

CHAPTER 12

OTHER TOPICS IN CAPITAL BUDGETING

(Difficulty: E = Easy, M = Medium, and T = Tough)

Multiple Choice: Conceptual

Easy:

Abandonment option

Answer: b Diff: E

1. Which of the following statements best describes the likely impact that an abandonment option will have on a project's expected cash flow and risk?
- a. No impact on expected cash flow, but risk will increase.
 - b. Expected cash flow increases and risk decreases.
 - c. Expected cash flow increases and risk increases.
 - d. Expected cash flow decreases and risk decreases.
 - e. Expected cash flow decreases and risk increases.

Investment timing option

Answer: e Diff: E

2. Commodore Corporation is deciding whether it makes sense to invest in a project today, or to postpone this decision for one year. Which of the following statements best describes the issues that Commodore faces when considering this investment timing option?
- a. The investment timing option does not affect the expected cash flows and should therefore have no impact on the project's risk.
 - b. The more uncertainty about the project's future cash flows the more likely it is that Commodore will go ahead with the project today.
 - c. If the project has a positive expected NPV today, this means that its expected NPV will be even higher if it chooses to wait a year.
 - d. All of the above statements are correct.
 - e. None of the above statements is correct.

Flexibility option

Answer: c Diff: E N

3. Which of the following is an example of a flexibility option?
- a. A company has the option to invest in a project today or to wait a year.
 - b. A company has the option to back out of a project that turns out to be unproductive.
 - c. A company pays a higher cost today in order to be able to reconfigure the project's inputs or outputs at a later date.
 - d. A company invests in a project today that may lead to enhanced technological improvements that allow it to expand into different markets at a later date.
 - e. All of the statements above are correct.

Real options**Answer: c Diff: E**

4. Which of the following is an example of a flexibility option?
- a. A company has the option to invest in a project today or to wait a year.
 - b. A company has the option to back out of a project that turns out to be unproductive.
 - c. A company pays a higher cost today in order to be able to reconfigure the project's input or outputs at a later date.
 - d. A company invests in a project today that may lead to enhanced technological improvements that allow it to expand into different markets at a later date.
 - e. All of the statements above are correct.

Real options**Answer: b Diff: E N**

5. Whalen Maritime Research Inc. regularly takes real options into account when evaluating its proposed projects. Specifically, Whalen considers the option to abandon a project whenever it turns out to be unsuccessful (the abandonment option). In addition, it usually evaluates whether it makes sense to invest in a project today or whether to wait to collect more information (the investment timing option). Assume the proposed projects can be abandoned at any time without penalty. Which of the following statements is most correct?
- a. The abandonment option tends to reduce a project's NPV.
 - b. The abandonment option tends to reduce a project's risk.
 - c. If there are important first-mover advantages, this tends to increase the value of waiting a year to collect more information before proceeding with a proposed project.
 - d. Statements a and b are correct.
 - e. All of the statements above are correct.

Real options**Answer: b Diff: E N**

6. Harmon Industries is considering adding a new store. As a final step in reviewing the proposed project, the CFO wants to take into account two real options that are attached to the proposed project.

First, there is a timing option. One year from now, the company will have a much better idea of whether the county will raise or lower its property taxes. The firm might want to wait a year to decide whether it makes sense to proceed with their proposed project because the county taxes could significantly affect the project's cash flows.

Second, there is an abandonment option. After two years, the company will have the option to shut down the store if it is determined that the store is losing money and will continue to lose money.

Which of the following statements is most correct?

- a. The greater the uncertainty regarding the county tax rates, the less valuable is the option to delay the project.
- b. The abandonment option is likely to increase the project's expected cash flows.
- c. The abandonment option is likely to increase the project's risk.
- d. Statements a and b are correct.
- e. All of the statements above are correct.

Real options**Answer: a Diff: E N**

7. Which of the following statements is most correct?

- a. In general, the more uncertainty there is about market conditions, the more attractive it may be to wait before making an investment.
- b. In general, the greater the strategic advantages of being the first competitor to enter a given market, the more attractive it may be to wait before making an investment.
- c. In general, the higher the discount rate, the more attractive it may be to wait before making an investment.
- d. Statements b and c are correct.
- e. All of the statements above are correct.

Real options**Answer: d Diff: E N**

8. Seaver Electronics is considering investing in Hong Kong. Which of the following factors would make the company more likely to proceed with the investment?

- a. The company would have the option to withdraw from the investment after 2 years, if it turns out to be unprofitable.
- b. The investment would increase the odds of the company being able to subsequently make a successful entry into the China market.
- c. The investment would preclude the company from being able to make a profitable investment in Japan.
- d. Statements a and b are correct.
- e. All of the statements above are correct.

Miscellaneous capital budgeting topics**Answer: d Diff: E N**

9. Which of the following statements is most correct?
- a. If you have an option to abandon a project at a later date, this increases the likelihood that you will select the project today.
 - b. When evaluating potential projects you always include opportunity costs in the estimated cash flows.
 - c. When evaluating potential projects you should always include sunk costs in the estimated cash flows.
 - d. Statements a and b are correct.
 - e. All of the statements above are correct.

Medium:**Real options****Answer: b Diff: M**

10. Which of the following are not real options?
- a. The option to expand production if the product is successful.
 - b. The option to buy additional shares of stock if the stock price goes up.
 - c. The option to expand into a new geographic region.
 - d. The option to abandon a project.
 - e. The option to switch sources of fuel used in an industrial furnace.

Real options**Answer: d Diff: M**

11. Which of the following will not increase the value of a real option?
- a. An increase in the time remaining until the real option must be exercised.
 - b. An increase in the volatility of the underlying source of risk.
 - c. An increase in the risk-free rate.
 - d. An increase in the cost of exercising the real option.
 - e. Statements b and d.

Abandonment and growth options**Answer: a Diff: M**

12. Clueless Corporation never considers abandonment options or growth options when estimating its optimal capital budget. What impact does this policy have on the company's optimal capital budget?
- a. Its estimated capital budget is too small because it fails to consider abandonment and growth options.
 - b. Its estimated capital budget is too large because it fails to consider abandonment and growth options.
 - c. Failing to consider abandonment options makes the optimal capital budget too large, but failing to consider growth options makes the optimal capital budget too small, so it is unclear what impact this policy has on the overall capital budget.
 - d. Failing to consider abandonment options makes the optimal capital budget too small, but failing to consider growth options makes the optimal capital budget too large, so it is unclear what impact this policy has on the overall capital budget.
 - e. Neither abandonment nor growth options should have an effect on the company's optimal capital budget.

Multiple Choice: Problems

Easy:

Optimal capital budget and divisional risk

Answer: c Diff: E

13. Shanahan Inc. has two divisions: Division A makes up 50 percent of the company, while Division B makes up the other 50 percent. Shanahan's beta is 1.2. Looking at stand-alone competitors, Shanahan's CFO estimates that Division A's beta is 1.5, while Division B's beta is 0.9. The risk-free rate is 5 percent and the market risk premium is 5 percent. The company is 100 percent equity-financed. ($WACC = k_s$, the cost of equity).

Division B is considering the following projects given below. Each of the projects has the same risk and all have the same risk as a "typical" Division B project.

<u>Project</u>	<u>Capital Required</u>	<u>IRR</u>
1	\$400 million	14.0%
2	300 million	10.7
3	250 million	10.5
4	320 million	10.0
5	230 million	9.0

The company is debating which cost of capital they should use to evaluate Division B's projects. John Green argues that Shanahan should use the same cost of capital for each of its divisions, and believes it should base the cost of equity on Shanahan's overall beta. Becky White argues that the cost of capital should vary for each division, and that Division B's beta should be used to estimate the cost of equity for Division B's projects.

If the company uses White's approach, how much larger will the capital budget be than if it uses Green's approach?

- a. Capital budget is \$320 million larger using White's approach.
- b. Capital budget is \$550 million larger using White's approach.
- c. Capital budget is \$870 million larger using White's approach.
- d. Capital budget is \$1,200 million larger using White's approach.
- e. The capital budget is the same using the two approaches.

Replacement chain**Answer: b Diff: E**

14. Jayhawk Jets must choose one of two mutually exclusive projects. Project A has an up-front cost ($t = 0$) of \$120,000, and it is expected to produce cash inflows of \$80,000 per year at the end of each of the next two years. Two years from now, the project can be repeated at a higher up-front cost of \$125,000, but the cash inflows will remain the same. Project B has an up-front cost of \$100,000, and it is expected to produce cash inflows of \$41,000 per year at the end of each of the next four years. Project B cannot be repeated. Both projects have a cost of capital of 10 percent. Jayhawk wants to select the project that provides the most value over the next four years. What is the net present value (NPV) of the project that creates the most value for Jayhawk?
- a. \$34,425
 - b. \$30,283
 - c. \$29,964
 - d. \$29,240
 - e. \$24,537

Replacement chain**Answer: d Diff: E**

15. Vanderheiden Inc. is considering two average-risk alternative ways of producing its patented polo shirts. Process S has a cost of \$8,000 and will produce net cash flows of \$5,000 per year for 2 years. Process L will cost \$11,500 and will produce cash flows of \$4,000 per year for 4 years. The company has a contract that requires it to produce the shirts for 4 years, but the patent will expire after 4 years, so the shirts will not be produced after 4 years. Inflation is expected to be zero during the next 4 years. If cash inflows occur at the end of each year, and if Vanderheiden's cost of capital is 10 percent, by what amount will the better project increase Vanderheiden's value?
- a. \$ 677.69
 - b. \$1,098.89
 - c. \$1,179.46
 - d. \$1,237.76
 - e. \$1,312.31

Investment timing option**Answer: d Diff: E N**

16. Marichal Motors is considering an investment in a proposed project. Rather than making the investment today, the company wants to wait a year to collect additional information about the project. If Marichal waits a year, it will not have to invest any cash flows unless it decides to make the investment. If it waits, there is a 25 percent chance the project's expected NPV one year from today will be \$10 million, a 50 percent chance that the project's expected NPV one year from now will be \$4 million, and a 25 percent chance that the project's expected NPV one year from now will be -\$10 million. All expected cash flows are discounted at 10 percent. What is the expected NPV (in today's dollars) if the company chooses to wait a year before deciding whether to make the investment?
- a. \$2.9889 million
 - b. \$3.1496 million
 - c. \$3.6875 million
 - d. \$4.0909 million
 - e. \$4.5000 million

Medium:**Replacement chain****Answer: c Diff: M**

17. Borden Books is interested in purchasing a computer system to use for the next 10 years. Currently, Borden is considering two mutually exclusive systems, System S and System L.
- System S has an up-front cost of \$3 million at $t = 0$ and will produce positive cash flows of \$2.5 million per year for two years (at $t = 1$ and 2). This system can be repeated forever. In other words, every two years the company can repurchase the system under exactly the same terms.
- System L has an up-front cost of \$5 million at $t = 0$ and will produce positive cash flows of \$2 million per year for five years (at $t = 1, 2, 3, 4$, and 5). This system can be replaced at a cost of \$4 million at $t = 5$, after which time it will produce positive cash flows of \$1.5 million per year for the subsequent five years (at $t = 6, 7, 8, 9$, and 10).
- Borden's CFO has determined that the company's WACC is 12 percent. Over a 10-year extended basis, which system is the better system and what is its NPV?
- a. System L; \$2.21 million
 - b. System L; \$3.01 million
 - c. System S; \$4.10 million
 - d. System L; \$4.41 million
 - e. System S; \$6.13 million

Replacement chain**Answer: c Diff: M**

18. Doherty Industries wants to invest in a new computer system. The company only wants to invest in one system, and has narrowed the choice down to System A and System B.

System A requires an up-front cost of \$100,000 and then generates positive after-tax cash flows of \$60,000 at the end of each of the next two years. The system can be replaced every two years with the cash inflows and outflows remaining the same.

System B also requires an up-front cost of \$100,000 and then generates positive after-tax cash flows of \$48,000 at the end of each of the next three years. System B can be replaced every three years, but each time the system is replaced, both the cash inflows and outflows increase by 10 percent.

The company needs a computer system for the 6-year period, after which time the current owners plan on retiring and liquidating the firm. The company's cost of capital is 11 percent. What is the NPV (on a 6-year extended basis) of the system that creates the most value to the company?

- a. \$ 17,298.30
- b. \$ 22,634.77
- c. \$ 31,211.52
- d. \$ 38,523.43
- e. \$103,065.82

Replacement chain**Answer: e Diff: M**

19. Johnson Jets is considering two mutually exclusive machines. Machine A has an up-front cost of \$100,000 ($CF_0 = -100,000$) and produces positive after-tax cash inflows of \$40,000 a year at the end of each of the next six years.

Machine B has an up-front cost of \$50,000 ($CF_0 = -50,000$) and produces after-tax cash inflows of \$30,000 a year at the end of the next three years. After three years, Machine B can be replaced at a cost of \$55,000 (paid at $t = 3$). The replacement machine will produce after-tax cash inflows of \$32,000 a year for three years (inflows received at $t = 4, 5$, and 6).

The company's cost of capital is 10.5 percent. What is the net present value (on a 6-year extended basis) of the most profitable machine?

- a. \$23,950
- b. \$41,656
- c. \$56,238
- d. \$62,456
- e. \$71,687

Replacement chain**Answer: d Diff: M**

20. A small manufacturer is considering two alternative machines. Machine A costs \$1 million, has an expected life of 5 years, and generates after-tax cash flows of \$350,000 per year. At the end of 5 years, the salvage value of the original machine is zero, but the company will be able to purchase another Machine A at a cost of \$1.2 million. The second Machine A will generate after-tax cash flows of \$375,000 a year for another 5 years at which time its salvage value will again be zero. Alternatively, the company can buy Machine B at a cost of \$1.5 million today. Machine B will produce after-tax cash flows of \$400,000 a year for 10 years, and after 10 years it will have an after-tax salvage value of \$100,000. Assume that the cost of capital is 12 percent. If the company chooses the machine that adds the most value to the firm, by how much will the company's value increase?
- a. \$347,802.00
 - b. \$451,775.21
 - c. \$633,481.19
 - d. \$792,286.54
 - e. \$811,357.66

Replacement chain**Answer: c Diff: M**

21. Gainesville Bus Lines (GBL) is considering two alternative busses to transport people from the commuter lot to the main campus. Bus S has a cost of \$50,000 and will produce end-of-year net cash flows of \$25,000 per year for 3 years. Bus L will cost \$75,000 and will produce cash flows of \$23,000 per year for 6 years. The company must provide bus service for 6 years, after which it plans to give up its franchise and to cease operating the route. Inflation is not expected to affect either costs or revenues during the next 6 years. If GBL's cost of capital is 15 percent, by what amount will the better project change the company's value?
- a. \$10,225.18
 - b. \$11,736.26
 - c. \$12,043.10
 - d. \$13,424.66
 - e. \$14,081.19

Replacement chain**Answer: e Diff: M N**

22. Projects X and Y have the following expected net cash flows:

	Project X	Project Y
<u>Time</u>	<u>Cash Flow</u>	<u>Cash Flow</u>
0	-\$500,000	-\$500,000
1	250,000	350,000
2	250,000	350,000
3	250,000	

Assume that both projects have a 10 percent cost of capital, and each of the projects can be indefinitely repeated with the same net cash flows. What is the 6-year extended NPV of the project that creates the most value?

- a. \$184,462.62
- b. \$204,844.61
- c. \$213,157.77
- d. \$248,803.75
- e. \$269,611.38

Replacement chain**Answer: a Diff: M N**

23. Whitman Motors is considering two projects, Project A and Project B. The projects have the following cash flows:

	Project A	Project B
<u>Year</u>	<u>Cash Flow</u>	<u>Cash Flow</u>
0	-\$300	-\$300
1	150	200
2	150	200
3	150	

Assume that each project has a 10 percent cost of capital, and assume that the company is not capital constrained. Which of the following statements is most correct?

- a. If the two projects are independent (stand-alone) projects, then the company would select both projects.
- b. If the two projects are mutually exclusive and cannot be repeated, then the company would select Project B.
- c. If the two projects are mutually exclusive, and each can be repeated indefinitely with the same expected cash flows, then the company would select Project B.
- d. Statements a and c are correct.
- e. All of the statements above are correct.

Investment timing option**Answer: b Diff: M**

24. Nebraska Instruments (NI) is considering a project that has an up-front cost at $t = 0$ of \$1,500,000. The project's subsequent cash flows critically depend on whether its products become the industry standard. There is a 75 percent chance that the products will become the industry standard, in which case the project's expected cash flows will be \$500,000 at the end of each of the next seven years ($t = 1 \dots 7$). There is a 25 percent chance that the products will not become the industry standard, in which case the expected cash flows from the project will be \$50,000 at the end of each of the next seven years ($t = 1 \dots 7$). NI will know for sure one year from today whether its products will have become the industry standard. It is considering whether to make the investment today or to wait a year until after it finds out if the products have become the industry standard. If it waits a year, the project's up-front cost at $t = 1$ will remain at \$1,500,000. If it chooses to wait, the subsequent cash flows will remain at \$500,000 per year if the product becomes the industry standard, and \$50,000 per year if the product does not become the industry standard. However, if it decides to wait, the subsequent cash flows will be received only for six years ($t = 1 \dots 7$). Assume that all cash flows are discounted at 10 percent. If NI chooses to wait a year before proceeding, how much will this increase or decrease the project's expected NPV in today's dollars ($t = 0$), relative to the project's NPV if it proceeds today?
- a. \$135,472
 - b. \$229,516
 - c. \$386,512
 - d. \$494,337
 - e. \$616,028

Investment timing option**Answer: a Diff: M N**

25. Gibson Grocers is considering a proposed project. The company estimates that if it invests in the project today, the project's estimated NPV is \$10 million, but there remains a lot of uncertainty about the project's profitability.

As an alternative to making the investment today, the company is considering waiting a year. In particular, it is considering spending some money today to collect additional information, which would enable the firm to make a better assessment of the project's value one year from now. Gibson believes that if it waits a year, there is a 50 percent chance the information collected will be positive and the project's expected NPV one year from now (not including the cost of obtaining the information) will be \$25 million. There is also a 50 percent chance the information collected will be negative and the project's expected NPV one year from now (not including the cost of obtaining the information) will be -\$15 million.

If the company chooses to collect additional information, the costs of collecting this information will be incurred today. Moreover, if the company chooses to wait a year, it has the option to invest or not invest in the project after receiving the information about the project's prospects. Assume that all cash flows are discounted at 12 percent. What is the maximum amount of money the company would be willing to spend to collect this information?

- a. \$ 1.1607 million
- b. \$ 2.5000 million
- c. \$ 5.8938 million
- d. \$10.0000 million
- e. \$11.1607 million

Abandonment option**Answer: e Diff: M**

26. Holmes Corporation recently purchased a new delivery truck. The new truck costs \$25,000 and is expected to generate net after-tax operating cash flows, including depreciation, of \$7,000 at the end of each year. The truck has a 5-year expected life. The expected abandonment values (salvage values after tax adjustments) at different points in time are given below. (Note that these abandonment value estimates assume that the truck is sold after receiving the project's cash flow for the year.) The firm's cost of capital is 10 percent.

<u>Year</u>	<u>Abandonment value</u>
1	\$20,000
2	15,000
3	10,000
4	5,000
5	0

At what point in time would the company choose to sell (abandon) the truck in order to maximize its NPV?

- a. After one year
- b. After two years
- c. After three years
- d. After four years
- e. It would never choose to sell the truck.

Tough:**Optimal project selection****Answer: a Diff: T**

27. Jackson Corporation is evaluating the following four independent, investment opportunities:

<u>Project</u>	<u>Cost</u>	<u>Rate of Return</u>
A	\$300,000	14%
B	150,000	10
C	200,000	13
D	400,000	11

Jackson's target capital structure is 60 percent debt and 40 percent equity. The yield to maturity on the company's debt is 10 percent. Jackson will incur flotation costs for a new equity issuance of 12 percent. The growth rate is a constant 6 percent. The stock price is currently \$35 per share for each of the 10,000 shares outstanding. Jackson expects to earn net income of \$100,000 this coming year and the dividend payout ratio will be 50 percent. If the company's tax rate is 30 percent, which of the projects will be accepted?

- a. Project A
- b. Projects A and C
- c. Projects A, C, and D
- d. All of the investment projects will be taken.
- e. None of the investment projects will be taken.

Optimal capital budget**Answer: b Diff: T**

28. Gibson Inc. is considering the following five independent projects:

<u>Project</u>	<u>Cost</u>	<u>IRR</u>
A	\$200,000	20%
B	600,000	15
C	400,000	12
D	400,000	11
E	400,000	10

The company has a target capital structure that consists of 40 percent debt and 60 percent common equity. The company can issue bonds with a yield to maturity of 11 percent. The company has \$600,000 in retained earnings, and the current stock price is \$42 per share. The flotation costs associated with issuing new equity are \$2 per share. Gibson's earnings are expected to continue to grow at 6 percent per year. Next year's dividend (D_1) is forecasted to be \$4.00. The firm faces a 40 percent tax rate. What is the size of Gibson's optimal capital budget?

- a. \$ 200,000
- b. \$ 800,000
- c. \$1,200,000
- d. \$1,600,000
- e. \$2,000,000

Optimal capital budget**Answer: b Diff: T**

29. Photon Corporation has a target capital structure that consists of 60 percent equity and 40 percent debt. The firm can raise an unlimited amount of debt at a before-tax cost of 9 percent. The company expects to retain earnings of \$300,000 in the coming year and to face a tax rate of 35 percent. The last dividend (D_0) was \$2 per share and the growth rate of the company is constant at 6 percent. If the company needs to issue new equity, then the flotation cost will be \$5 per share. The current stock price (P_0) is \$30. Photon has the following investment opportunities:

<u>Project</u>	<u>Cost</u>	<u>IRR</u>
1	\$100,000	10.5%
2	200,000	13.0
3	100,000	12.0
4	150,000	14.0
5	75,000	9.0

What is the company's optimal capital budget?

- a. \$625,000
- b. \$450,000
- c. \$350,000
- d. \$550,000
- e. \$150,000

Optimal capital budget**Answer: b Diff: T**

30. Atlee Associates has a capital structure that consists of 40 percent debt and 60 percent common stock. The yield to maturity on the company's debt is 8 percent, the cost of retained earnings is 12 percent, and the cost of issuing new equity is 13 percent. The company expects its net income to be \$500,000, the dividend payout is expected to be 40 percent, and its tax rate is 40 percent. The company is considering five projects, all with the same risk. The size and estimated returns of the proposed projects are listed below:

<u>Project</u>	<u>Cost</u>	<u>IRR</u>
A	\$200,000	11.00%
B	100,000	10.00
C	100,000	9.95
D	200,000	9.85
E	200,000	9.25

On the basis of this information, what is Atlee's optimal capital budget?

- a. \$800,000
- b. \$600,000
- c. \$400,000
- d. \$300,000
- e. \$200,000

Real options**Answer: e Diff: T N**

31. Bucholz Brands is considering the development of a new ketchup product. The ketchup will be sold in a variety of different colors and will be marketed to young children. In evaluating the proposed project, the company has collected the following information:

- The company estimates that the project will last for four years.
- The company will need to purchase new machinery that has an up-front cost of \$300 million (incurred at $t = 0$). At $t = 4$, the machinery has an estimated salvage value of \$50 million.
- The machinery will be depreciated on a 4-year straight-line basis.
- Production on the new ketchup product will take place in a recently vacated facility that the company owns. The facility is empty and Bucholz does not intend to lease the facility.
- The project will require a \$60 million increase in inventory at $t = 0$. The company expects that its accounts payable will rise by \$10 million at $t = 0$. After $t = 0$, there will be no changes in net operating working capital, until $t = 4$ when the project is completed, and the net operating working capital is completely recovered.
- The company estimates that sales of the new ketchup will be \$200 million each of the next four years.
- The operating costs, excluding depreciation, are expected to be \$100 million each year.
- The company's tax rate is 40 percent.
- The project's WACC is 10 percent.

If Bucholz goes ahead with the project, they will have the option to pursue a second stage project at $t = 4$. This second-stage project will involve a full line of multi-colored condiments. This second stage project cannot be undertaken, unless the first-stage project (the new ketchup product) is undertaken today. The company estimates today, that if they want to go ahead with the second stage project that this will require a significant expenditure at $t = 4$. However, the company does not have to decide whether to pursue the second stage project or to spend any funds on the second stage project until $t = 4$. Currently, the company's analysts estimate that there is a 25 percent chance that demand will be high and the second stage will have an estimated NPV (at $t = 4$) of \$40 million, and there is a 75 percent chance that demand will be weak and the second stage will have an estimated NPV (at $t = 4$) of -\$75 million. Furthermore, the analysts believe that, by the fourth year (at $t = 4$), consumer preferences and demands for the second stage project will be known with certainty. Assume that all cash flows are discounted at the cost of capital (10 percent). How much of an impact will this second stage option have on the company's decision to pursue the first stage project today?

- a. Since the second stage project has an expected NPV that is negative, the existence of the second stage project makes it less likely that the company will go ahead with the first stage project today.
- b. Since the second stage project has an expected NPV that is negative, the company will never pursue the second stage project, therefore it will have no impact on the company's decision to undertake the first stage project today.
- c. Even though there is a second stage project, the company will reject the first stage project as long as the NPV of the first stage project is less than zero.
- d. The existence of the second stage project means that the company will proceed with the first stage project as long as the NPV of the first stage project (calculated at $t = 0$) is greater than negative \$10 million (i.e., NPV of first stage $> -\$10$ million.)
- e. The existence of the second stage project means that the company will proceed with the first stage project as long as the NPV of the first stage project (calculated at $t = 0$) is greater than negative \$6.83 million (i.e., NPV of first stage $> -\$6.83$ million.)

Multiple Part:

(The following information applies to the next two problems.)

Diplomat.com is considering a project that has an up-front cost of \$3 million and produces an expected cash flow of \$500,000 at the end of each of the next five years. The project's cost of capital is 10 percent.

Project's NPV

Answer: d Diff: E

32. Based on this information what is the project's net present value?

- a. -\$ 875,203
- b. -\$ 506,498
- c. \$ 54,307
- d. -\$1,104,607
- e. \$ 105,999

Growth options

Answer: a Diff: M

33. If Diplomat goes ahead with this project today, the project will create additional opportunities five years from now ($t = 5$). The company can decide at $t = 5$ whether or not it wants to pursue these additional opportunities. Based on the best information that is available today, the company estimates that there is a 35 percent chance that its technology will be successful, in which case the future investment opportunities will have a net present value of \$6 million at $t = 5$. There is a 65 percent chance that its technology will not succeed, in which case the future investment opportunities will have a net present value of -\$6 million at $t = 5$. Diplomat.com does not have to decide today whether it wants to pursue these additional opportunities. Instead, it can wait until after it finds out if its technology is successful. However, Diplomat.com cannot pursue these additional opportunities in the future unless it makes the initial investment today. What is the estimated net present value of the project, after taking into account the future opportunities?

- a. \$ 199,328
- b. \$ 561,947
- c. \$ 898,205
- d. -\$1,104,607
- e. -\$2,222,265

(The following information applies to the next two problems.)

Oklahoma Instruments (OI) is considering a project that has an up-front cost of \$250,000. The project's subsequent cash flows critically depend on whether its products become the industry standard. There is a 50 percent chance that the products will become the industry standard, in which case the project's expected cash flows will be \$110,000 at the end of each of the next five years. There is a 50 percent chance that the products will not become the industry standard, in which case the project's expected cash flows will be \$25,000 at the end of each of the next five years. Assume that the cost of capital is 12 percent.

Project's NPV**Answer: a Diff: E**

34. Based on this information, what is the project's expected net present value?
- a. -\$ 6,678
 - b. \$20,004
 - c. -\$24,701
 - d. \$45,965
 - e. \$15,303

Value of abandonment option**Answer: e Diff: M**

35. Now assume that one year from now OI will know if its products will have become the industry standard. Also assume that after receiving the cash flows at $t = 1$, the company has the option to abandon the project. If it abandons the project it will receive an additional \$100,000 at $t = 1$, but will no longer receive any cash flows after $t = 1$. Assume that the abandonment option does not affect the cost of capital. What is the estimated value of the abandonment option?
- a. \$ 0
 - b. \$ 2,075
 - c. \$ 4,067
 - d. \$ 8,945
 - e. \$10,745

(The following information applies to the next two problems.)

Fair Oil owns a tract of land that may be rich with oil. Fair must decide whether or not to drill on this land. Fair estimates that the project would cost \$25 million today ($t = 0$), and generate positive net cash flows of \$10 million a year at the end of each of the next four years ($t = 1, 2, 3$, and 4). While the company is fairly confident about its cash flow forecast, it recognizes that if it waits 1 year, it would have more information about the local geology and the price of oil. Fair estimates that if it waits one year, the project will cost \$26 million (at $t = 1$). If Fair Oil waits a year, there is an 80% chance that market conditions will be favorable, in which case the project will generate net cash flows of \$12 million a year for four years ($t = 2, 3, 4$, and 5). There is a 20% chance that market conditions will be poor, in which case the project will generate net cash flows of \$2 million a year for four years ($t = 2, 3, 4$, and 5). After finding out the market conditions at $t = 1$, Fair will then decide whether to invest in the project (i.e., it is not obligated to undertake the project). Assume that all cash flows are discounted at 10 percent.

New project NPV**Answer: e Diff: E N**

36. If the company chooses to drill today, what is the project's net present value (NPV)?
- a. \$4.62 million
 - b. \$5.15 million
 - c. \$5.80 million
 - d. \$6.22 million
 - e. \$6.70 million

Investment timing option

Answer: c Diff: M N

37. Fair must decide if it makes sense for the company to wait a year to drill. If it waits a year, what would be the expected net present value (NPV) at $t = 0$?
- a. \$7.629 million
 - b. \$8.262 million
 - c. \$8.755 million
 - d. \$9.264 million
 - e. \$9.391 million

<p style="text-align: center;">CHAPTER 12 ANSWERS AND SOLUTIONS</p>

1. Abandonment option

Answer: b Diff: E

The option to abandon will increase expected cash flow and decrease risk. If a firm has the option to abandon a project, it will choose to do so only when things look bad (negative NPV). Thus, abandoning a project eliminates the low/negative cash flows. Therefore, statement b is correct.

2. Investment timing option

Answer: e Diff: E

By having the ability to wait and see you reduce the risk of the project. Therefore, statement a is false. The greater the uncertainty, the more value there is in waiting for additional information before going on with a project. Therefore, statement b is false. Statement c is not necessarily true. By waiting to do a project you may lose strategic advantages associated with being the first competitor to enter a new line of business, which may alter the cash flows. Since statements a, b, and c are false, the correct choice is statement e.

3. Flexibility option

Answer: c Diff: E N

Statements a, b, c, and d are all examples of different types of real options. A flexibility option permits the firm to alter operations depending on how conditions change during the life of the project. Typically, either inputs or outputs, or both, can be changed. Statement a is an example of an investment timing option, while statement b is an example of an abandonment option. Statement c is an example of a flexibility option, while statement d is an example of a growth/expansion option. Therefore, statement c is the correct choice.

4. Real options

Answer: c Diff: E

Statements a, b, c, and d are all examples of different types of real options. A flexibility option permits the firm to alter operations depending on how conditions change during the life of the project. Typically, either inputs or outputs, or both, can be changed. Statement a is an example of an investment timing option, while statement b is an example of an abandonment option. Statement c is an example of a flexibility option, while statement d is an example of a growth option. Therefore, statement c is the correct choice.

5. Real options

Answer: b Diff: E N

The correct answer is statement b. Statement a is incorrect; the abandonment option will tend to increase a project's NPV. Statement b is correct; the abandonment option will tend to reduce a project's risk. Statement c is incorrect; if there are first-mover advantages, it may be harmful (lowers value) to wait a year to collect information.

6. Real options

Answer: b Diff: E N

The correct answer is statement b. Statement a is clearly incorrect. If there is no uncertainty, the option has no value. The option has value due to the uncertainty. The value of the option increases as the uncertainty increases. Statement b is correct. The firm will shut down instead of realizing negative cash flows. This will tend to increase the project's expected cash flows. The option will decrease the project's risk; if not, the option will not even be considered! So, statement c is also incorrect.

7. Real options

Answer: a Diff: E N

8. Real options

Answer: d Diff: E N

9. Miscellaneous capital budgeting topics

Answer: d Diff: E N

The correct answer is statement d. The option to abandon the project is a real option and this adds value to the project. Opportunity costs are always included when evaluating capital budgeting projects, while sunk costs are never included. Therefore, the correct choice is statement d.

10. Real options

Answer: b Diff: M

11. Real options

Answer: d Diff: M

12. Abandonment and growth options

Answer: a Diff: M

By failing to consider both abandonment and growth options, the firm's capital budget would be too small. In both cases, the firm might reject what might otherwise be profitable projects if these options had been considered. Therefore, the correct choice is statement a.

13. Optimal capital budget and divisional risk**Answer: c Diff: E**

Find the WACCs using both John's and Becky's methods. (WACC = k_s because there is no debt).

John's WACC for Division B based on overall company's beta:

$$k = k_{RF} + RP_M(b)$$

$$k = 5\% + 5\%(1.2)$$

$$k = 5\% + 6\%$$

$$k = 11\%.$$

Therefore, John would only choose Project 1, because it is the only project whose IRR exceeds its cost of capital. Consequently, the firm's capital budget (based on John's WACC) is only \$400 million.

Becky's WACC for Division B:

$$k = k_{RF} + RP_M(b)$$

$$k = 5\% + 5\%(0.9)$$

$$k = 5\% + 4.5\%$$

$$k = 9.5\%.$$

Becky would choose projects 1, 2, 3, and 4 because all of these projects have an IRR that exceeds the Division's 9.5 percent cost of capital. Based on Becky's WACC, the firm's capital budget would be \$1,270 million (\$400 + \$300 + \$250 + \$320). Therefore, the firm's capital budget based on Becky's WACC is \$870 million (\$1,270 - \$400) larger than the one based on John's WACC.

14. Replacement chain**Answer: b Diff: E**

Step 1: Determine each project's cash flows during the 4-year period.

Year	Project A Cash Flows	Project B Cash Flows
0	(\$120,000)	(\$100,000)
1	80,000	41,000
2	80,000 - 125,000 = (45,000)	41,000
3	80,000	41,000
4	80,000	41,000

Step 2: Determine each project's NPV by entering the cash flows into the cash flow register and using 10 percent for the cost of capital.

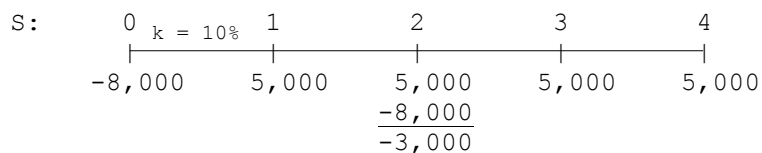
$$NPV_A = \$30,283.45 \approx \$30,283.$$

$$NPV_B = \$29,964.48 \approx \$29,964.$$

Therefore, Jayhawk should select Project A since it adds more value.

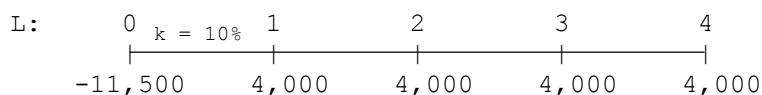
15. Replacement chain

Answer: d Diff: E



$$IRR_S = 16.26\%$$

$$NPV_S = \$1,237.76. \quad (\text{extended NPV})$$



$$IRR_L = 14.66\%$$

$$NPV_L = \$1,179.46.$$

16. Investment timing option

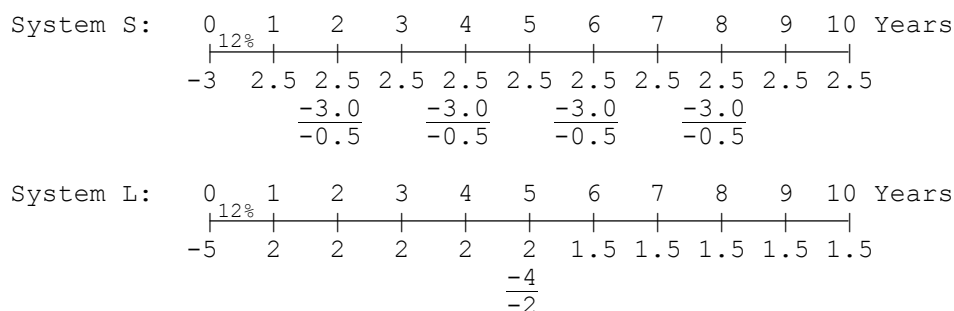
Answer: d Diff: E N

Expected NPV one year from now = $0.25(\$10 \text{ million}) + 0.50(\$4 \text{ million}) + 0.25(\$0) = \$4.5 \text{ million}$. Expected NPV in today's dollars = $\$4.5 \text{ million} / 1.10 = \4.0909 million .

17. Replacement chain

Answer: c Diff: M

Step 1: Draw the time lines (in millions of dollars):



Step 2: Calculate the NPV for each system:

$$NPV_S = -\$3 + \$2.5/1.12 - \$0.5/(1.12)^2 + \$2.5/(1.12)^3 - \$0.5/(1.12)^4 + \$2.5/(1.12)^5 - \$0.5/(1.12)^6 + \$2.5/(1.12)^7 - \$0.5/(1.12)^8 + \$2.5/(1.12)^9 + \$2.5/(1.12)^{10}$$

$$NPV_S = -\$3 + \$2.232 - \$0.399 + \$1.779 - \$0.318 + \$1.419 - \$0.253 + \$1.131 - \$0.202 + \$0.902 + \$0.805$$

$$NPV_S = \$4.096 \approx \$4.1 \text{ million.}$$

$$NPV_L = -\$5 + \$2/(1.12)^1 + \$2/(1.12)^2 + \$2/(1.12)^3 + \$2/(1.12)^4 - \$2/(1.12)^5 + \$1.5/(1.12)^6 + \$1.5/(1.12)^7 + \$1.5/(1.12)^8 + \$1.5/(1.12)^9 + \$1.5/(1.12)^{10}$$

$$NPV_L = -\$5 + \$1.786 + \$1.594 + \$1.424 + \$1.271 - \$1.135 + \$0.760 + \$0.679 + \$0.606 + \$0.541 + \$0.483$$

$$NPV_L = \$3.009 \approx \$3.01 \text{ million.}$$

18. Replacement chain

Answer: c Diff: M

To find the NPV of the system we must use the replacement chain approach.

Time	System A	System B
0	-100,000	-100,000
1	60,000	48,000
2	60,000 - 100,000 = -40,000	48,000
3	60,000	48,000 - 110,000 = -62,000
4	60,000 - 100,000 = -40,000	52,800
5	60,000	52,800
6	60,000	52,800

Use the CF key to enter the cash flows for each period and enter I/YR = 11. This should give the following NPVs:
 $NPV_A = \$6,796.93$. $NPV_B = \$31,211.52$.

Computer system B creates the most value for the firm, so the correct answer is c.

19. Replacement chain

Answer: e Diff: M

The CFs and NPVs (calculated with $I = 10.5\%$) are as follows:

t	Project A	Project B
0	-100,000	-50,000
1	40,000	30,000
2	40,000	30,000
3	40,000	30,000 - 55,000 = -25,000
4	40,000	32,000
5	40,000	32,000
6	40,000	32,000
NPV	\$71,687.18 \approx \$71,687	\$41,655.58 \approx \$41,656

20. Replacement chain

Answer: d Diff: M

Machine A (time line in thousands):

0	1	5	6	10
k = 12%				
-1,000	350	350	375	375
		-1,200		
		<u>-850</u>		

With a financial calculator input the following:

$CF_0 = -1000000$; $CF_{1-4} = 350000$; $CF_5 = -850000$; $CF_{6-10} = 375000$; $I = 12$; and then solve for $NPV_A = \$347,802$.

Machine B (time line in thousands):

0	1	9	10
k = 12%			
-1,500	400	400	400
			100
			<u>500</u>

$CF_0 = -1500000$; $CF_{1-9} = 400000$; $CF_{10} = 500000$; $I = 12$; and then solve for $NPV_B = \$792,286.54$.

21. Replacement chain

Answer: c Diff: M

Bus S:

0	1	2	3	4	5	6
$k = 15\%$						
-50,000	25,000	25,000	25,000	25,000	25,000	25,000
			-50,000			
			<u>-25,000</u>			

$$IRR_S = 23.38\%.$$

$$NPV_S = \$11,736.26 \text{ (extended NPV).}$$

Bus L:

0	1	2	3	4	5	6
$k = 15\%$						
-75,000	23,000	23,000	23,000	23,000	23,000	23,000

$$IRR_L = 20.80\%.$$

$$NPV_L = \$12,043.10.$$

The better project will change GBL's value by \$12,043.10.

22. Replacement chain

Answer: e Diff: M N

The cash flows (using the replacement chain) for both projects are:

Project X: $CF_0 = -500000$; $CF_1 = 250000$; $CF_2 = 250000$; $CF_3 = -250000$; $CF_4 = 250000$; $CF_5 = 250000$; $CF_6 = 250000$; $I/YR = 10$; and then solve for $NPV = \$213,157.77$.

Project Y: $CF_0 = -500000$; $CF_1 = 350000$; $CF_2 = -150000$; $CF_3 = 350000$; $CF_4 = -150000$; $CF_5 = 350000$; $CF_6 = 350000$; $I/YR = 10$; and then solve for $NPV = \$269,611.38$.

Hence, Project Y adds more value and should be accepted. It is expected to provide an NPV of \$269,611.38.

23. Replacement chain**Answer: a Diff: M N**

The NPV for Project A is calculated as follows:

$CF_0 = -300$; $CF_{1-3} = 150$; $I = 10$; and then solve for $NPV_A = \$73.03$.

The NPV for Project B is calculated as follows:

$CF_0 = -300$; $CF_{1-2} = 200$; $I = 10$; and then solve for $NPV_B = \$47.11$.

Statement a is correct. As long as both projects are independent, both projects can be accepted as long as both NPVs are positive. Statement b is incorrect. If the two projects are mutually exclusive, then only one project can be chosen. The project chosen should be the one with the highest NPV; therefore, Project A would be selected over Project B.

Assume that both projects can be repeated:

Year	Project A	Project B
0	-\$300	-\$300
1	150	200
2	150	200 - 300 = -100
3	150 - 300 = -150	200
4	150	200 - 300 = -100
5	150	200
6	150	200

The extended NPV for Project A is calculated as follows:

$CF_0 = -300$; $CF_{1-2} = 150$; $CF_3 = -150$; $CF_{4-6} = 150$; $I = 10$; and then solve for $NPV_A = \$127.89$.

The extended NPV for Project B is calculated as follows:

$CF_0 = -300$; $CF_1 = 200$; $CF_2 = -100$; $CF_3 = 200$; $CF_4 = -100$; $CF_{5-6} = 200$; $I = 10$; and then solve for $NPV_B = \$118.21$.

Statement c is incorrect because if both projects are repeatable and the projects are mutually exclusive, then Project A should be selected since it has a higher extended NPV than Project B.

24. Investment timing option**Answer: b Diff: M**

Step 1: Calculate the expected NPV of the project today. The expected cash flow is $(0.75)(\$500,000) + (0.25)(\$50,000) = \$387,500$. To find the NPV of the project, enter the following data inputs in the financial calculator:

$CF_0 = -1500000$; $CF_{1-7} = 387500$; $I = 10$; and then solve for $NPV = \$386,512$.

Step 2: Calculate the NPV of the project if it waits. If the firm waits, it will know with certainty whether the product has become the industry standard. It will do the project only if the cash flows are \$500,000. To find the NPV at $t = 0$ of the project if it waits, enter the following data inputs in the financial calculator:

$CF_0 = 0$; $CF_1 = -1500000$; $CF_{2-7} = 500000$; $I = 10$; and then solve for $NPV = \$616,028$.

Step 3: Calculate the increase in the NPV from waiting:

$\$616,028 - \$386,512 = \$229,516$.

25. Investment timing option

Answer: a Diff: M N

Expected NPV if the firm proceeds today: \$10 million.

Expected NPV if the firm waits a year (in today's dollars):

$[0.50(\$25 \text{ million})/1.12] + [0.5(\$0)/1.12] - (\text{Cost of collecting information}).$

The maximum amount that the company would be willing to pay to collect this information would be the amount that makes the expected NPV from waiting a year just equal to the expected NPV of proceeding today:

$\$10 \text{ million} = \$11.1607 \text{ million} - (\text{Cost of collecting information}).$

Therefore, the maximum cost would be \$1.1607 million.

26. Abandonment option

Answer: e Diff: M

In order to solve this problem, you calculate the truck's NPV at each point in time and then choose the truck life that maximizes its NPV.

Abandon after Year 1: $CF_0 = -25000$; $CF_1 = 27000$; $I = 10$; and then solve for NPV = -\$455.

Abandon after Year 2: $CF_0 = -25000$; $CF_1 = 7000$; $CF_2 = 22000$; $I = 10$; and then solve for NPV = -\$455.

Abandon after Year 3: $CF_0 = -25000$; $CF_{1-2} = 7000$; $CF_3 = 17000$; $I = 10$; and then solve for NPV = -\$79.

Abandon after Year 4: $CF_0 = -25000$; $CF_{1-3} = 7000$; $CF_4 = 12000$; $I = 10$; and then solve for NPV = \$604.

No abandonment: $CF_0 = -25000$; $CF_{1-5} = 7000$; $I = 10$; and then solve for NPV = \$1,536.

Thus, the firm (in order to maximize its NPV) would never choose to sell the truck.

27. Optimal project selection

Answer: a Diff: T

Calculate the after-tax component cost of debt as $10\%(1 - 0.3) = 7\%$. If the company has earnings of \$100,000 and pays out 50% or \$50,000 in dividends, then it will retain earnings of \$50,000. The retained earnings breakpoint is $\$50,000/0.4 = \$125,000$. Since it will require financing in excess of \$125,000 to undertake any of the alternatives, we can conclude the firm must issue new equity. Therefore, the pertinent component cost of equity is the cost of new equity. Calculate the expected dividend per share (note this is D_1) as $\$50,000/10,000 = \5 . Thus, the cost of new equity is $\$5/[(\$35(1 - 0.12)] + 6\% = 22.23\%$. Jackson's WACC is $7\%(0.6) + 22.23\%(0.4) = 13.09\%$. Only the return on Project A exceeds the WACC, so only Project A will be undertaken.

28. Optimal capital budget**Answer: b Diff: T**

The size of Gibson's capital budget will be determined by the number of projects it can profitably undertake, that is, those projects for which $IRR > \text{applicable WACC}$. First, find the costs of each type of financing: cost of retained earnings = $k_s = \$4/\$42 + 0.06 = 15.52\%$ and cost of debt = $k_d = 11\%$. To calculate the cost of new equity, k_e we solve for $k_e = \$4/(\$42 - \$2) + 0.06 = 0.16 = 16\%$. Given the firm's target capital structure and its retained earnings balance of \$600,000, the firm can raise \$1,000,000 with debt and retained earnings before it must use outside equity. Therefore, the WACC for 0 through \$1,000,000 of financing = $0.4(0.11)(1 - 0.4) + 0.6(0.1552) = 11.95\%$. Above \$1,000,000, the firm must issue some new equity, so the WACC = $0.4(0.11)(1 - 0.4) + 0.6(0.16) = 12.24\%$. Obviously, Projects A and B will be undertaken. You must then determine whether Project C will be profitable. Since in taking A and B we will need financing of \$800,000, the \$400,000 needed for Project C would involve financing \$200,000 with debt and retained earnings and \$200,000 with debt and new equity. Thus, the WACC for Project C is $(\$200,000/\$400,000) \times 0.1195 + (\$200,000/\$400,000) \times 0.1224 = 12.095\%$, which is greater than Project C's IRR. Clearly, only Projects A and B should be accepted, and the firm's capital budget is \$800,000.

29. Optimal capital budget**Answer: b Diff: T**

Calculate the retained earnings break point (BP_{RE}) as $\$300,000/0.6 = \$500,000$. Calculate k_s as $D_1/P_0 + g = \$2(1.06)/\$30 + 6\% = 13.07\%$. Calculate k_e as $D_1/(P_0 - F) + g = \$2(1.06)/(\$30 - \$5) + 6\% = 14.48\%$. Find WACC below BP_{RE} as: $WACC = 0.6(13.07\%) + 0.4(9\%)(1 - 0.35) = 10.18\%$. Thus, up to \$500,000 can be financed at 10.18%. Find WACC above BP_{RE} as: $WACC = 0.6(14.48\%) + 0.4(9\%)(1 - 0.35) = 11.03\%$. Thus, financing in excess of \$500,000 costs 11.03%. Projects 2, 3, and 4 all have IRRs exceeding either WACC and should be accepted. These projects require \$450,000 in financing. Project 1 is the next most profitable project. Given its cost of \$100,000, half or \$50,000 can be financed at 10.18% and the other half must be financed at 11.03%. The relevant cost of capital for Project 1 is then $0.5(10.18\%) + 0.5(11.03\%) = 10.61\%$. Since Project 1's IRR is less than the cost of capital, it should not be accepted. The firm's optimal capital budget is \$450,000.

30. Optimal capital budget

Answer: b Diff: T

Step 1: Calculate the retained earnings breakpoint:

$$BP_{RE} = \text{Retained earnings}/w_c = (\$500,000 \times 0.6)/0.6 = \$500,000.$$

Step 2: Calculate the WACCs: (There will be two: one with retained earnings and one with new equity.)

$$WACC_1 = [0.4 \times 8\% \times (1 - 0.4)] + [0.6 \times 12\%] = 9.12\%.$$

$$WACC_2 = [0.4 \times 8\% \times (1 - 0.4)] + [0.6 \times 13\%] = 9.72\%.$$

Step 3: Determine the optimal capital budget:

Now, work through the projects, starting with the highest-return project first, to determine the firm's optimal capital budget. Initially, the WACC is 9.12 percent for the first \$500,000 of projects, providing they return more than 9.12 percent. On the basis of this, we will take Projects A, B, and C, for a total budget of \$400,000. Project D will be funded half by $WACC_1$ and half by $WACC_2$; however, since Project D returns 9.85 percent, we should still accept it because this is greater than $WACC_2$. Project E returns 9.25 percent, but it will be funded entirely out of $WACC_2$ funds at 9.72 percent, so we would not accept Project E. Therefore, Projects A, B, C, and D should be accepted and the total capital budget is \$600,000.

31. Real options**Answer: e Diff: T N**

The correct answer is statement e. To see this, you must evaluate the follow-on project after the initial project has been evaluated.

The project cash flows are shown below (in millions of dollars):

Year	0	1	2	3	4
Up-front costs	-300				
Increase in NOWC	-50				
Sales		200	200	200	200
Operating costs		-100	-100	-100	-100
Depreciation		-75	-75	-75	-75
EBIT		25	25	25	25
Taxes		-10	-10	-10	-10
EBIT(1 - T)		15	15	15	15
Depreciation		75	75	75	75
Operating CF		90	90	90	90
AT(SV)					30
NOWC recovery					50
Net CF	-350	90	90	90	170

Using your financial calculator, enter the following data inputs:

$CF_0 = -350$; $CF_{1-3} = 90$; $CF_4 = 170$; $I = 10$; and then solve for NPV = -\$10.07 million.

The NPV at Year 4 of the second stage project is $(0.25)(\$40) + (0.75)(0) = \10 million. Using your financial calculator, compare the second stage project with the first stage project by entering the following input data (in millions of dollars):

$CF_0 = -10.07$; $CF_{1-3} = 0$; $CF_4 = 10$; $I = 10$; and then solve for NPV = -\$3.24 million.

Statement a is incorrect. Both are negative NPV projects; so, the second stage project has no impact on the first stage project. You would not do the first stage project. Statement b is incorrect. This assumes the first project has a negative NPV. The company may consider taking a first stage project with a positive NPV and a second stage project with a negative NPV, as long as the combined project has a positive NPV. Statement c is incorrect. If a positive NPV second stage project is greater than the negative NPV first stage project, the company may consider taking the project. Statement d is incorrect. Since the NPV of the whole project needs to be positive, changing CF_0 to -9.99 million does not do the trick. It is still a negative NPV project. Statement e is correct. Changing CF_0 to -6.82 million makes the project a positive NPV project.

32. Project's NPV**Answer: d Diff: E**

Find the project's NPV using a financial calculator and entering the following data inputs:

$CF_0 = -3000000$; $CF_{1-5} = 500000$; $I = 10$; and then solve for NPV = -\$1,104,607.

33. Growth options

Answer: a Diff: M

	0	$k = 10\%$	1	2	3	4	5
	-3,000,000		500,000	500,000	500,000	500,000	500,000
NPV =	-1,104,607						
	+1,303,935						NPV = +6,000,000 (35%)
	<u>\$ 199,328</u>						NPV = -6,000,000 (65%)

- Step 1: Find the NPV at $t = 0$ of the first project:
Enter the following data inputs in the financial calculator:
 $CF_0 = -3000000$; $CF_{1-5} = 500000$; $I = 10$; and then solve for NPV = $-\$1,104,607$.
- Step 2: Find the NPV at $t = 0$ of the new projects:
If at $t = 5$ the firm's technology is not successful, the firm will choose to not do the additional projects (since their NPV is $-\$6,000,000$). Therefore, the NPV at $t = 5$ is calculated as $0.35(\$6,000,000) + 0.65(\$0) = \$2,100,000$.
- However, this is the NPV at $t = 5$, so we need to discount this NPV to find the NPV of the additional projects today. Enter the following data inputs in the financial calculator:
 $N = 5$; $I = 10$; $PMT = 0$; $FV = 2100000$; and then solve for PV = $\$1,303,935$.
- Step 3: Find the NPV of the entire project considering its future opportunities:
 $-\$1,104,607 + \$1,303,935 = \$199,328$.

34. Project's NPV

Answer: a Diff: E

- Step 1: Find the project's expected cash flows in Years 1 through 5:
 $(0.5)(\$110,000) + (0.5)(\$25,000) = \$67,500$.
- Step 2: Find the project's NPV by entering the following data inputs in the financial calculator:
 $CF_0 = -250000$; $CF_{1-5} = 67500$; $I = 12$; and then solve for NPV = $-\$6,678$.

35. Value of abandonment option

Answer: e Diff: M

No abandonment:

<u>Yr. 0</u>		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>Prob</u>	<u>NPV</u>	<u>Prob × NPV</u>
-250,000	0.5	110,000	110,000	110,000	110,000	110,000	0.5	\$146,525	\$73,263
	0.5	25,000	25,000	25,000	25,000	25,000	0.5	159,881	<u>-79,941</u>
E (NPV) =									<u>\$-6,678</u>

Abandonment:

<u>Yr. 0</u>							<u>Prob</u>	<u>NPV</u>	<u>Prob × NPV</u>
		1	2	3	4	5			
	0.5	110,000	110,000	110,000	110,000	110,000	0.5	\$146,525	\$73,263
-250,000	0.5	125,000					0.5	-138,393	<u>-69,196</u>
								E (NPV) = \$	<u>4,067</u>

$$\text{Value of Abandonment} = \$4,067 - (-\$6,678) = \underline{\underline{\$10,745}}$$

36. New project NPV

Answer: e Diff: E N

We can solve for NPV by entering the following data into the cash flow register.

$CF_0 = -25000000$; $CF_1 = 10000000$; $CF_2 = 10000000$; $CF_3 = 10000000$; $CF_4 = 10000000$; $I/YR = 10$; and then solve for $NPV = \$6,698,654 \approx \$6,700,000$.

37. Investment timing option

Answer: c Diff: M N

Fair will only invest if market conditions are favorable, hence the 20% chance of receiving \$2 million annual cash flows is really 0% because the $NPV < 0$. Therefore, the NPV of the project as of $t = 1$, can be found using the calculator and entering the following data:

$CF_0 = -26000000$; $CF_1 = 12000000$; $CF_2 = 12000000$; $CF_3 = 12000000$; $CF_4 = 12000000$; $I/YR = 10$; and then solve for $NPV = \$12,038,385$. But, there is only an 80% chance of this occurring so expected $NPV = 0.8 \times \$12,038,385 = \$9,630,708$.

Now, we must find the NPV of the project as of Year 0, which is found by taking the present value of \$9,630,708 received in Year 1.

$$\begin{aligned} \text{NPV of project} &= \$9,630,708/1.1 \\ \text{NPV of project} &= \$8,755,189. \end{aligned}$$