1. To calculate the payback period, we need to find the time that the project has recovered its initial investment. After three years, the project has created:

$1,600 + 1,900 + 2,300 = $5,800

in cash flows. The project still needs to create another:

$6,400 – 5,800 = $600

in cash flows. During the fourth year, the cash flows from the project will be $1,400. So, the payback period will be 3 years, plus what we still need to make divided by what we will make during the fourth year. The payback period is:

Payback = 3 + ($600 / $1,400) = 3.43 years

2. To calculate the payback period, we need to find the time that the project has recovered its initial investment. The cash flows in this problem are an annuity, so the calculation is simpler. If the initial cost is $2,400, the payback period is:

Payback = 3 + ($105 / $765) = 3.14 years

There is a shortcut to calculate the future cash flows are an annuity. Just divide the initial cost by the annual cash flow. For the $2,400 cost, the payback period is:

Payback = $2,400 / $765 = 3.14 years

For an initial cost of $3,600, the payback period is:

Payback = $3,600 / $765 = 4.71 years

The payback period for an initial cost of $6,500 is a little trickier. Notice that the total cash inflows after eight years will be:

Total cash inflows = 8($765) = $6,120

If the initial cost is $6,500, the project never pays back. Notice that if you use the shortcut for annuity cash flows, you get:

Payback = $6,500 / $765 = 8.50 years

This answer does not make sense since the cash flows stop after eight years, so again, we must conclude the payback period is never.

3. Project A has cash flows of \$19,000 in Year 1, so the cash flows are short by \$21,000 of recapturing the initial investment, so the payback for Project A is:

Payback = 1 + (\$21,000 / \$25,000) = 1.84 years

Project B has cash flows of:

Cash flows = \$14,000 + 17,000 + 24,000 = \$55,000

during this first three years. The cash flows are still short by \$5,000 of recapturing the initial investment, so the payback for Project B is:

B: Payback = 3 + (\$5,000 / \$270,000) = 3.019 years

Using the payback criterion and a cutoff of 3 years, accept project A and reject project B.

4. When we use discounted payback, we need to find the value of all cash flows today. The value today of the project cash flows for the first four years is:

Value today of Year 1 cash flow = \$4,200/1.14 = \$3,684.21
Value today of Year 2 cash flow = \$5,300/1.14^2 = \$4,078.18
Value today of Year 3 cash flow = \$6,100/1.14^3 = \$4,117.33
Value today of Year 4 cash flow = \$7,400/1.14^4 = \$4,381.39

To find the discounted payback, we use these values to find the payback period. The discounted first year cash flow is \$3,684.21, so the discounted payback for a \$7,000 initial cost is:

Discounted payback = 1 + (\$7,000 – 3,684.21)/\$4,078.18 = 1.81 years

For an initial cost of \$10,000, the discounted payback is:

Discounted payback = 2 + (\$10,000 – 3,684.21 – 4,078.18)/\$4,117.33 = 2.54 years

Notice the calculation of discounted payback. We know the payback period is between two and three years, so we subtract the discounted values of the Year 1 and Year 2 cash flows from the initial cost. This is the numerator, which is the discounted amount we still need to make to recover our initial investment. We divide this amount by the discounted amount we will earn in Year 3 to get the fractional portion of the discounted payback.

If the initial cost is \$13,000, the discounted payback is:

Discounted payback = 3 + (\$13,000 – 3,684.21 – 4,078.18 – 4,117.33) / \$4,381.39 = 3.26 years

5. R = 0%: 3 + (\$2,100 / \$4,300) = 3.49 years
discounted payback = regular payback = 3.49 years

R = 5%: \$4,300/1.05 + \$4,300/1.05^2 + \$4,300/1.05^3 = \$11,709.97
\$4,300/1.05^4 = \$3,537.62
discounted payback = 3 + (\$15,000 – 11,709.97) / \$3,537.62 = 3.93 years

R = 19%: $\$4{,}300(PVIFA_{19\%,6}) = \$14{,}662.04$
The project never pays back.

6. Our definition of AAR is the average net income divided by the average book value. The average net income for this project is:

Average net income = (\$1,938,200 + 2,201,600 + 1,876,000 + 1,329,500) / 4 = \$1,836,325

And the average book value is:

Average book value = (\$15,000,000 + 0) / 2 = \$7,500,000

So, the AAR for this project is:

AAR = Average net income / Average book value = \$1,836,325 / \$7,500,000 = .2448 or 24.48%

7. The IRR is the interest rate that makes the NPV of the project equal to zero. So, the equation that defines the IRR for this project is:

$$0 = -\$34{,}000 + \$16{,}000/(1+IRR) + \$18{,}000/(1+IRR)^2 + \$15{,}000/(1+IRR)^3$$

Using a spreadsheet, financial calculator, or trial and error to find the root of the equation, we find that:

IRR = 20.97%

Since the IRR is greater than the required return we would accept the project.

8. The NPV of a project is the PV of the outflows minus the PV of the inflows. The equation for the NPV of this project at an 11 percent required return is:

$$NPV = -\$34{,}000 + \$16{,}000/1.11 + \$18{,}000/1.11^2 + \$15{,}000/1.11^3 = \$5{,}991.49$$

At an 11 percent required return, the NPV is positive, so we would accept the project.

The equation for the NPV of the project at a 30 percent required return is:

$$NPV = -\$34{,}000 + \$16{,}000/1.30 + \$18{,}000/1.30^2 + \$15{,}000/1.30^3 = -\$4{,}213.93$$

At a 30 percent required return, the NPV is negative, so we would reject the project.

9. The NPV of a project is the PV of the outflows minus the PV of the inflows. Since the cash inflows are an annuity, the equation for the NPV of this project at an 8 percent required return is:

$$NPV = -\$138{,}000 + \$28{,}500(PVIFA_{8\%,\,9}) = \$40{,}036.31$$

At an 8 percent required return, the NPV is positive, so we would accept the project.

The equation for the NPV of the project at a 20 percent required return is:

$$NPV = -\$138{,}000 + \$28{,}500(PVIFA_{20\%,\,9}) = -\$23{,}117.45$$

At a 20 percent required return, the NPV is negative, so we would reject the project.

We would be indifferent to the project if the required return was equal to the IRR of the project, since at that required return the NPV is zero. The IRR of the project is:

$$0 = -\$138{,}000 + \$28{,}500(PVIFA_{IRR,\,9})$$

$$IRR = 14.59\%$$