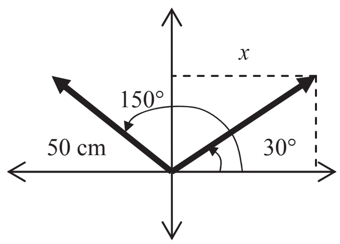
Then, the angle in standard position for the flowering dogwood is 180° − 30° or 150°, to the nearest degree. The angle in standard position for the river birch is 180° + 30° or 210°, to the nearest degree. The angle in standard position for the white pine is 360° − 30° or 330°, to the nearest degree.

c) On the grid, there are 4 vertical units of distance between the red maple and the white pine. Since each grid mark represents 10 m, the distance between these two trees is 40 m.

Section 2.1 Page 84 Question 11



$$\cos 30° = \frac{x}{50}$$
$$\frac{\sqrt{3}}{2} = \frac{x}{50}$$
$$x = 25\sqrt{3}$$

By symmetry, the horizontal distance that the tip of the wiper travels in one swipe will be $2x$, or $50\sqrt{3}$ cm.

Section 2.1 Page 84 Question 12

a) Using the symmetries of the diagram, the coordinates are $A'(x, -y)$, $A''(-x, y)$ and $A'''(-x, -y)$.

b) A' is in quadrant IV, so $\angle A'OC = 360° - \theta$.
A'' is in quadrant II, so $\angle A''OC = 180° - \theta$.
A''' is in quadrant III, so $\angle A'''OC = 180° + \theta$.

Section 2.1 Page 84 Question 13

$$\sin 60° = \frac{v_1}{10}$$
$$\frac{\sqrt{3}}{2} = \frac{v_1}{10}$$
$$v_1 = 5\sqrt{3}$$

$$\sin 30° = \frac{v_2}{10}$$
$$\frac{1}{2} = \frac{v_2}{10}$$
$$v_2 = 5$$

Then, $v_1 - v_2 = 5\sqrt{3} - 5$.
The exact vertical displacement of the boom is $\left(5\sqrt{3} - 5\right)$ m.

Section 2.1 Page 85 Question 14

The 72° angle is in quadrant III, so in standard position the angle is 180° + 72 ° or 252°.

Section 2.1 Page 85 Question 15

An angle of 110° will be in quadrant II. Using a protractor to determine where this angle falls on the diagram, it is found that the terminal arm passes through Cu, Ag, and Au. These elements are copper, silver, and gold, respectively.

Section 2.1 Page 85 Question 16

a) The terminal arm of the blue angle falls at the end of the 12th day of 20 on the second ring. Since there are 360° in the circle, the blue angle measures $\left(\frac{12}{20}\right)360°$ or 216°.

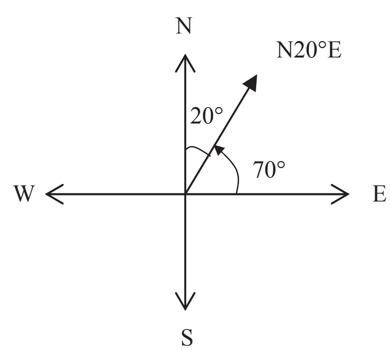
b) If the angle was in quadrant II, it would be the 8th day of 20. The angle would measure $\left(\frac{8}{20}\right)360°$ or 144°.

You can check this using reference angles. For 216°, the reference angle is 216° − 180° or 36°. So, the same reference angle in quadrant II is 180° – 36° or 144°.

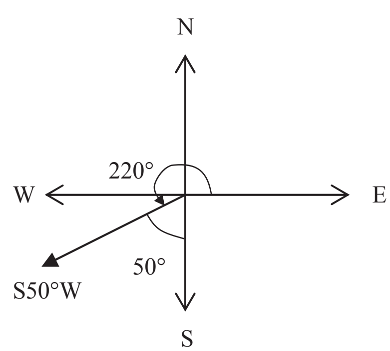
c) In quadrant IV, this reference angle would give and angle of 360° − 36° or 324°. This represents 2 short of 20 days, or 18 days.

Section 2.1 Page 85 Question 17

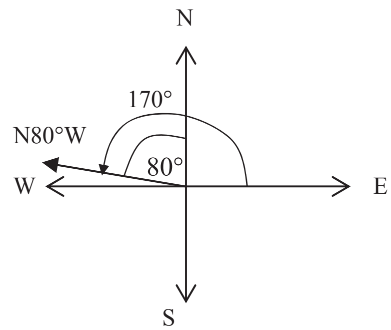
a) N20°E is equivalent to 70° in standard position.



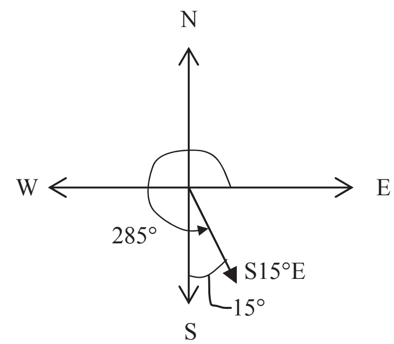
b) S50°W is equivalent to 180° + 40° or 220° in standard position.



c) N80°W is equivalent to 90° + 80° or 170° in standard position.



d) S15°E is equivalent to 270° + 15° or 285° in standard position.



Section 2.1 Page 86 Question 18

a) $\sin\theta = \dfrac{h_{arm}}{45}$, where h_{arm} is the height of the fingertips above the centre of rotation.

$h_{arm} = 45\sin\theta$

Then, the height of the arm above the table is given by $h = 12 + 45 \sin \theta$.

θ	0°	15°	30°	45°	60°	75°	90°
$h = 12 + 45 \sin \theta$ (in centimetres)	12.0	23.6	34.5	43.8	51.0	55.5	57.0

b) From the table, it is clear that the increase in h is not constant. For example, from 0° to 15° the height increases 11.6 cm, while from 30° to 45° the height increases 9.3 cm. the rate of increase lessens as the measure of θ approaches 90°.

c) If θ were extended 90°, my conjecture is that the height would decrease, reaching 12 cm when θ = 180°, and that the height would decrease slowly for angles just past 90° but the rate of decrease would be greater towards the horizontal position.

Section 2.1 Page 86 Question 19

Let x and y represent the two angles. Supplementary angles have a sum of 180°, so $x + y = 180°$.
If the terminal arms of the two angles are perpendicular, then one angle is 90° more than the other, or $y = x + 90°$.

Substituting, $x + x + 90° = 180°$
Then, $x = 45°$.
The two angles must be 45° and 135°.

Section 2.1 Page 86 Question 20

a) Let y_s represent the height of the seat above the centre of rotation.

$$\sin 72° = \frac{y_s}{9}$$
$$y_s = 9\sin 72°$$
$$y_s = 8.559...$$

So, the height of Carl's seat above the ground is 11 + 8.559… or approximately 19.56 m.

b) i) If the speed is 4 rev/min, then in 5 s Carl has moved $\left(\frac{4}{60}\right)5$ or $\frac{1}{3}$ of a revolution.

So , the second stop is 120° past the 72° position. The angle of the seat that Carl is on, in standard position, is 72° + 120° or 192°.

ii) The second stop is 12° below the horizontal. So, in this position

$$\sin 12° = \frac{y_s}{9}$$
$$y_s = 9\sin 12°$$
$$y_s = 1.871...$$

In this case, Carls seat is 11 − 1.871… or approximately 9.13 m above the ground.

Section 2.1 Page 86 Question 21

a) $\sin\theta = \frac{\text{CD}}{\text{OC}}$

$\sin\theta = \frac{\text{CD}}{1}$, since the radius is 1.

So, option B is correct.

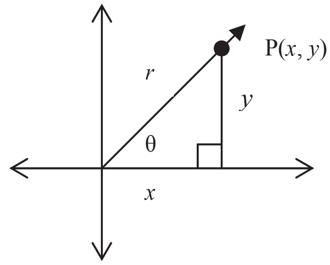
b) $\tan\theta = \frac{\text{BA}}{\text{OA}}$

$\sin\theta = \frac{\text{BA}}{1}$, since the radius is 1.

So, option D is correct.

Section 2.1 Page 86 Question 22

Using the Pythagorean Theorem,
$x^2 + y^2 = r^2$



Section 2.1 Page 86 Question 23

a)

θ	20°	40°	60°	80°
$\sin \theta$	0.3420	0.6428	0.8660	0.9848
$\sin (180° - \theta)$	0.3420	0.6428	0.8660	0.9848
$\sin (180° + \theta)$	−0.3420	−0.6428	−0.8660	−0.9848
$\sin (360° - \theta)$	−0.3420	−0.6428	−0.8660	−0.9848

b) My conjecture is that $\sin \theta$ and $\sin (180° - \theta)$ have the same value. Also, $\sin (180° + \theta)$ and $\sin (360° - \theta)$ have the opposite value to $\sin \theta$ (i.e., same numeric value but negative).

c) Similar results will hold true for values of cosine and tangent, but they will be negative in different quadrants. Refer to the diagram in the previous question and think of a point on the terminal arm in each quadrant. Cosine will be negative in quadrants II and III, because cosine involves the adjacent side which is negative in those quadrants. Tangent will be negative in quadrants II and IV, because either the adjacent side or the opposite side is negative in those quadrants.

Section 2.1 Page 86 Question 24

a) Substitute $V = 110$ and $\theta = 30°$ into the formula $d = \dfrac{V^2 \cos\theta \sin\theta}{16}$.

$$d = \frac{110^2 \cos 30° \sin 30°}{16}$$

$$d = \frac{3025}{4}\left(\frac{\sqrt{3}}{2}\right)\left(\frac{1}{2}\right)$$

$$d = \frac{3025\sqrt{3}}{16}$$

The exact distance that Daria hit the ball with this driver was $\dfrac{3025\sqrt{3}}{16}$ ft.