Why Transition Metals Have High Melting Points

In transition metals the (n−1)d electrons join the ns electrons in metallic bonding, so the bonds are strong and the metals are hard with high melting points. Across the 3d series melting points peak near the middle (Mn is an exception) and fall to zinc (d^{10}).

Name: Date: Score: ____ / 15

A. Fill in the blanks

1. In transition metals, (n−1)d electrons take part in ____ bonding along with ns electrons.

2. In the 3d series, melting points are highest near the ____ of the series.

3. The anomalously low melting point in the middle of the 3d series is shown by ____.

4. The transition-group metal that is liquid at room temperature is ____.

B. True or False

5. Zinc has the lowest melting point in the 3d series. True / False

6. More electrons in metallic bonding give weaker bonds. True / False

7. Tungsten is used in bulb filaments because of its very high melting point. True / False

C. Assertion and reason

8. Assertion (A): Zinc has a low melting point.
Reason (R): Zinc has a full $3d^{10}$ subshell with no unpaired d electrons for bonding.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

9. Assertion (A): Chromium has a high melting point.
Reason (R): Chromium is in group 6.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

D. Choose the correct option

10. Main reason for high melting points of transition metals:

(a) ionic bonding
(b) d electrons in metallic bonding
(c) hydrogen bonding
(d) low atomic mass

Answer: _____

11. Highest melting point among:

(a) Zn
(b) Cu
(c) Cr
(d) Mn

Answer: _____

12. Melting point of mercury:

(a) 420 °C (b) 321 °C

(c) −39 °C (d) 1085 °C

Answer: _____

E. Numerical problems

13. How many unpaired d electrons does Cr ($3d^5\ 4s^1$) have?

F. Short answer questions

14. Why do melting points rise to a maximum near the middle of the 3d series and then fall?

G. Match the columns

15. Match each item in Column A with the correct item in Column B.

Column A	Column B	Your answer
1. V, Cr	(a) liquid	1 → ____
2. Mn	(b) lowest (d^{10})	2 → ____
3. Zn	(c) anomalously low	3 → ____
4. Hg	(d) highest in the 3d series	4 → ____

Detailed solutions

1. metallic

2. middle

3. manganese

4. mercury

5. True. 420 °C; d^{10}.

6. False. More bonding electrons give stronger bonds.

7. True. 3422 °C.

8. (a) R explains A.

9. (b) Both true; R does not explain A: many unpaired d electrons bond.

10. (b) d electrons in metallic bonding. (n−1)d + ns electrons bond.

11. (c) Cr. Cr 1907 °C.

12. (c) −39 °C. A liquid.

13. count the 3d arrows. **Answer: 5**

14. The number of unpaired d electrons available for metallic bonding grows up to about d^5, then electrons pair up and fewer take part.

15. 1 → (d), 2 → (c), 3 → (b), 4 → (a). Each item matches its description.