```
(* question 1 *)
Solve[{Dt[Sin[y] - Exp[x], x] == 0, Sin[y] == Exp[x]}, Dt[y, x], y]
```

Solve::bdomv : Warning: y is not a valid domain specification. Assuming it is a variable to eliminate. ≫

Solve::ifun :

Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information. ≫

Out[32]= $\left\{\left\{\text{Dt}[y, x] \to -\frac{i\, e^{x}}{\sqrt{-1 + e^{2x}}}\right\}, \left\{\text{Dt}[y, x] \to \frac{i\, e^{x}}{\sqrt{-1 + e^{2x}}}\right\}\right\}$

```
(* question 2 *)
FindRoot[x^2 == Tanh[x], {x, 1.1}]
```

Out[2]= {x → 0.822429}

In[3]:=
```
(* question 3 *)
x = a Cos[t];
y = b Sin[t];
Tan[θ] = y/x;
```

Set::write : Tag Tan in Tan[θ] is Protected. ≫

In[8]:=
```
Solve[{0 == Dt[Tan[θ] - y/x, t] /. Dt[a, t] → 0 /. Dt[b, t] → 0, Tan[θ] == y/x}, Dt[θ, t], θ]
```

Solve::bdomv : Warning: θ is not a valid domain specification. Assuming it is a variable to eliminate. ≫

Solve::ifun :

Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information. ≫

Out[8]= $\left\{\left\{\text{Dt}[\theta, t] \to \frac{a\, b\, \text{Sec}[t]^2}{a^2 + b^2\, \text{Tan}[t]^2}\right\}\right\}$

In[9]:=
```
area = 4 Integrate[1/2 (x^2 + y^2) Dt[θ, t] /. Dt[θ, t] → a b Sec[t]^2/(a^2 + b^2 Tan[t]^2), {t, 0, π/2}]
```

Out[9]= a b π

In[10]:=
```
(* question 5 *)
Solve[{m1 v1 + m2 v2 == m1 vA + m2 vB, 1/2 m1 v1^2 + 1/2 m2 v2^2 == 1/2 m1 vA^2 + 1/2 m2 vB^2}, {vA, vB}]
```

Out[10]= $\left\{\{v_A \to v_1, v_B \to v_2\}, \left\{v_A \to \frac{m_1 v_1 - m_2 v_1 + 2 m_2 v_2}{m_1 + m_2}, v_B \to \frac{2 m_1 v_1 - m_1 v_2 + m_2 v_2}{m_1 + m_2}\right\}\right\}$

In[13]:=
```
Simplify[(vB - vA) /. vA → (m1 v1 - m2 v1 + 2 m2 v2)/(m1 + m2) /. vB → (2 m1 v1 - m1 v2 + m2 v2)/(m1 + m2)]
```

Out[13]= $v_1 - v_2$

In[15]:=
```
(* question 6 *)
Solve[{m1 g - T1 == m1 a1, m2 g - T2 == m2 a2, m3 g - T2 == m3 a3, T1 == 2 T2, 2 a1 + a2 + a3 == 0},
 {a1, a2, a3, T1}, {T2}]
```

Out[15]=
$$\left\{\left\{a_1 \to -\frac{-g m_1 m_2 - g m_1 m_3 + 4 g m_2 m_3}{m_1 m_2 + m_1 m_3 + 4 m_2 m_3}, a_2 \to -\frac{-g m_1 m_2 + 3 g m_1 m_3 - 4 g m_2 m_3}{m_1 m_2 + m_1 m_3 + 4 m_2 m_3}, a_3 \to -\frac{3 g m_1 m_2 - g m_1 m_3 - 4 g m_2 m_3}{m_1 m_2 + m_1 m_3 + 4 m_2 m_3}, T_1 \to \frac{8 g m_1 m_2 m_3}{m_1 m_2 + m_1 m_3 + 4 m_2 m_3}\right\}\right\}$$

In[16]:=
```
Simplify[(a1 m1 + a2 m2 + a3 m3 + 2 T1) /. a1 → -(-g m1 m2 - g m1 m3 + 4 g m2 m3)/(m1 m2 + m1 m3 + 4 m2 m3) /.
  a2 → -(-g m1 m2 + 3 g m1 m3 - 4 g m2 m3)/(m1 m2 + m1 m3 + 4 m2 m3) /.
  a3 → -(3 g m1 m2 - g m1 m3 - 4 g m2 m3)/(m1 m2 + m1 m3 + 4 m2 m3) /. T1 → (8 g m1 m2 m3)/(m1 m2 + m1 m3 + 4 m2 m3)]
```

Out[16]=
$$g\,(m_1 + m_2 + m_3)$$