Zombie Bedtime Rhymes 17 Questions and Answers with explanation- Part 1.
Make sure you are also reading the actual event questions with story line, which contains important information.

1. “Brendan, let’s get our bearings. Washington is bordered on the West by the Pacific Ocean. What U.S. States and/or Canadian Provinces form its borders on the other three sides?” (See Mapscan 2: Driving Distance Chart for question #1)
Answer: British Columbia, Idaho, Oregon
   Straight map reading. On the mapscan, find BC Canada (British Columbia) on north, ID (Idaho) on east, OR (Oregon) on south. This is easier on hard copy map.

2. “Now, Brendan, remember our destination is Rock Island, WA. What are the AAA map grid references for Rock Island?” (See Mapscan 7: Columbia River Area for ques 2)
Answer: K-55
   Map grid references are the grid number (north/south) and letter (east/west) at map margins. Find Rock Island at K-55. On the hard copy AAA use the index.

3. What body of water separates the US and Canada at Port Angeles? (See Mapscan 1: Olympic Peninsula for ques 3)
Answer: Strait of Juan De Fuca
   See blue marking in the body of water between the Olympic Peninsula and Victoria, Canada (in tan). Juan De Fuca was a Greek navigator working for Spain, who may have sailed the strait while looking a shortcut to Asia. Juan also shows up in murder mysteries:

4. What would the cost be for Brendan, who is five years old, for the ferry from Port Angeles to Victoria? Just find the fare for Brendan—Mom can get her own ticket. They are not taking the car. (See Mapscan 5: Toll Facilities for ques 4)
Answer: Free/$0

See Toll Facilities chart- Juan De Fuca Strait. There is no car and you are not counting mom, so Brendan is free. Portion of chart shows on mapscan below:

5. As she drives west from Port Angeles, how does mom know that US 101 will be especially pretty?  *(See Mapscan 1: Olympic Peninsula for ques 5)*

Answer: Blue dots = designated scenic highway

There are a series of blue dots along US 101 at this point. See map legend/maps can; this translates to a designated scenic highway.

6. What is the latitude at Forks, WA? Express your answer to the nearest tenth of a degree. Don't forget North or South! *(See Mapscan 1: Olympic Peninsula for ques 6)*

Answer: range 47.7° - 48° N

Latitude is marked on the left margin of the mapscan area. Find 48° marked a bit north of Forks. The Twilight vampire books were set in Forks. Great place to be a vampire, because there are not many sunny days on the Olympic Peninsula, and you know how vampires feel about sunlight. The hard copy map will give you an answer of 48° N.

7. Within the dark green Olympic National Park, name two areas where it rains even more than the rest. *(See Mapscan 1: Olympic Peninsula for ques 7)*

Answer: Hoh, Quinault, Queets Rain Forest (any two)

You can figure that it rains a lot in the rain forest. The center of the Olympic Peninsula is mostly light green national forest land and darker green national park land. In the darker green area, find three Rain Forest areas: the Hoh Rain Forest, the Quinault Rain Forest, and the Queets Rain Forest. Moist air moves in from the Pacific and dumps lots of rain as it is forced upwards over the Olympic Mountains. These are temperate rain forests, not the tropical rain forest jungles you hear more about.

8. What is the minimum number of lights that Michael will have to pass as he carries his package? *(See Mapscan 1: Olympic Peninsula for ques 8)*

Answer: 4 or 5

Since the story says there is a light at each intersection, all you have to do is find a route from Michael’s office to Pike Market that crosses the minimum number of intersections. There are either 4 or 5, depending on which side of the street you think Pike Place Market is on. The real Market is a few blocks long - it’s a big group of stalls and small food places. One of the fish stores is famous for throwing whole salmon across the room - you’ve got to duck! Starbucks also started here.

9. How high is Mt. Rainier? Express your answer in feet. *(See Mapscan 8: Mt Rainier Insert for ques 9)*

Answer: 14,416ft

Straight map reading - Mt. Rainier is marked at 14,416ft. All you are doing is copying this so you need it exact.

10. What geologic features are shown all around the summit of Mt Rainier? *(See Mapscan 8: Mt Rainier Insert for ques 10)*
Answer: Glaciers A little trickier map symbol question. The maps clearly shows glaciers, but the AAA map legend does not key this. Good thing you have already studied the USGS symbol sheet showing glaciers!

11. Why must we visit Paradise in summer? (See Mapscan 8: Mt Rainier Insert for ques 11)  
Answer: Road closed in winter  
To reach Paradise you must travel on Stevens Canyon Road, which is marked as closed in winter. You also better behave!

12. Why is it legal for a gambling casino to operate in Toppenish, WA even though gambling is not legal in the State of Washington? (See Mapscan 9: Yakima-Toppenish Area for ques 12)  
Answer: Land is on Indian Reservation  
This is an inference question with come general knowledge thrown in. It’s a few steps removed from straight map reading. The map shows that Toppenish is located within the Yakima Indian Reservation (easier to see on hard copy). Indian Reservations exist because of treaties between the United States and individual Indian Nations. Treaties have not always been honored over the years, but state laws against gambling do not apply on the reservation. The Indian Nation can thus open a casino.

13. We stop at the AAA office in Kennewick, WA (R-57 on insert map) to replace our worn out map. What intersection closest to the AAA office? Express as the intersection of ___ and ___. (See Mapscan 3: Pasco-Kennewick Insert for ques 13)  
Answer: Canal Drive and Center (or Columbia Center) Blvd  
The red oval AAA office marking and red building marking shows on the South bank of the Columbia/Lake Wallula, so look for the nearest intersection of marked roads. The office is on Canal Drive close to Center (or Columbia Center) Blvd.

14. What type of overnight accommodations does the AAA show to be available at Ritzville, WA? (See Mapscan 6: I-90 and Ritzville and Mapscan 4 Legend for ques 14)  
Answer: Campground  
A map symbol question. At Ritzville, a red tepee is marked. Look on the map legend to reveal that this is a campground, with details provided by Woodall’s.

15. What distance along I-90 does the map show for this trip? (See Mapscan 6: I-90 and Ritzville for ques 15)  
Answer: 67 or 69 miles  
This question involves locating map symbols—in this case the mileage markings along I-90. The story tells you "the AAA actually shows road mileage right on the map"... "just look at those little black diamonds at some of the intersections!" Working Eastward from Interchange 151 to 220, the mileage marked on the map is 27 + 27 + 13 = 67 miles.

Another perfectly good method will give you a different answer. Most (not all) interstate highways number the exits in a given state by their mileage starting from a state line. I-90 starts a few feet from the waterfront in Seattle, WA and goes to Boston, MA. In Washington State, interchange 1 is a mile from start; interchange 5 is 4 miles further along, and interchange 151 is a total of 151 miles from the start. The numbers start over again in Idaho (the next state you would enter going east). This system is nice if you are driving because you get an immediate and pretty accurate idea of how far you have to go to get to a specific interchange. In this case, Interchange 151 to 220 is 220 – 151 = 69 miles. Either of these answers should be exact because you are not
measuring anything, just adding up a few numbers. You could also determine the distance by measuring and using map scale bar or math, but that is really the hard way. Read the story!

16. We pass many hay fields along I-90. I-90 is remarkably straight along this stretch, as are most of the other roads in this area. What does the straightness of the roads suggest about the topography in this area? (See Mapscan 6: I-90 and Ritzville for ques 16)

Answer: Flat

This requires a general feel for topographic maps and understanding of the way roads are constructed. Straight roads are cheaper to build - they're shorter. If a highway twists and turns it's because the land is hilly or presents other barriers. If the roads are straight, then the land is flat.

17. What is the straight-line distance between the town of Grand Coulee and the town of Rock Island? Express your answer to the nearest whole kilometer. (See Mapscan 7: Columbia River Area for ques 17)

Answer: Range 94-115 km

This is a straight map scale question. Scale questions are common in Road Scholar and can be done in two basic ways. You can use the bar scale on the map legend and "walk it off" the distance with pencil and paper, or you can calculate the distance based on the map scale. A straight math solution is faster but you must be able to handle the decimal places. You should always make these measurements in metric units. You will have 25 mm in the same ruler space as 16-inch fractions--thus a better guide--and you won’t have to work with fractions. Note that in this case the answer must be in metric units anyway. Answer keys are normally set up to allow for the slightly different answers each method will yield, with an acceptable range to allow for how different eyes make measurements.

Math and map scale method:

I measure this distance from the town of Rock Island to the Town of Grand Coulee (both marked by circles so I have an exact target) as 108.5 mm. On the map legend the scale is 1:988,416. Thus a 1-meter map distance (if you could fit it) is 988,416 meters on the Earth. Now for the tricky part: 108.5 mm is 0.1085 meters. Multiply this by the scale, and the distance between towns is 107243 meters. A distance that long would be expressed in kilometers. Dividing the 107243 meters by 1,000 gives the answer, 107 km. This sounds complicated, but it is all done very quickly on a basic $12 calculator.

Bar scale and "walk it off" method:

Using one of the blank pieces of unlined paper you always bring to Road Scholar, mark the location of each town on the map. Place this paper next to the scale bar on map legend enlarged here:

Using the kilometer bar, there are 44 km total shown. (Don’t use this enlarged bar to check your answer). Walk off your marked paper in 44 km groups--44 +44, and more remaining. For the remaining part you must use the finer graduations on the left end of the bar. I see this as 3.5 divisions. There are 8 divisions in 22 km, so each one is 2.75 km. Then 3.5 x 2.75 = 9.6 km, in addition to the 44 + 44 you already had, for a total of 97.6 or 98 km.
Note that the two methods give two different answers. This is common, and answer keys will normally allow for both methods.

18. Name the three dams on the Columbia between Grand Coulee and Rock Island Dam. (See Mapscan 7: Columbia River Area for ques 18)

Answer: Chief Joseph, Wells, Rocky Reach

Follow the river downstream from Grand Coulee Dam. (You-tube "coulee" for a musical geology lesson on coulees) The Columbia flows north from the dam, then west - see Chief Joseph dam. Follow River south to Wells Dam. Continue south to Rocky Reach Dam, a few miles above Wenatchee. Google "Nez Pierce Chief Joseph".

19. Using the driving distance and time chart, exactly how long would it have taken to drive from Seattle to Wenatchee? You must pass through Everett and Skykomish. Express as: ___ hours:___ minutes. (See Mapscan 2: Driving Distance Chart for ques 19)

Answer: 3 hours, 03 minutes.

The hard copy map is much easier to read than mapscan for this question. Driving time between points is shown in light blue as hours, minutes.

<table>
<thead>
<tr>
<th>Trip leg</th>
<th>hours:min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle to Everett</td>
<td>0:31</td>
</tr>
<tr>
<td>Everett to Skykomish</td>
<td>1:07</td>
</tr>
<tr>
<td>Skykomish to Leavenworth</td>
<td>0:55</td>
</tr>
<tr>
<td>Leavenworth to Wenatchee</td>
<td>0:30</td>
</tr>
<tr>
<td><strong>Total time</strong></td>
<td><strong>3:03</strong></td>
</tr>
</tbody>
</table>

Many students have trouble with the "hour and minute" math. In this problem minutes add up to 123. 120 minutes converts to two hours, so you have a total trip of 3 hours and 03 minutes. You are not making any measurements, just adding up the numbers from the map, so the answer must be exact.

20. What is the contour interval of this map? 40 ft

Answer: 40 ft

This is a straight marginal Information question. All USGS topographic maps show the contour interval, which depends on how steep inclines are in the map area. Flatter areas may have an interval of 3 ft, steeper 40 ft. (Some USGS maps are in metric units.) Questa is 40 feet. Copy it onto your answer sheet and you’re done. Make sure to include units; just 40 is not correct. Some USGS maps use metric units, and some use both English and metric on the same map.

21. USGS maps cover an area designated by latitude and longitude rather than by miles. How many degrees, minutes and seconds of latitude are covered in this map area? Express as: _____°, _____', ______". (No “North” or “South” needed)

Answer: 000° 07’ 30"

Marginal information with a little interpretation. Questa is a 7.5 minute quadrangle map, as are most topo maps used in Road Scholar. That means it covers an area of 7.5 minutes of latitude and longitude. Writing this in degrees, minutes, and second gives you 000°, 07’, 30”. No north, south, etc., is needed because you are not giving a specific location, just describing the size of the map.
On a 7.5 minute map, if the latitude at the lower edge (or neat line) is 10° 00’ 00” N, then the upper edge will be 10° 07’ 30” N. Same with longitude; the western neat line will always be 07’ 30” greater than the eastern neat line. Maps are further divided into Sectors—see ques #24.

22. The Questa, NM map has a scale of 1:24,000. If two points are exactly 2 cm apart on the map, how far apart are they on the earth’s surface? Express your answer in whole meters.

**Answer: 480 meters**

This is a scale question—see explanation for question 17. The scale here is 1:24,000 so the distance of 2 cm is calculated as 0.02 meters x 24,000 = 480 meters.

23. Most of the map area is composed of a mountain range that is also a protected area. Name both the mountain range and the protected national area.

**Answer: Sangre de Christo Mountains and Carson National Forest**

Straight map reading. Find Sangre de Christo Mountains and Carson National Forest (the protected national area).

24. Yolanda knows the map area is divided into nine Map Sectors. In which sector is downtown Questa located?

**Answer: West 4 or W4 or 4**

This is a map grid question, similar to Ques #2. "Downtown" Questa is in Sector West 4, or just 4.

**Background - Grid systems**

There are four grid systems you must know for topographic maps. They are Sector Reference System, Public Land Survey System (PLSS), Latitude and Longitude, and Universal Transverse Mercator (UTM).

a) **Sector Reference System** - Divides topo maps into nine sections (called 1 to 9) like a tic-tac-toe grid. Map sectors are based on 2.5’ of latitude and longitude.

b) **Public Land Survey System (PLSS)** - Thomas Jefferson set up this grid system to organize public lands for settlement. It is not used all states, including the original 13 colonies.

c) **Latitude and Longitude** - On topo maps, finding exact locations involves accurately locating a target point, expressed geometrically in degrees, minutes and seconds by doing proportions. This is a guaranteed two questions that are always done exactly the same way.

d) **Universal Transverse Mercator (UTM)** - Is a newer system of designating earth locations that is more computer-friendly. It uses the black 1 km grid on newer topo maps. UTM involves large numbers and many students are leery of it, but it is actually easy to use in Road Scholar.

**Background: - Map Sector Reference System Grid**

You absolutely must know the Sector Reference System grid system. It will show up in many story line directions, direct questions on sectors, and is needed to do latitude/longitude problems. The Map Sectors let you find things much faster than just looking all over the map. They are not precise, but are very fast to use. It takes a few minutes to learn with a map in front of you and is really easy after that. Map Sectors divide the map into nine sectors like a tic-tac-toe grid. Look at the grid below. Sectors are numbered from 1 to 9 and usually also named as Northwest, Southeast, etc. I suggest you remember them as Northwest 1, etc., to remember where they are.
The grid below has some of the coordinates from Questa, NM on it. Compare them to the actual map. If you look carefully at the Eastern neat line, you will see 36° 37’ 30” at the southeastern corner. A third of the way up find a small mark just inside the neat line marked 40’ and two thirds of the way up find 42’ 30”. The northern edge is marked 39° 45”. Longitude is marked the same way. For Questa it starts at 105° 30’ at the northeastern corner and increases going west to 105° 37’ 30”.

The map is thus broken down into three sections each way, each section being 2’ 30” of latitude and 2’ 30” of longitude. That’s nine sectors. The diagram below shows Questa Map Sectors. To keep things simple the latitude is only marked on the east and the longitude only on the north. Anything shown here in (parenthesis) is not actually printed on the real map - you have to figure it out yourself.

<table>
<thead>
<tr>
<th>Northwest 1</th>
<th>North 2</th>
<th>Northeast 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(105° 37’30” (W))</td>
<td>(105° 35’00” W)</td>
<td>(105° 32’ 30” W)</td>
</tr>
<tr>
<td>36°45’ (00” N)</td>
<td>(36°) 42’ 30” (N)</td>
<td>(36°) 40’ (00” N)</td>
</tr>
<tr>
<td>West 4</td>
<td>Central 5</td>
<td>East 6</td>
</tr>
<tr>
<td>&quot;downtown Questa&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southwest 7</td>
<td>South 8</td>
<td>Southeast 9</td>
</tr>
<tr>
<td>36° 37’ 30” (N)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Just in case you are not yet insane, the actual grid lines are not marked on the map as continuous lines. They are marked just inside the map edges (called “neat lines”, because they make the map neat) and as a series of four small crosses or "graticule intersections" or ("graticule ticks") at the corners of Central 5. Look at Central 5 in the Questa grid above and imagine erasing all the lines.
except the corners of C5. That should give you a good idea of the way the Sector Reference grid shows on hard copy USGS maps.

On the map scan below see a graticule intersection or tick mark in the upper right:

Those little crosses can be hard to see if the map has a lot of green and contour lines but they are there. On a map if you take one of the pieces of blank, unlined paper you should always bring to a Road event and put it on the neat lines at the 2.5’ ticks, then lay it across, you will hit the inside graticule intersections that give you the Sector boundaries. Make sure you are not using either the UTM grid (1 km grid in solid black lines) or the PLSS grid (1 mile grid in solid red).

25. What is the maximum straight-line distance within the larger of the two tailings ponds? Express your answer in whole meters.

Answer: 2040 meters

This is a straight-line distance question, just like #17. Playing around with your ruler will show a maximum map length of 85mm in the large tailings pond. That’s 0.085m. Multiply by the scale - 24,000 - to get the answer of 2040 meters.

26. If a sudden thunderstorm were to drop 7 cm of rain in the town of Questa, what changes would probably be recorded at the Water Gaging Station? It would_____
A) go up 7 cm  B) go down 12 cm  C) go up 25 cm  D) not change

Answer: D) not change

This is a stream direction question. To answer this question, you must determine if water will flow from the town of Questa towards the Water Gage. The story says "Southwest part of PLSS Section 33, you can see a Water Gaging Station on the Red River—it’s right next to our Questa School". If you did not read the story you are already lost. How sad! The Gaging Station is at about 7500 ft elevation and much of Questa is about 7300 ft, so the Gaging Station is upstream from Questa. Rain in Questa will therefore not have any effect on the Gage. Answer is D) not change.

Check You Tube – Stevie Nicks – Red River Valley.
27. Using the Public Land Survey System, give the three part description of the Water Gaging Station's location. Express as: Section ___, Township ___, Range ___

Answer: Sec 33, Township 29N, Range 13E

**Background: - PLSS**

This is a Public Land Survey System (PLSS) question. Thomas Jefferson set up the Public Land Survey System (PLSS) grid to organize public lands in the newly purchased Northwest Territories for sale and settlement. It is not used in the original 13 colonies and several other areas. PLSS takes getting used to and looks hard, but isn’t. If you own land in a PLSS state your deed and survey use PLSS to list boundaries; if you are in other areas you may have a "metes and bounds" description using landmarks like rocks, compass bearings and distances.

Check [dnr.wi.gov/topic/forestmanagement/documents/plsstutorial.pdf](dnr.wi.gov/topic/forestmanagement/documents/plsstutorial.pdf). Starting from scratch, this is a good explanation of the Public Land Survey System grid.

In PLSS, surveyors on the ground established base lines. The land along these lines is divided into Townships of 36 square miles. (These are not towns with stores, people, and Science Olympiad teams - just areas of land). Townships are given numbers - Township 1 North is north of the base line, Township 7 South is the seventh town south of the base line. East and west dimensions are named Ranges. A given 36 square mile township thus might be called Township 3 North, Range 15 West.

Each township is divided into 36 one square mile Sections, which are numbered as shown below. Assume this is Township 3 North, Range 13 East (T3N, R13E):

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
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<td>2</td>
<td>13</td>
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<td>3</td>
<td>24</td>
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<td>19</td>
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<tr>
<td>4</td>
<td>36</td>
<td>35</td>
<td>34</td>
<td>33</td>
<td>32</td>
<td>31</td>
</tr>
</tbody>
</table>

Notice that the number pattern is not like reading print on a page. This made perfect sense to surveyors walking on the ground, because they had to walk from one section to another to do the surveys. You would not finish a row of sections and then walk back six miles to start again; you just turn around and work the other way. It’s like plowing a corn field or cutting grass.

Each PLSS section is shown on topo maps with red boundaries and numbers. Township and Range numbers are on the neat lines. See mapscan below, neat line southwest of Questa.
In flat areas, these red lines can be hard to see because roads are often built right on them.

**Problem solution:**
Find PLSS Sec 33 (mapscan with Ques #28). Looking straight west to neat line shows T29N. Looking along northern neat line shows R13E.

**28. Let's get super accurate! Make that the five-part location! Express as ____ ____ Sec__, Township ____, Range _____**

**Answer: SW ¼ (or NW ¼), SW ¼, Sec 33, Township 29N, Range 13E.**

This is a problem that depends on your answer to the previous question. You already know that the gaging station is in Sec 33, Town 29N, Range 13E. Now add the details of where the gaging station is located within Section 33.

Each Section is divided into quarters, and each of them is also divided into quarters, called quarter-quarters. None of the divisions is marked on the map but you can figure them out. See mapscan below:

A section is one square mile, or 640 acres. The section is divided into four quarters. Each quarter section is 160 acres--about the amount of land needed for a sustainable family farm working on horse power.

Section 33
<table>
<thead>
<tr>
<th>Northwest 1/4</th>
<th>Northeast 1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southwest 1/4</td>
<td>Southeast 1/4</td>
</tr>
<tr>
<td><em>Gage</em></td>
<td></td>
</tr>
</tbody>
</table>

To figure closely, measure the section box on the Questa map or insert scan. The Gaging station is easily in the SW ¼. It’s a pretty much right on the border between the SW ¼ and the NW ¼ of the southwest quarter, so both answers were allowed. Answer: SW ¼ (or NW ¼), SW ¼, Sec 33, Township 29N, Range 13E.

Since PLSS sections are defined as one mile on each side, you can save some time by making up an overlay 1 x 1 mile square, drawn at 1:24000 ahead of time, with the quarter sections, etc., marked. Use the scale bar on a hard copy topo. You can also get commercial grids for this - try maptools.com. Note - PLSS sections are always 1 x 1 mile except for when they are not. Sometimes boundaries are indefinite, cut off, or otherwise unusual. PLSS grids do not show in bodies of water.

The PLSS let the US Government sell land to settlers and give them accurate deeds. The list price in 1820 was $1.25 per acre - about a day’s wages for a skilled tradesman. If you were Homesteading, you usually got 1/4 Section (160 acres) of land for free. You had to build a house and produce a crop within five years. You can still Homestead in Alaska, but bring a warm coat and lots of bear spray.

29. What is the highest possible elevation at Questa High School building?

   **Answer:** 7679 ft (exact no range)

   This question involves reading the contour lines and doing some thinking; it is not a straight "copy the map" answer.

**Background: - Elevation Contours**

   All points on a contour line have the same elevation. The interval between lines is shown on the map—commonly 10, 20, or 40 feet but could be something else, or metric. Index lines are heavier than others and have elevation labels, but the label may be a ways away from where you are looking. You need index lines to find the value of the other lines easily.

   If a given point is exactly on a line, its elevation is the value of the line. If it is not touching the line it cannot be that value.

   The map below has 20 ft contour intervals. Note index lines at 800ft and 900 ft. These would actually be labeled on the USGS map. The lighter lines at 820, 840, 860, 880 ft, etc., would show on the USGS but would not have labels.
Which way are the elevations going? The assumption is that for enclosed lines, the ground is getting higher towards the center.

Look at the points labeled A, B, C, & D on the map.

A = exactly 840 ft because it is directly on the 840 ft line.
B = exactly 860 ft for the same reason.
C = the exact elevation is not shown, but must be more than 860 ft and less than 880 ft.

The lowest possible elevation is 861, the highest possible 879. The ‘midrange” elevation is halfway between the known contour lines, or 870 ft. The phrasing of the question is important—it’s not designed to trick you, but you must know what is being asked.

D = the highest possible point, because of the assumption that the land is at the highest in the center. Note the “x” here. It must be higher than 940 ft, which is the highest shown contour line. But it cannot be as high as 960 ft because there is no 960 ft contour line. The highest possible elevation for D is thus 959 ft. If the height is actually marked directly on the map then that is the height used.

**Problem Solution:**

All points exactly on a contour line are the same elevation - so if the high school (the large building with the flag) was exactly on the 7680 ft line, its elevation at ground level would be 7680 ft. If it is not touching the line it must be higher or lower. In the map scan below, note the labeled contour lines at 40 ft intervals. 7720 and 7760 are not actually labeled but you can figure them out:
The school is west of the 7680, and the pattern of contour lines show the land is increasing in elevation to the east. So the school is below the 7680 line, and the highest possible elevation is therefore 7679 ft.

If a question asks for the exact elevation of something between lines--like the pond in the map scan above, between 7720 and 7760 ft - you can calculate a good estimate by using the same proportion method as in question # 45 for latitude.

You can use Google Earth or other satellite data for elevations of visible map features that you calculated from a USGS map. However, satellites do not show elevations above sea level as maps do. Instead of sea level, they use a mathematical base called “the Geoid”. For this reason elevations from satellite images are close to what shows on topo maps, but maybe not exactly the same even if both measurements are totally correct in their own systems.

30. **What does the grey shading in the mine area tell about the mine land?**

**Answer:** **Non-National Forest System Lands within the National Forest**

This is a map symbol question, but the symbol explanation is usually not in with other legend information. Look on the lower left of the map - the grey area shows land within a National Forest that is privately owned, so no problem running a mine. See map scan below.

31. **What is the exact latitude at this + mark? Express in degrees, minutes, and seconds. Don’t forget North or South!**

**Answer:** **36° 42’ 30” N (exact no range)**

This is a map sector question similar to # 24, but a little deeper. The + is a Sector boundary hachure mark, also called a graticule intersection. Use a piece of paper to follow this line East or West to either neat line and see the 42’ 30” notation. Then add the 36° and the North, which are not on the map directly but you can figure out, to express the actual latitude. There is no calculation involved but it’s more than copying from the map.

32. **What material composes the surface of the mine road?**

**Answer:** **Dirt**

This is a map symbol question. The USGS symbol sheet you should download and bring to any Road event shows map symbols. In this case, the symbol is also on the map itself.
33. According to the grade sign, how many feet of roadway would be needed for the road to climb a vertical distance of 600 feet? Express in feet.

Answer: 7,500 feet

Since you read the story, you know the road has an 8% grade. That means it climbs 8 feet for each 100 feet of length. Since you need to find how many feet of road is need for 600 vertical feet, set up a proportion:

\[
\frac{8 \text{ ft vertical}}{100 \text{ ft horizontal}} = \frac{600 \text{ ft vertical}}{?? \text{ ft horizontal}}
\]

Answer = 7,500 ft

34. Why doesn’t USGS show contour lines in the mine area?

Answer: Surface constantly changes (or similar)

By its nature, the area in an active mine is constantly changing. USGS does not show contour lines because of this--it’s just not worth it. Active volcanic areas may be treated the same way.

35. What is the stream gradient for Deer Creek from the Eastern Neat Line to Columbine Creek? Express as feet of drop per 1,000 feet of stream distance.

Answer: 166.6 ft/thousand feet (Range 161 to 171)

This is a nasty stream gradient problem. Like a road grade, stream gradient is a measure of a stream’s slope. It is expressed as feet of drop per 1,000 feet of length. Stream gradient has a big effect on water flow, erosion, and sediment movement. The map scan below is enlarged to help read elevations. You should bring a good magnifier to Road Scholar events.

To determine stream gradient, you must know the vertical and horizontal distance of stream travel. The shape of contours shows the direction of stream flow--note the "V" shape of contours around Deer Creek; the V points upstream.

Deer Creek flows into Columbine Creek between two 8400 ft index (heavy) contours. Reading from the left of the scan, the contour elevations are 8440, 8400, 8360, 8320 (at stream), 8360, 8400, and up. Deer Creek hits Columbine right at the 8320 line.

At the Eastern neat line, Deer Creek exits the map almost, but not quite, touching the 9200 ft index line. Its elevation can be read as 9199 ft. The total vertical distance of Deer Creek in this area is thus 879 ft (9199 – 8320).
On the Questa map (not the enlarged map scan above) measure along the stream from Columbine to the neat line. You should get 67 mm, or 0.67 meters.

The distance on earth is 0.067 m x 24,000 scale = 1608 meters.
Converting to feet, 1608m x 3.2808 ft / meter = 5276 feet.
Since the formula calls for drop per thousand feet, this is 5.276 thousands of feet.
Stream gradient = change in height/distance in thousands

Stream gradient = 879/5.276 = 166.6 ft / thousand feet.

The range of acceptable answers reflects variations students might get in their measurements of stream length. Note that stream gradient questions usually require you to figure out both elevation changes and stream length, then determine the gradient. Sometimes you are given the distance, but don't count on it.

36. The Rock Island topo map covers the same degrees, minutes, and seconds of Longitude as the Questa topo. But even a human can see that the Rock Island map is much narrower than the Questa map. Why is this so?

**Answer:** lines of longitude converge towards north (or similar)

This is a fairly common type of question if an event involves two different topo maps. Lines of latitude are always the same space apart, but lines of longitude are not. It's a result of the pesky fact that the Earth is round. Degrees of longitude start off about 67 miles apart at the equator (24,900 mile Earth circumference divided by 360), but they converge at the poles. Since topo maps are set up as 07° 30" longitude across, a map closer to the equator is wider than one further north. The Questa, NM map is 18.5 inches wide, but the Rock Island WA map is only 15.5 inches wide. That's the map area, not the paper it is printed on. For comparison, notice the different widths of two map scans below. Hilo is almost the southernmost point in the U.S. States, and Angle Inlet is the northernmost quadrangle in the lower 48 states (the blank northern part is in Canada).
37. In this map area, the Columbia River is marked as flowing eastward. In Sector SW7, mile 460 is also marked. What geographic feature would be found 460 miles away measured along the Columbia?

**Answer: The River's mouth**

This question involves the markings on rivers. Rivers flow from their source to their mouth. The mouth, where the river empties, might be an ocean or another river. Just like mile markers along a highway, USGS marks miles on rivers to help locate features along the river. Mile 0 is at the mouth. So the feature found 460 miles downstream from mile 460 on the Columbia River is the mouth or Pacific Ocean. On tributaries, mile 0 might be a larger river. Lewis and Clark spent a lot to effort traveling to the mouth of the Columbia.

38. Not counting the irrigated orchards, what percentage of the map area is forested? A) less than 5%  B) 0 to 20%  C) 50-60%  D) 90-100%

**Answer: A) Less than 5%**

This question requires you to look over the entire map and make an estimate of how much of the land area is covered with trees, grass, etc. Vegetation shows green on USGS maps, but there is almost no green in the Rock Island area--just a bit along creek bottoms in Sector NE3. You can see why irrigation is so important.

39. What Azimuth will we be using as we approach?

**Answer: 317° (range 314 - 320)**

Note: Questions # 39, 40, 41, and 43 all deal with using compass readings and involve Azimuth, Compass Bearings, and Declination.

The story says you are approaching from the Southeast. To line up with the runway, you must fly on the same Azimuth as the runway itself.

**Background: - Azimuths, Bearings, Declination**

Azimuths and bearings are both ways of expressing compass direction from you to another place. They are different from North or South, which are fixed direction and do not depend on where you are. Azimuths are more generally used today and are all numerical; bearings are an older way of saying the same thing. A bearing always starts with either "north" or "south", then a number in degrees, and finally either "east" or "west". Bearings are less common but still in use.

To find either azimuth or bearing on a map you need a protractor. Full circle protractors (compass protractors) are best. The graduations should start with 0 and go clockwise around to 359. (0 and 360 are the same thing). Get one on-line for a few dollars. Try mapatools.com, benmeadows.com, and forestry-suppliers.com. (Thanks to the student who left this behind at a Road event!)
The starting point for measuring Azimuth is wherever you are, or whatever point on the map is designated. The azimuth is the direction from there to another specific point. The hardest part is making sure that 0 degrees on your protractor is aligned with North on the map, and held steady while you make your degree reading. Center the protractor on the start point, use a piece of paper to align the North - South or East - West axis with the map margins, another paper to align the protractor center with your target, and read the azimuth. A partner is good for lending a hand here.

40. Yolanda checks her compass. What is the magnetic declination at the center of the map area? Express as degrees East or West of true North.
Answer: 17.5° East of North (exact no range)

A regular compass points north based on alignment with the Earth's magnetic field. The magnetic North Pole is not in the same place as the geographic North Pole, and it moves a little each year. It is about 250 miles away from the geographic North Pole.

USGS Maps always list declination at the center of the map, in Sector Center 5. The declination as of the map date is shown as marginal information as on the mapsan below.

The star is Polaris, or true north. GN is not geographic north; it is Grid North and is used in UTM grid coordinates. MN is magnetic north. The difference East or West between true north and magnetic north is the declination (also called variation). Depending on where you are, it can be almost nothing or about 20°. To get an idea of how important this is, suppose a rifle shooter is aiming at a golf ball a football field away. If her aim is off by 1 minute, she misses by an inch. One
degree off and she misses by five feet. Imagine how far she would miss if flying 100 miles, but in the wrong direction by 17.5°! A given question in a Road Scholar should tell you if you must correct azimuths for declination.

41. Yolanda does some quick mental math—she's got a heck of a brain! What will her compass azimuth be after correcting for magnetic declination?

Answer: 299.5° (range 295 - 305)

This can drive you crazy. If the declination is to the East, subtract from true azimuth to get magnetic direction. If declination is west of north, add to true azimuth to get magnetic direction.

The Google Earth image below is the actual runway at Rock Island. Note the "30" painted on the end as you approach from the Southeast. Most runways are marked with the correct approach magnetic azimuth as an aid to pilots. The actual magnetic azimuth is rounded to the nearest ten degrees and last digit is dropped. For an approach azimuth of 300°, the runway number is thus 30. The other end of the same runway would be marked "12", since the pilot is approaching from the Northwest on a magnetic azimuth of 120°--opposite of 300°.

42. How long is runway # 2? Express in meters.

Answer: 1680 meters (range 1650 - 1700)

This is a straightforward scale question. On the full map scan the runway measures 70 mm = 0.07 m x 24,000 scale = 1680 m (range 1650-1700)

43. What is the old fashioned compass bearing Yolanda would use if approaching on runway # 1? (She is approaching from the South; ignore declination)

Answer: North 9° West (range N 06 W - N 12 W)

Background: - Compass Bearings

Another way of giving compass directions is compass bearings—an older and different way of saying the same thing. The idea is to give basic information first, then the details. The basic information is whether you are going north or south, and then ask just how far away from straight north or south. A compass bearing, therefore, will always start with either "north" or "south", then a number in degrees, and finally either "east" or "west".

For this problem, the approach azimuth to the runway is measured by protractor at 351°. That's 9° to the west of true north, and is written as North 09° West.

While azimuths can be numbered from 0° to 359°, bearings cannot be above 90°. If the bearing given above was 91° west of north, it is actually closer to south and would be written as South 89° West.
Both azimuths and bearings are currently in use. Older records—logs, deeds, etc., are almost always in bearings. See below:

*An excerpt from the Journal of Lewis and Clark, November 4th, 1805. They are on the Columbia River. Original spelling retained.*

...met a large canoe from below with 12 men, the canoe ornamented with *Images* carved and ...fixed very netely on the canoe ... we had a full view of Mt. St. Helien which is perhaps the highest pinnacle in America it bears North 25° East about 90 miles...it rises Something in the form of a Sugar lofe.

***************Continue in Coach Answers Part 2***************