6 (a) Two resistors P and Q are connected in series to a power supply of electromotive force (e.m.f.) 9.0 V and negligible internal resistance to form a potential divider, as shown in Fig. 6.1.

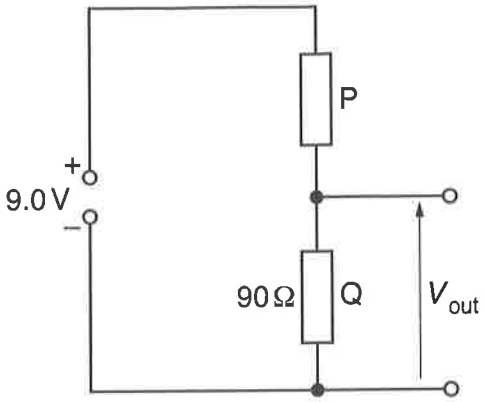

Fig. 6.1

The resistance of Q is 90 Ω.

The current in P is 27 mA.

The potential difference across Q is V_{out}.

(i) Calculate V_{out}.

V_{out} = ... V [1]

(ii) An NTC thermistor is now connected in parallel with Q, as shown in Fig. 6.2.

The resistance of the thermistor is 120 Ω.

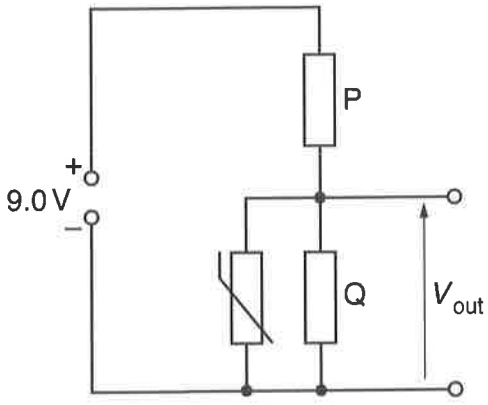

Fig. 6.2

Calculate the new value of V_{out}.

V_{out} = ... V [3]

(iii) The temperature of the thermistor is increased.

State and explain the change, if any, to the value of V_{out}.

.....

.....

.....

.....

.....[3]

(b) A rotary potentiometer is illustrated in Fig. 6.3.

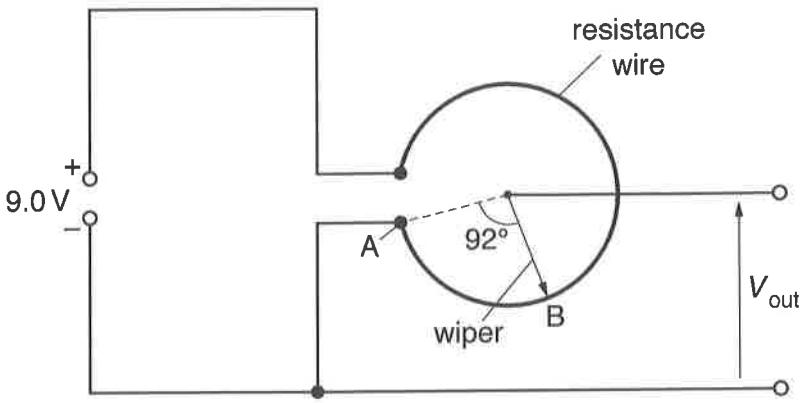

Fig. 6.3 (not to scale)

The potentiometer consists of a length of uniform resistance wire connected to the terminals of the power supply.

A wiper (variable terminal) can rotate and make contact with any part of the resistance wire.

The connection wires to the power supply and the wiper have zero resistance.

The power supply has e.m.f. 9.0 V and zero internal resistance.

The resistance wire has length 6.5 cm and is arranged in part of a circle of radius 1.2 cm.

The wiper is rotated to point B through an angle of 92° from point A.

Calculate the output voltage V_{out} when the wiper is at point B.

V_{out} = ... V [3]

[Total: 10]