ELASTICITY

When we introduced demand we noticed that consumers usually buy more of a good when its price is low or their income is higher etc. However when discussing demand we only talked about the direction that quantity demanded moved following a price change or a decrease in income. We never said by how much demand changes. In order to measure this change in demand economists use the concept of elasticity.

On the Leaving Cert course there are 4 different types of elasticity.

1) Price Elasticity of demand (PED)

2) Income Elasticity of Demand (YED)

3) Cross-Price Elasticity of Demand (CED)

4) Price Elasticity of Supply (PES)

The one that we shall start off with and perhaps the most important is Price Elasticity of Demand (PED).

Price Elasticity of Demand (PED)

> **Price Elasticity of Demand:** Measures the percentage change in the demand for a good caused by the percentage change in the price of that good.

The Law of Demand states that a rise in the price of a good lowers the quantity demanded and a fall in the price of a good increases the quantity demanded. PED measures by how much the quantity demanded responds to a change in price.

In order to compute PED we use the following formula

$$PED = \frac{P_1 + P_2}{Q_1 + Q_2} \times \frac{\Delta Q}{\Delta P}$$

Where:

P_1 = Original Price of the good

P_2 = New Price of the good

Q_1 = Original Quantity Demanded

Q_2 = New Quantity Demanded

ΔQ = The Change in Quantity

ΔP = The change in Price

EXAMPLE 1

Find the PED of the following goods

1) A consumer buys 150 Big Macs per month when the price is €1 each. Now their price is €2 each and he only buys 75.

$$PED = \frac{1+2}{150+75} \times \frac{-75}{1} = \frac{3}{225} \times \frac{-75}{1} = \frac{-225}{225} = -1$$

Therefore the answer is -1. This means that if price changes by 1%, quantity demanded will change by 1%. What if price changes by 2%?

% Change in Price X PED = % Change in Quantity

2 X 1 = 2%. If price increases by 2%, quantity demanded will fall by 2%

2) A man bought 50 pints of Heineken per week when its price was €1 per pint. When the price rose to €1.20 per pint , he bought 40 pints.

$$PED = \frac{1+1.2}{50+40} \times \frac{-10}{0.2} = \frac{2.2}{90} \times \frac{-10}{0.2} = \frac{-22}{18} = -1.222$$

Therefore the answer is -1.222222. This means that if price changes by 1%, quantity demanded will change by 1.2222%. What if price changes by 5%?

% Change in Price X PED = % Change in Quantity

5 X 1.2222 = 6.111%. If price falls by 5%, quantity demanded will rise by 6.111%

3) A man bought 200 litres of petrol per month when its price was €1 per litre. Now he buys 180 litres per month and its price is €1.50.

$$PED = \frac{1+1.5}{200+180} \times \frac{-20}{0.5} = \frac{2.5}{380} \times \frac{-20}{0.5} = \frac{-50}{140} = -0.26315$$

Therefore the answer is -0.26. This means that if price changes by 1%, quantity demanded will change by 0.26%. What if price changes by 7.5%?

% Change in Price X PED = % Change in Quantity

7.5 X 0.26351 = 1.976352%. If price increases by 7.5%, quantity demanded will fall by 1.976352%

INTERPRETATION OF YOUR ANSWER

As we can see from the examples above, all the answers were minus numbers.

It is this minus sign that tells us that these goods are normal goods and obey the law of demand.

This is because, for a normal good, as price rises (+) demand falls (-) and as price falls (-) demand rises (+). Mathematically, a plus divided by a minus is always a minus and likewise a minus divided by a plus is again a minus. As such a normal good always yields a minus answer.

What if the answer is a plus? This would mean that the good broke the Law of Demand and as such would be either

1) A good of Ostentation

2) A good of Expectation

3) A Giffen Good

4) A good of Addiction

You cannot tell which one of these goods it is just from a plus answer to the formula but you might be asked to explain a positive result.
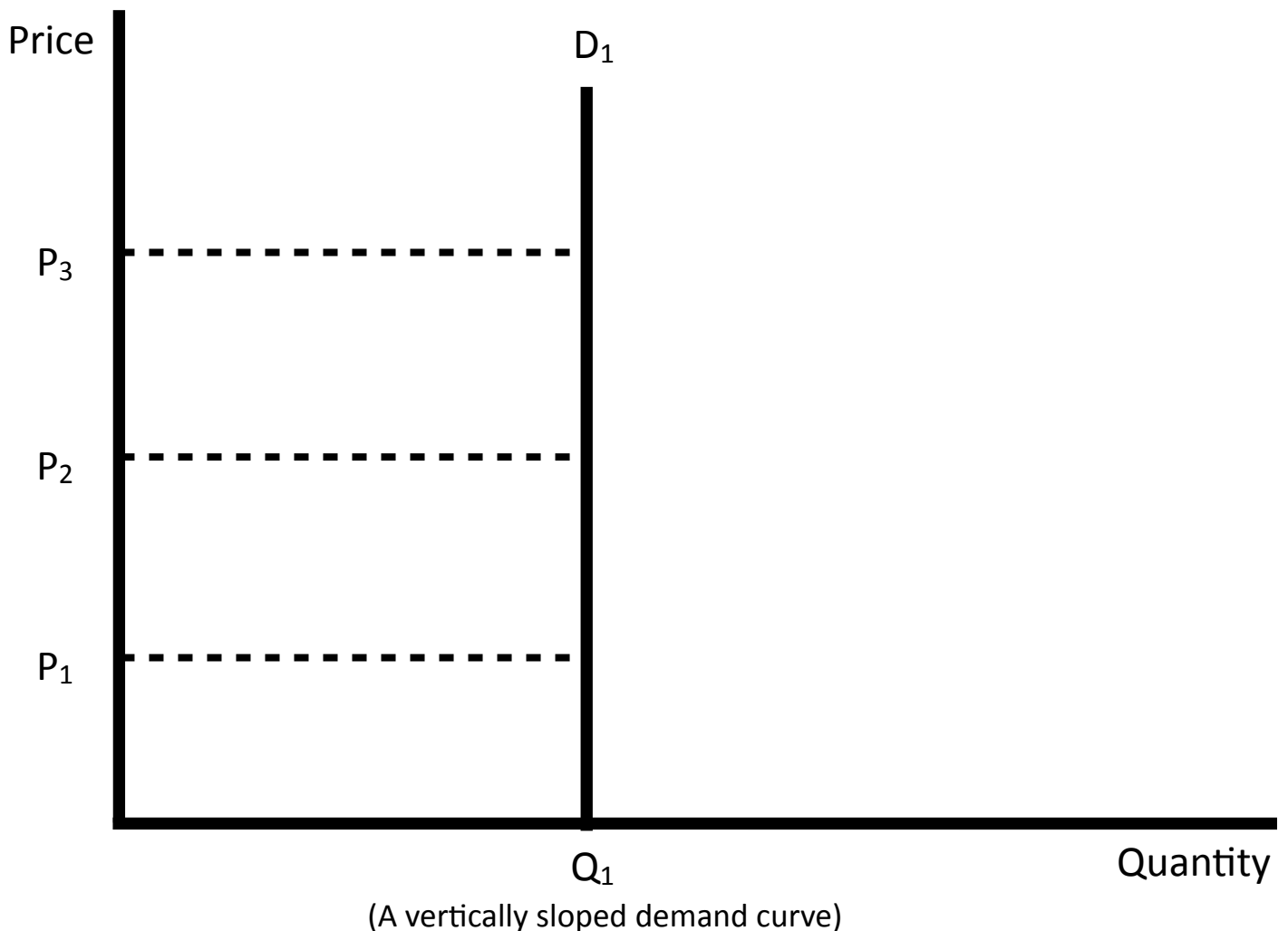
Also the numerical answer is very important. Once we have identified whether the good is normal or not we ignore the sign and we take the number for its absolute value. From this number we can tell how the good will react to a price change.

There are five different types of PED

1) Perfectly Inelastic Demand

2) Inelastic Demand

3) Unit Elastic Demand\ Unitary

4) Elastic Demand

5) Perfectly Elastic Demand

All of these must be known together with the demand curve accompanying them.

Perfectly Inelastic Demand

(A vertically sloped demand curve)

Perfectly Inelastic Demand: The percentage change in price causes no change in the quantity demanded.

If a good has a PED of 0 (i.e. the answer to the PED formula is 0), then the demand for this good is said to be perfectly inelastic.
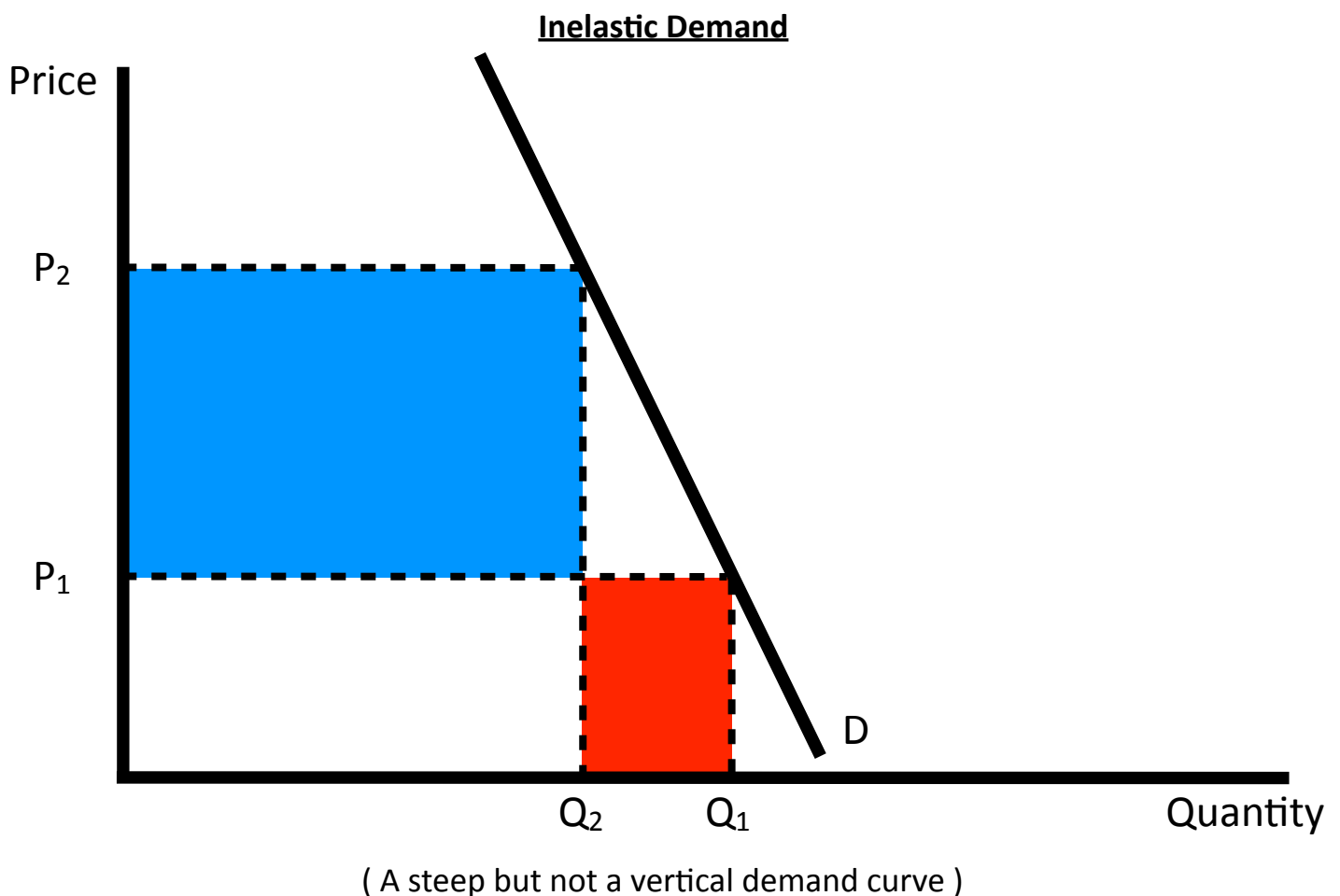
E.g. Insulin for a diabetic or any life saving medicine.

A rise or fall in price causes no change in the Quantity demanded.

The supplier could increase revenue by increasing the price of the good.

A good that is perfectly inelastic

1) Has a PED = 0
2) Demand does not change
3) Has a vertically sloped demand curve
4) E.g. Any life saving medicine (Insulin for a diabetic)
5) A rise or fall in price causes no change in quantity demanded
6) If the seller of a perfectly inelastic good wanted to increase revenue, he should increase price

Inelastic Demand

(A steep but not a vertical demand curve)

Inelastic Demand: The percentage change in quantity demanded responds less than proportionately than the percentage change in price
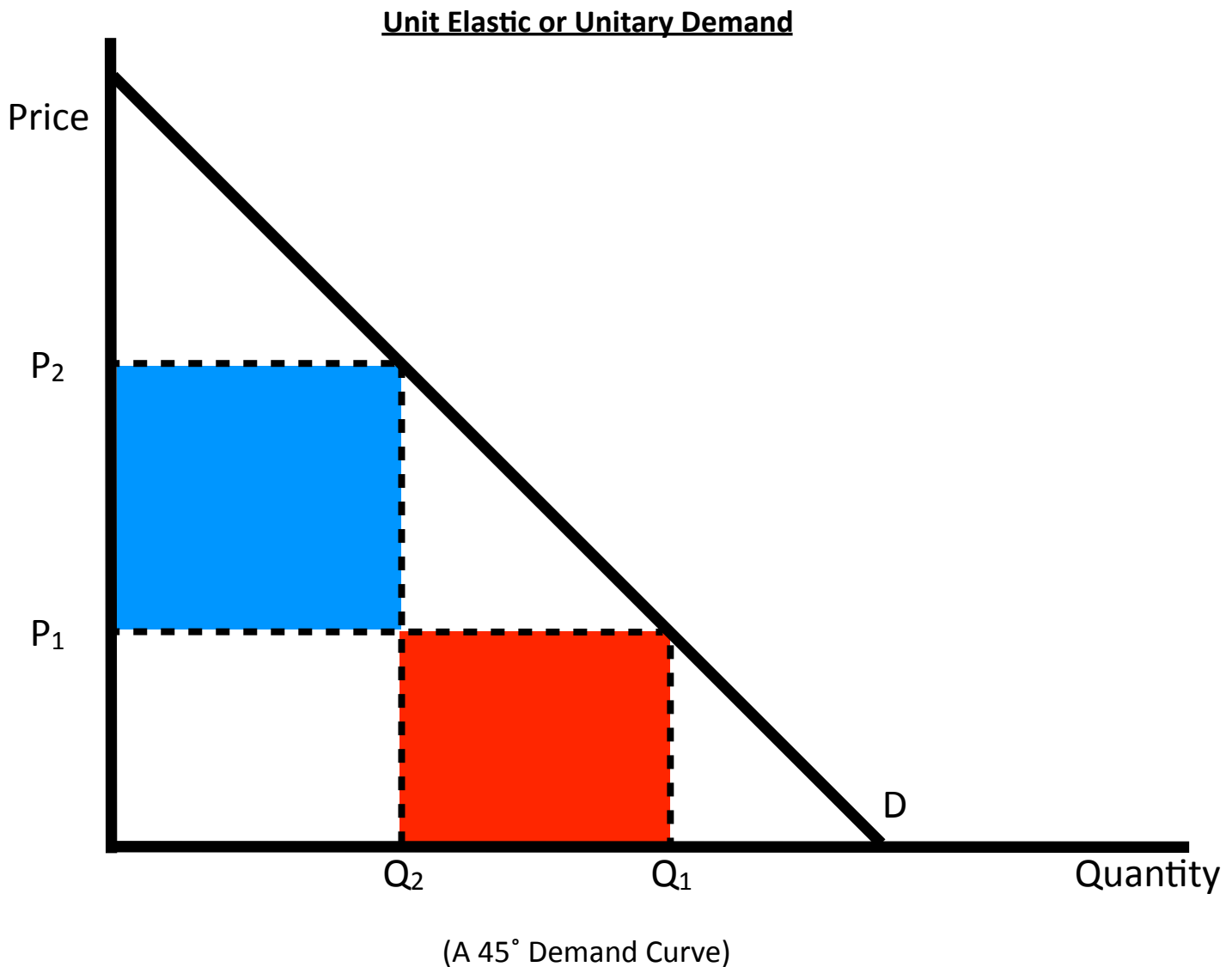
If a good has a PED between 0 and 1 then it is said to be inelastic.
e.g. Petrol and cigarettes.
This means that quantity demanded responds less than proportionately to a change in the level of price. E.g. A good with a PED of -0.1 means that if price rises by 10% quantity demanded will fall by 1% and vice versa.
The supplier of these goods could raise revenue by increasing price.
The loss of revenue from increasing price (represented by the red box) would be more than offset by the increase in revenue from the price rise (represented by the blue box)
A good that is inelastic

1) Has a PED between 0 and 1
2) Quantity Demanded changes by a smaller percentage then the percentage change in price
3) Has a steeply sloped demand curve
4) E.g. Petrol or Cigarettes
5) A rise or fall in price causes a change in quantity demanded.
6) If the seller of an inelastic good wanted to increase revenue, he should increase price

Unit Elastic or Unitary Demand

(A 45˚ Demand Curve)

> **Unit Elastic Demand:** The percentage change in demand is equal to the percentage change in the price of the good.

If a good has a PED of exactly 1 it is said to have be unit elastic. This means that quantity demand is equally responsive to a change in the selling price.

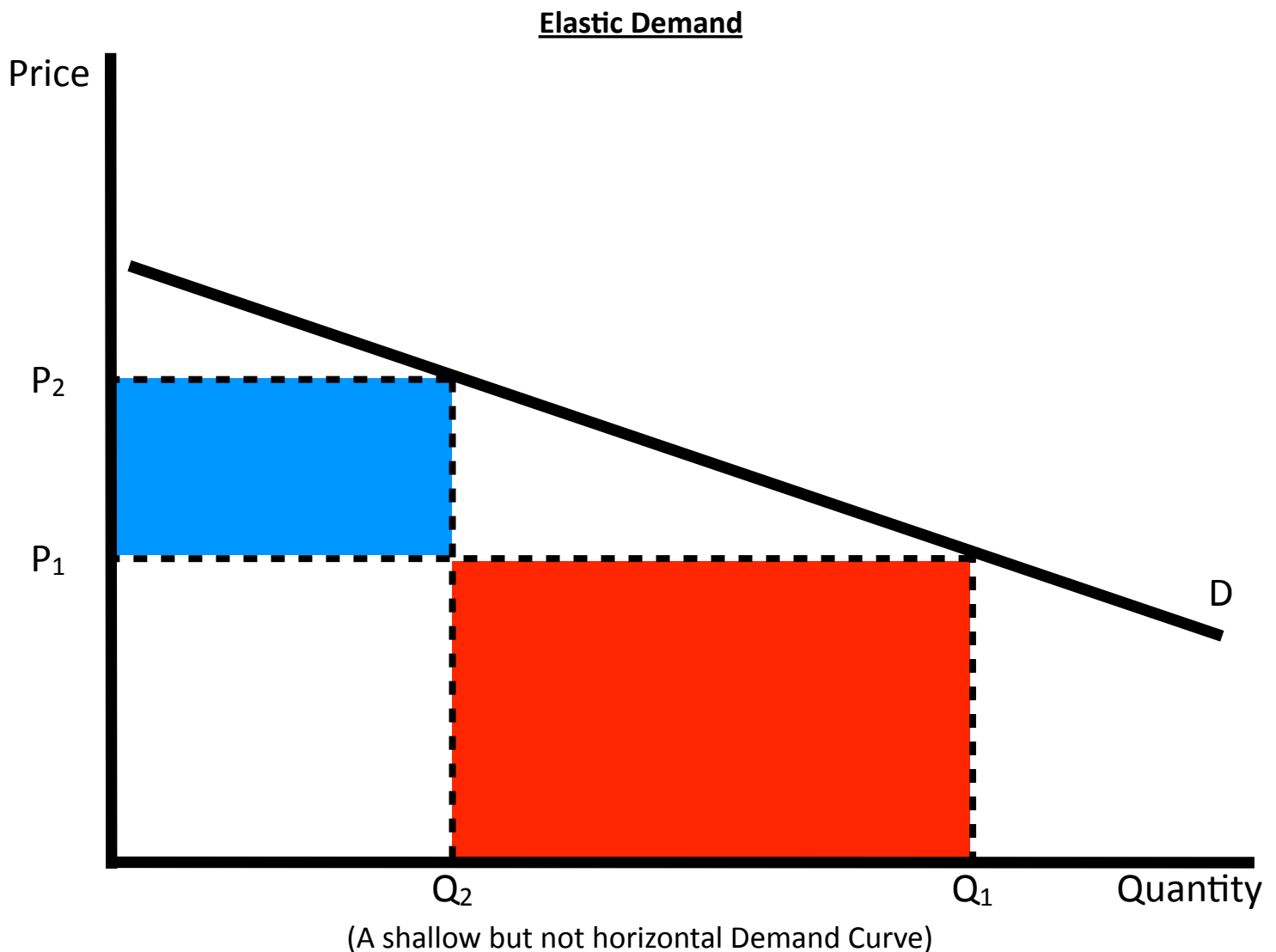i.e. If price increases by 1% quantity demanded decreases by 1%.

From this direct relationship we can see that Total Revenue cannot change. However the entrepreneur can increase profit (TR-TC) by charging the higher price, selling less goods and as such having lower input costs as less raw materials and workers are needed to produce the smaller amount.

An unchanged TR but a lower TC means higher profit.

The loss in revenue (represented by the red box) is exactly equal to the increase in revenue (represented by the blue box) following the price increase.

A good that is unit elastic

1) Has a PED = 1

2) Quantity Demanded changes by the same percentage as the percentage change in price

3) Has a 45˚ sloped demand curve

4) E.g. DVD players or T.V.'s

5) A rise or fall in price causes an equal percentage change in quantity demanded.

6) If the seller of a unit elastic good wanted to increase revenue, he can't.

Elastic Demand

(A shallow but not horizontal Demand Curve)

Elastic Demand: The percentage change in quantity demanded is greater than the percentage change in the price of the good.

If a good has a PED greater than 1 but less than ∞, the good is said to be an elastic good. For elastic goods, quantity demanded responds more than proportionately to a change in price.

i.e. A good has a PED of -2.
If price rose by 1% quantity demanded would fall by 2%.
e.g. Expensive luxury goods like yachts and goods with many substitutes such as different chocolate bars.

In order to increase revenue the supplier would reduce price. We can see this from the diagram above. If price rises from P_1 to P_2 the loss in revenue (represented by the red box) is far greater in area (P x Q) than the increase in revenue (represented by the blue box) following the price rise. i.e. the supplier incurs a net loss.
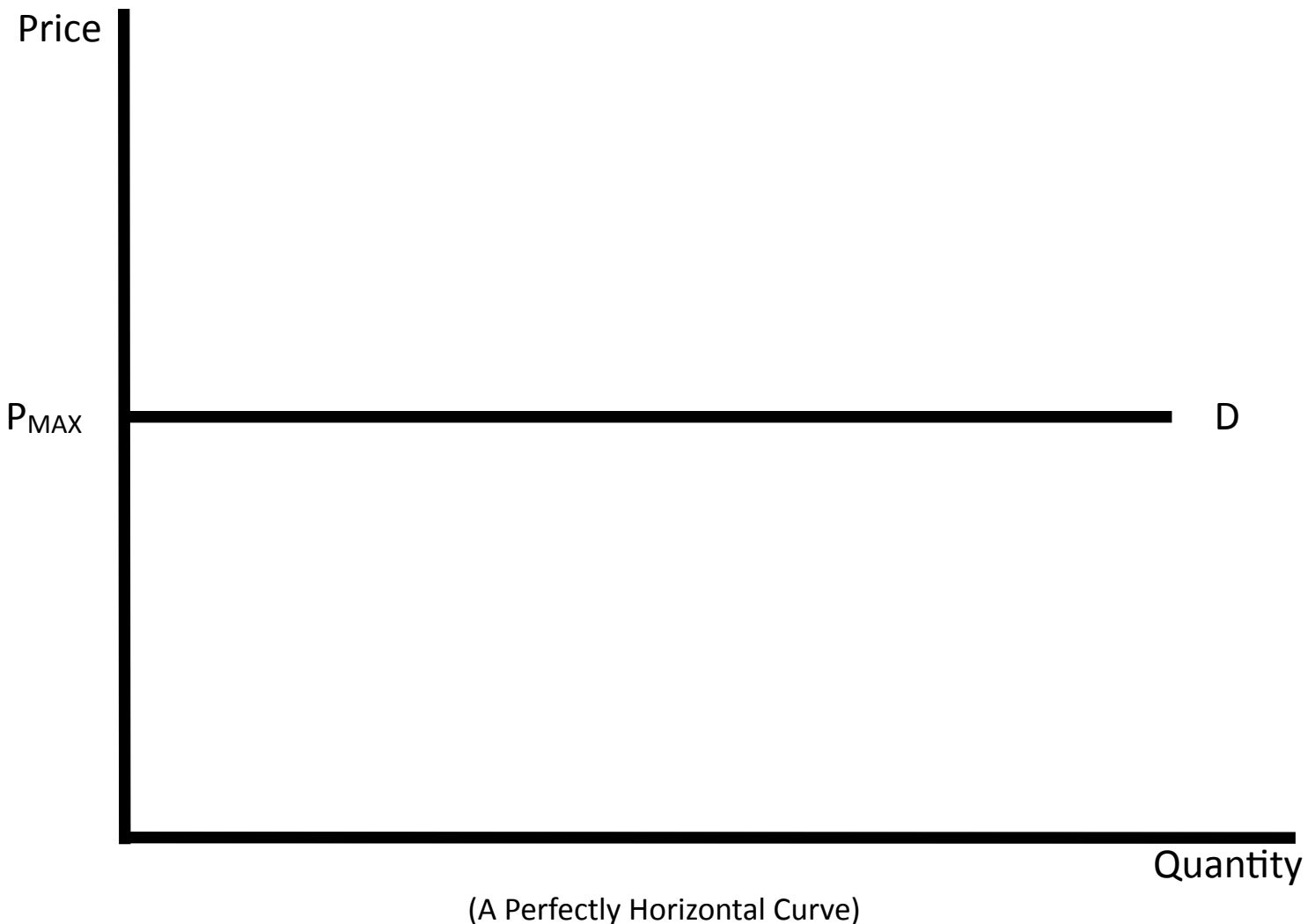
However, if we were to look at this from the opposite direction and said that price were to fall from P_2 to P_1 we see that the increase in revenue (represented by the red box) is far greater than the loss in revenue (represented by the blue box) following the price fall.

Again the supplier of elastic goods should lower price in order to increase revenue.

A good that is elastic

1) Has a PED greater than 1

2) Quantity Demanded changes by a greater percentage as the percentage change in price

3) Has a very flat sloped demand curve

4) E.g. Moro bars

5) A rise or fall in price causes a change in quantity demanded.

6) If the seller of an elastic good wanted to increase revenue, he should lower price

Perfectly Elastic Demand

Price

P_{MAX} ————————————————————————————————————— D

Quantity

(A Perfectly Horizontal Curve)

Perfectly Elastic Demand: This occurs when consumers are prepared to buy all they can of a good at a given price, while any increase in price above this given price will result in quantity demanded to fall to zero.

If a good has a PED of ∞ it is said to be perfectly elastic. This is the demand curve facing a firm that operates in a Perfectly Competitive market. (We will come to that later)
Customers purchase a large quantity of the good once the price does not go over a certain price P_{MAX}. So there is no incentive for the supplier to lower his price.

However above this price, P_{MAX}, nothing will be demanded as quantity demanded is infinitely responsive to a price rise. As such the seller will leave the price unchanged.

WHY IS PRICE ELASTICITY OF DEMAND USUALLY NEGATIVE

PED is usually negative because most goods obey the Law of Demand (that's why it's a law). There is a negative relationship between quantity demanded and price. When price rises, quantity falls and when price falls, quantity demanded rises.

A positive result indicates that the good being examined is either
1) A good of Ostentation
2) A good of Expectation
3) A Giffen good
4) A good of Addiction

Determinants of PED

1) **The Availability of Close Substitutes:** When a good has a close substitute and its price is increased the demand for the good will be elastic because people will switch to the cheaper substitute. Where a good has no substitutes and its price is increased there is no substitute to switch to and so it will be inelastic. The closer the substitutability between goods the more consumers will tend to switch their purchasing behaviour in response to a change in relative prices and thus the greater will be PED.

2) **Complementary Goods:** If the good in question is the cheaper of two goods, which are in joint demand, then the demand for it is likely to be relatively inelastic in response to changes in its own price.

3) **Is the Commodity a Luxury or Necessity:** It is not vital that one should possess luxuries and therefore the PED for them will be relatively elastic. Necessities are vital for life – people must buy them even when their price is increased, so their PED will be relatively inelastic.

4) **The Proportion of Income which is Spent on the Commodity:** In general the greater the proportion of income which is spent on a good, the more elastic the demand for it is likely to be, in response to a change in its own price. A rise of 50% in the price of a box of matches is unlikely to have a significant effect on its demand.

5) **<u>The Durability of the Commodity:</u>** The more durable the commodity, the more elastic is the demand for it likely to be in response to a change in its own price. If products such as motorcars increase in price, it is likely that the public will extend the life of their existing model and postpone the purchase of a replacement.

6) **<u>Expectations as to Future Changes in Price:</u>** If, in the face of a price reduction, the public considers that prices are likely to fall even further, they may wait for the further reduction in price, in which case demand may not be very elastic on the initial price reduction.

7) **<u>The Length of Time Allowed for Adjustment to Price Changes:</u>** In the long run, demand is more elastic as consumers have time to adjust to a change in price. If the price of electricity rose by 80% a consumer may economise on the use of various appliances in the short term. In the long term the consumer will have to consider substituting other forms of energy. The demand will at first be highly inelastic but as time goes on will become more elastic

8) **<u>Brand Loyalty:</u>** A consumer may become strongly attached to a particular product through habit or loyalty to that brand. An increase in price for that good will not cause him/her to consume less of the product or to switch to cheaper substitutes. The demand for such goods will therefore be price inelastic.

9) **<u>Number of Alternative Uses the Good Has:</u>** A commodity which has a large number of uses will usually have a relatively elastic demand. For example sugar is used in direct consumption, sweetening purposes, baking, food processing etc. Any increase in the price of sugar may only result in a small fall in its demand in each of these markets but the total drop overall may be significant.

Income Elasticity of Demand (YED)

Income Elasticity of Demand: Measures the percentage change in the demand for a good caused by the percentage change of the income of the consumer.

Formula

$$\frac{Y_1 + Y_2}{Q_1 + Q_2} \: X \: \frac{\Delta Q}{\Delta Y}$$

Where

Y_1 = Original Income

Y_2 = New Income

Q_1 = Original Quantity Demanded

Q_2 = New Quantity Demanded

ΔY = Change in Income

ΔQ = Change in quantity Demanded

Interpretation of the Result

Firstly we will discuss the sign.

Positive Result: If the result is positive this means that the good in question is a normal good. There is a positive relationship between income and quantity demanded.

A Normal Good: is a good with a positive income effect. The demand for normal goods rises as real income rises and falls as real income falls.

Negative Result: If your answer to the YED formula is a negative number then the good in question is an inferior good.

An Inferior Good: is a good with a negative income effect. When income rises quantity demanded for inferior goods falls and when income falls quantity demanded for inferior goods rises.

There is a negative relationship between income and the quantity demanded of inferior goods.

E.g. When income rises, the demand for bus journeys falls as the consumer will start to take taxi's or maybe buy their own car. Whereas when income falls, bus journeys are in greater demand as taxi's and affording your own car become too expensive.

The Significance of the Result

If the YED formula yields a minus answer the good in question is an inferior good like we said.

If the YED formula yields a positive number between 0 and 1 the good is a necessity.
E.g. suppose food has a YED of +0.1. This means that following a 10% increase in income, the quantity demanded of food increases by only 1%.

If the YED formula yields a positive number greater than 1, the good in question is a luxury.
E.g. suppose Armani sunglasses have a YED of +3. This means that following a 10% increase in income, the quantity demanded for Armani Sunglasses increases by 30%.

Cross Price Elasticity of Demand (CED)

> **Cross Price Elasticity of Demand (CED):** measures the percentage change in the demand for one good, caused by the percentage change in the price of other goods.

Formula

$$\frac{P_{1B} + P_{2B}}{Q_{1A} + Q_{2A}} \times \frac{\Delta Q_A}{\Delta P_B}$$

Where

P_{1B} = Original Price of good B

P_{2B} = New price of good B

Q_{1A} = Original Quantity demanded of good A

Q_{2A} = New quantity demanded of good A

ΔQ_A = Change in quantity demanded of good A

ΔP_B = Change in Price of good B

Interpreting the Result

Positive Result: indicates that the two goods in question are substitutes for each other.

> **A Substitute Good:** is a good that can fulfill the same function as the good in question.

A positive result tells us that there is a positive relationship between the price of good A and the quantity demanded of good B.
E.g. if the price of Pepsi rises, then the quantity demanded of Coke rises as consumers substitute the now relatively cheaper Coke for Pepsi.

The bigger the number the closer the substitutes.
E.g. Coke and Pepsi are closer substitutes than coke and coffee.
Therefore the CED for Coke and Pepsi would be a bigger number than the CED for Coke and coffee.

Negative Result: indicates that the two goods in question are compliments to each other.

Complimentary Goods: are goods that are used in joint demand

A negative result shows that there is a negative relationship between the price of good A and the quantity demanded of good B.

E.g. If the price of petrol rises then the quantity demanded for cars will fall.

The bigger the absolute number the stronger the link between the two goods.
E.g. Cars and Petrol are stronger compliments than ice cream and suntan lotion.
The formula will yield a bigger number in absolute terms for cars and petrol than it would for ice cream and suntan lotion.

A Result of Zero: If the CED formula yields a zero answer then there is no relationship between the two goods.
E.g. A change in the price of bottled water will have no effect on the quantity demanded of scissors.

Price Elasticity of Supply (PES)

Price Elasticity of Supply: measures the percentage change of quantity supplied to a percentage change in the level of price

Formula

$$\frac{P_1 + P_2}{Q_1 + Q_2} \times \frac{\Delta Q}{\Delta P}$$

Where

P_1 = Original Price of the good

P_2 = New price of the good

Q_1 = Original Quantity supplied

Q_2 = New Quantity supplied

ΔQ = Change in the quantity supplied

ΔP = Change in the price of the good

NOTE: The sign of PES is never negative

Interpreting The Result

Positive Result: indicated that the quantity supplied does responds to a change in price.

A large number indicates that supply is very responsive (elastic) to a change in price. A small number means that supply is not very responsive to a change in price (inelastic)

A Result of Zero: means that the producer does not or cannot respond to the change in price. There is no (zero) response by the supplier to the price change. Supply is perfectly inelastic.

THE DETERMINANTS OF PRICE ELASTICITY OF SUPPLY (PES)

1) **CAPACITY OF THE SELLER:** If the firm is operating at about half of its maximum capacity then, following a price change, it will find it very easy to change supply (elastic supply). However, if it is near or at full capacity and price rises, the firm will find it difficult to increase supply and as such will have an inelastic supply.

2) **TIME HORIZON:** Over short periods of time the firm cannot easily change the size of their factories to make more or less of a good. Thus in the short rum the quantity supplied is not very responsive to a change in price (inelastic). On the other hand, in the long run firms can build new factories or close old ones. Also, new firms can enter a market and old ones can leave.

3) **NATURE OF THE PRODUCT:** If a supplier is selling perishable goods, like fruit, even if the price of these fruit falls the supplier still wishes to sell them because soon they will go off and when that happens they will be worth nothing.

4) **MOBILITY OF FACTORS OF PRODUCTION:** The easier it is for a supply to switch from producing one good to producing another, the more elastic supply. The more difficult it is to switch the less elastic supply.

5) **FACTORS OUTSIDE THE FIRMS CONTROL:** If there is something out of the supplier's control, like a drought causing a bad harvest, then a firm would be unable to respond to a price rise.

<u>Explain how an understanding by the Minister for Finance of the concept Price Elasticity of Demand would help is setting levels of indirect taxation. Use examples to illustrate your answer. (20 marks)</u>

A knowledge of the concept of Price Elasticity of Demand could help the Minister for Finance in setting levels of indirect tax in two main ways:

1) How to raise more revenue from indirect taxation levels. An increase in indirect taxation on a commodity will only lead to increased tax revenue if the demand for the commodity is inelastic.

   <u>Example:</u> Price inelastic commodities [alcohol and cigarettes]. If the demand for these commodities is price inelastic then by increasing the VAT rate on these commodities, the Government will earn additional revenue because the percentage decrease in demand is less than the percentage increase in selling price.

2) How to reduce the consumption of 'harmful' commodities. Increasing the rate of indirect taxation on certain (elastic) commodities may help the government to reduce the consumption of commodities which may have high social costs. If the Minister knows they are elastic commodities, then by increasing VAT rates, the demand for these goods will fall, thus helping to achieve this objective.

   <u>Example:</u> Price elastic commodities. While an increase in the rate of indirect tax may not bring in additional revenue (due to the drop in demand) the aim of reducing consumption of these commodities may be achieved.