ECON 460 MIDTERM PART 2 - ANSWER KEY
Generated using Maple

```
>
> restart :
```

MIDTERM QUESTION 1

```
> u := x·y^2;
```

$$u := x\,y^2 \tag{1}$$

Demand functions from the Utility Max problem (Lagrange)

```
> xm := M/(3·px);
```

$$xm := \frac{1}{3}\,\frac{M}{px} \tag{2}$$

```
> ym := 2·M/(3·py);
```

$$ym := \frac{2}{3}\,\frac{M}{py} \tag{3}$$

```
> v := subs( {x = xm, y = ym}, u );
```

$$v := \frac{4}{27}\,\frac{M^3}{px\,py^2} \tag{4}$$

The EXPENDITURE FUNCTION

```
> B := (27/4·px·py^2·u0)^(1/3);
```

$$B := \frac{1}{4}\,27^{1/3}\,4^{2/3}\,(px\,py^2\,u0)^{1/3} \tag{5}$$

```
> py := 1;
```

$$py := 1 \tag{6}$$

```
> M1 := 36;
```

$$M1 := 36 \tag{7}$$

```
> px1 := 2;
```

$$px1 := 2 \tag{8}$$

```
> px2 := 1;
```

$$px2 := 1 \tag{9}$$

```
> Xold := subs( {px = px1, M = M1}, xm);
```

$$Xold := 6 \tag{10}$$

```
> Yold := subs(M = M1, ym);
```

$$Yold := 24 \tag{11}$$

```
> Uold := subs( {px = px1, M = M1}, v);
```

$$Uold := 3456 \tag{12}$$

```
> Xnew := subs( {px = px2, M = M1}, xm);
```

$$Xnew := 12 \tag{13}$$

```
> Ynew := Yold;
```

$$Ynew := 24 \quad \textbf{(14)}$$

```
> Unew := subs( { px = px2, M = M1 }, v );
```

$$Unew := 6912 \quad \textbf{(15)}$$

CV = Old U and New P

```
> CV := evalf (M1 − subs( { px = px2, u0 = Uold }, B) );
```

$$CV := 7.42678105 \quad \textbf{(16)}$$

EV = New U and old P

```
> EV := evalf (subs( { px = px1, u0 = Unew }, B) − M1);
```

$$EV := 9.35715780 \quad \textbf{(17)}$$

```
> restart :
```

MIDTERM QUESTION 2

```
> c := 600 + 4·q + q^2;
```

$$c := 600 + 4\,q + q^2 \quad (18)$$

```
> E := 3·q;
```

$$E := 3\,q \quad (19)$$

```
> r := 90·q;
```

$$r := 90\,q \quad (20)$$

total revenue is r = pq = 90q profit is denoted PS for producer surplus

```
> ps1 := r − c;
```

$$ps1 := 86\,q - 600 - q^2 \quad (21)$$

```
> qu := solve(diff(ps1, q) = 0, q);
```

$$qu := 43 \quad (22)$$

```
> Emax := subs(q = qu, E);
```

$$Emax := 129 \quad (23)$$

```
> subs(q = qu, ps1);
```

$$1249 \quad (24)$$

```
> ps2 := ps1 − 10·E;
```

$$ps2 := 56\,q - 600 - q^2 \quad (25)$$

```
> qt := solve(diff(ps2, q) = 0, q);
```

$$qt := 28 \quad (26)$$

```
> Etax := subs(q = qt, E);
```

$$Etax := 84 \quad (27)$$

```
> profitwithTax := subs(q = qt, ps2);
```

$$profitwithTax := 184 \quad (28)$$

```
> ps3 := ps1 + 10·(Emax − E);
```

$$ps3 := 56\,q + 690 - q^2 \quad (29)$$

```
> qs := solve(diff(ps3, q) = 0, q);
```

$$qs := 28 \quad (30)$$

```
> profitwithSubsidy := subs(q = qs, ps3);
```

$$profitwithSubsidy := 1474 \quad (31)$$

CHANGE of TECHNOLOGY UNDER TAX

```
> E := 2·q;
```

$$E := 2\,q \quad (32)$$

```
> ps2 := ps1 − 10·E;
```

$$ps2 := 66\,q - 600 - q^2 \quad (33)$$

```
> qt := solve(diff(ps2, q) = 0, q);
```

$$qt := 33 \quad (34)$$

```
> Etax := subs(q = qt, E);
```

$$Etax := 66 \quad (35)$$

```
> profitwithTax2 := subs(q = qt, ps2);
```

$$profitwithTax2 := 489 \quad (36)$$

```
> WTPnewTech := profitwithTax2 − profitwithTax;
```

$$WTPnewTech := 305 \quad (37)$$

MIDTERM QUESTION 3
x1 and x2 are emissions for firms 1 and 2

```
> restart :
```

Marginal Savings are m1 and m2

```
> m1 := 60 − x1;
```

$$m1 := 60 - x1 \quad (38)$$

```
> m2 := 60 − 2·x2;
```

$$m2 := 60 - 2\,x2 \quad (39)$$

To find Aggregate marginal savings, add Horizonally: rewrite m1, m2 as x1 = 60 - m and x2 =30 - 1/2m then aggregate to get:

```
> ms := 60 − (2/3)·x;
```

$$ms := 60 - \frac{2}{3}\,x \quad (40)$$

```
> md := (4/3)·x;
```

$$md := \frac{4}{3}\,x \quad (41)$$

```
> TD := (2/3)·x^2;
```

$$TD := \frac{2}{3}\,x^2 \quad (42)$$

```
> Xstar := solve(ms = md, x);
```

$$Xstar := 30 \quad (43)$$

```
> TDsocial := subs(x = Xstar, TD);
```

$$TDsocial := 600 \quad (44)$$

xs is emissions per firm under standard

```
> xs := Xstar/2;
```

$$xs := 15 \quad (45)$$

```
> m1s := subs(x1 = xs, m1);
```

$$m1s := 45 \quad (46)$$

```
> m2s := subs(x2 = xs, m2);
```

$$m2s := 30 \quad (47)$$

PRIVATE COSTS Standard: TAC1 and TAC2

```
> tac1 := 0.5·(subs(x1 = xs, m1)·(60 − xs));
```

$$tac1 := 1012.5 \quad (48)$$

```
> tac2 := 0.5·(subs(x2 = xs, m2)·(30 − xs));
```

$$tac2 := 225.0 \quad (49)$$

```
> t := subs(x = Xstar, md);
```

$$t := 40 \quad (50)$$

```
> x1t := solve(m1 = t, x1);
```

$$x1t := 20 \quad \textbf{(51)}$$

```
> x2t := solve(m2 = t, x2);
```

$$x2t := 10 \quad \textbf{(52)}$$

```
> tac1t := 0.5·(t·(60 − x1t));
```

$$tac1t := 800.0 \quad \textbf{(53)}$$

```
> tac2t := 0.5·(t·(30 − x2t));
```

$$tac2t := 400.0 \quad \textbf{(54)}$$

```
> SocialCostStandard := tac1 + tac2 + TDsocial;
```

$$SocialCostStandard := 1837.5 \quad \textbf{(55)}$$

```
> SocialCosttax := tac1t + tac2t + TDsocial;
```

$$SocialCosttax := 1800.0 \quad \textbf{(56)}$$

```
> Saving := tac1 + tac2 - tac1t − tac2t;
```

$$Saving := 37.5 \quad \textbf{(57)}$$

PRIVATE COSTS Tax: TAC1 and TAC2 plus Tax Bills

```
> TC1 := tac1t + t·x1t;
```

$$TC1 := 1600.0 \quad \textbf{(58)}$$

```
> TC2 := tac2t + t·x2t;
```

$$TC2 := 800.0 \quad \textbf{(59)}$$

```
>
>
```