may assume that the decelerating force acting on the jet engines remains constant.

distance = ____________________ m

(2)

(g) Suggest why in practice the decelerating force provided by the deflector plates may not remain constant.

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(2)

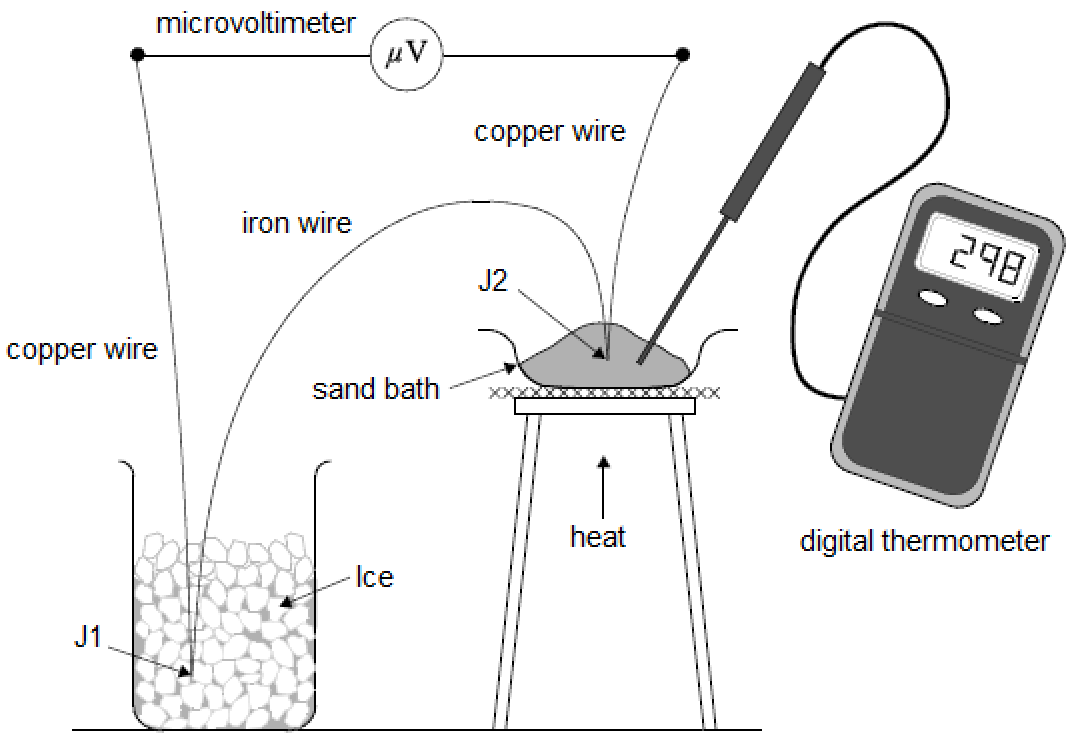
(Total 12 marks)

Q2.

Lengths of copper and iron wire are joined together to form junctions J1 and J2. When J1 and J2 are at different temperatures an emf ε is generated between them. This emf is measured using a microvoltmeter.

Figure 1 shows J1 kept at 0 °C while J2 is heated in a sand bath to a temperature θ measured by a digital thermometer.

Figure 1

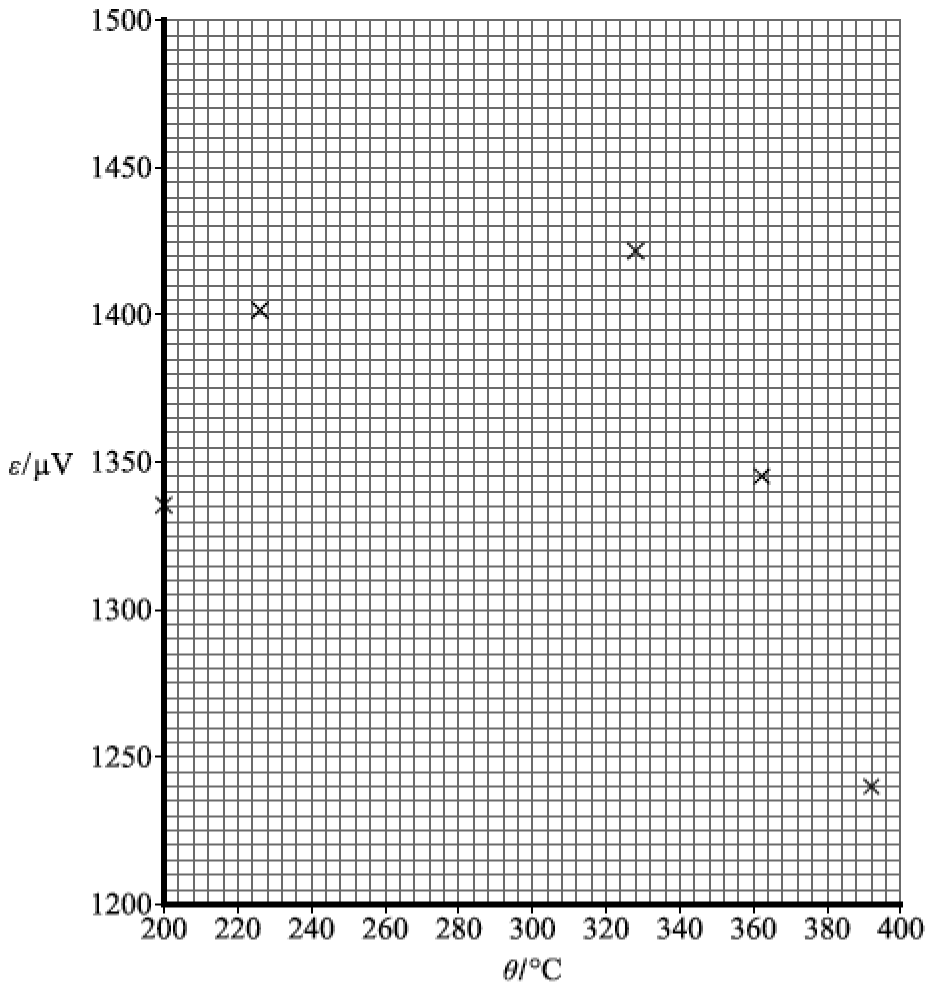


An experiment is carried out to determine how ε depends on θ.

The results of the experiment are shown in the table below and a graph of the data is shown in **Figure 2**.

θ / °C	ε / μV
200	1336
226	1402
258	1450
298	1456
328	1423
362	1345
392	1241

Figure 2



(a) Plot the points corresponding to θ = 258 °C and θ = 298 °C on **Figure 2**.

(1)

(b) Draw a suitable best fit line on **Figure 2**.

(1)

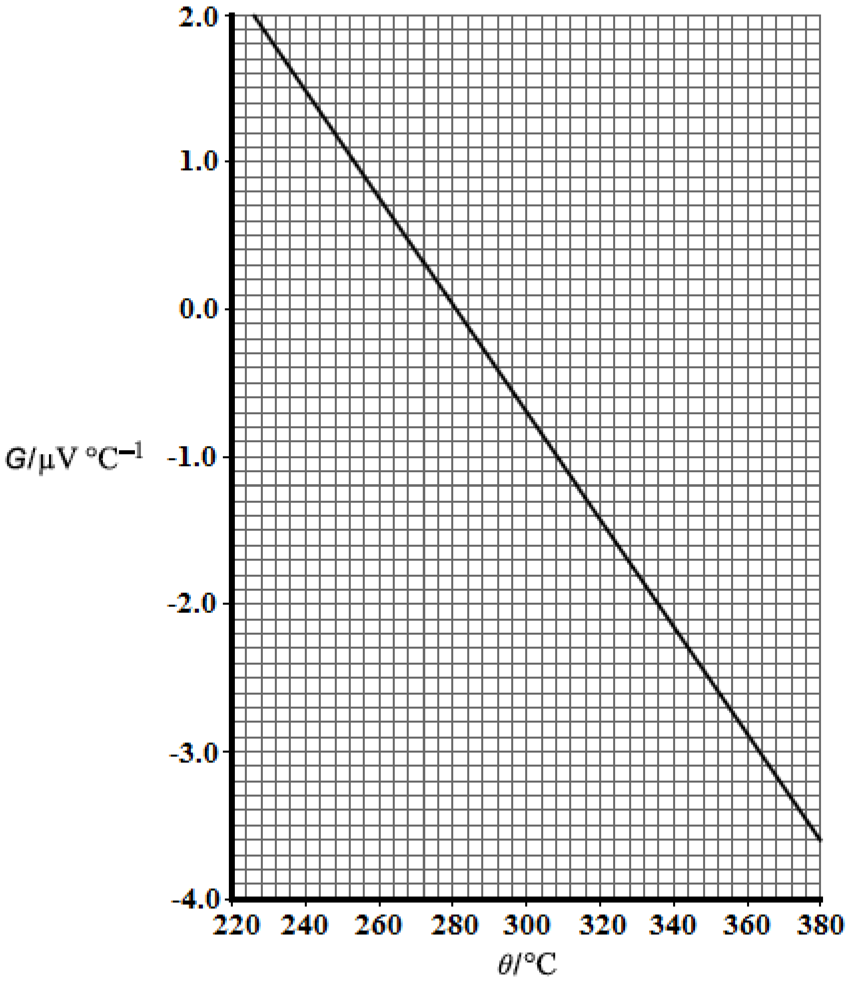
(c) Determine the maximum value of ε.

maximum value of ε = ____________________ μV

(1)

(d) The gradient G of the graph in **Figure 2** is measured for values of θ between 220 °C and 380 °C. A graph of G against θ is plotted in **Figure 3**.

Figure 3



The neutral temperature θ_n is the temperature corresponding to the maximum value of ε. θ_n can be determined using either **Figure 2** or **Figure 3**.

Explain why a more accurate result for θ_n may be obtained using **Figure 3**.

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(1)

(e) It can be shown that G is given by

$$G = \beta\theta + \alpha$$

where α and β are constants.

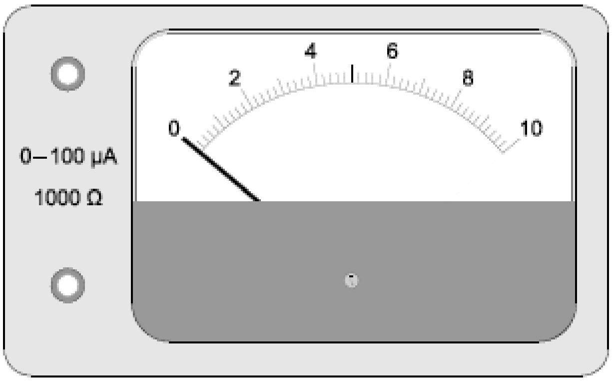
Determine α.

α = ____________________ μV °C^{-1}

(2)

(f) A student decides to carry out a similar experiment. The student thinks the meter in **Figure 4** could be used as the microvoltmeter to measure ε.

Figure 4



When this meter indicates a maximum reading and the needle points to the right-hand end of the scale (full-scale deflection), the current in the meter is 100 μA. The meter has a resistance of 1000 Ω.

Calculate the full-scale deflection of this meter when used as a microvoltmeter.

full-scale deflection = ____________________ μV

(1)

(g) The scale on the meter has 50 divisions between zero and full-scale deflection.

Discuss why this meter is not suitable for carrying out the experiment.

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(2)

(Total 9 marks)