



eduresourceza.com

QUESTION 1**TOTAL: /20**

Place an (x) over the correct letter on the answer sheet provided.

- 1.1) A body moving at a constant velocity has kinetic energy, **E**, as well as momentum, **p**. If the velocity of the body is doubled, which one of the following correctly gives the magnitudes of both kinetic energy and momentum?

	Kinetic Energy	Momentum
A	2E	2p
B	4E	4p
C	4E	2p
D	2E	4p

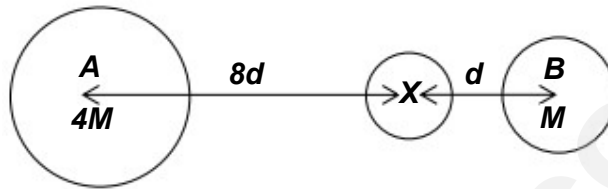
- 1.2) Three identical balls (**A**, **B** and **C**) are launched from the same height above the ground.

- Ball **A** is thrown up with an initial velocity of 13 m.s^{-1} .
- Ball **B** is thrown down with an initial velocity of 13 m.s^{-1} .
- Ball **C** is dropped from rest.

Which one of the following statements concerning the magnitude of the final velocity of the balls is TRUE?

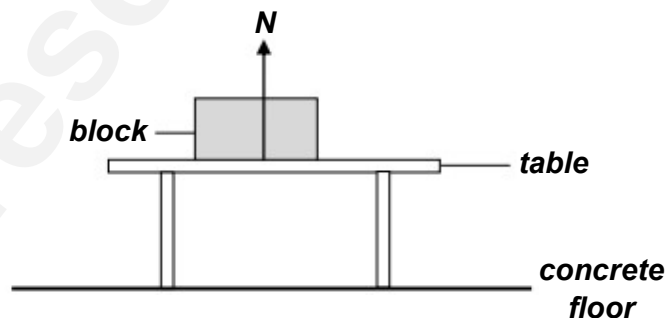
- A** Ball **A** has the lowest final velocity.
- B** Ball **B** has the greatest final velocity.
- C** Ball **A** and Ball **B** have the same final velocity.
- D** All three balls have the same final velocity.
- 1.3) A girl stands on a scale in a lift. When the lift is stationary, the scale reads 450 N. Later when the lift is in motion, the scale reading is 400 N at some stage. During this stage the lift could be moving ...
- A** upwards with an increasing speed.
- B** downwards with an increasing speed.
- C** upwards with a constant speed.
- D** downwards with a constant speed.

- 1.4) For a brief moment, planet **X** (mass **M**) moves in between two other planets, **A** and **B**. The mass of planet **A** is **4M** and the mass of planet **B** is **M**. The distance between the centres of planet **A** and planet **X** is 8 times greater than the distance **d** between the centres of planet **B** and planet **X**.



How does the magnitude of the force of attraction of planet **A** on planet **X** (**F_A**) compare with that of planet **B** on planet **X** (**F_B**)?

- A** $F_A = \frac{1}{64} F_B$
 - B** $F_A = \frac{1}{16} F_B$
 - C** $F_A = \frac{1}{8} F_B$
 - D** $F_A = \frac{1}{2} F_B$
- 1.5) A block rests on a table. The table stands on a concrete floor. The normal force is represented by **N**, as shown in the diagram below.



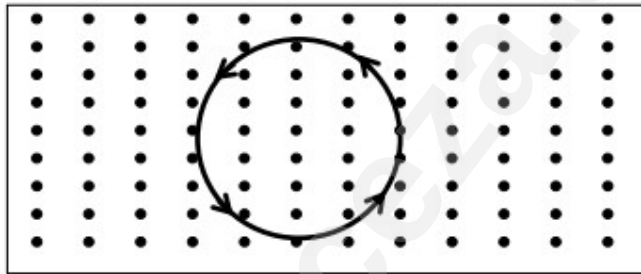
Which ONE of the following forces will form an action-reaction pair with the normal force (**N**)?

- A** Force of the block on the Earth.
- B** Force of the table surface on the block.
- C** Force of the table surface on the concrete floor.
- D** Force of the block on the table.

1.6) Which ONE of the energy conversions below takes place when a DC motor is in operation?

- A Kinetic to electrical.
- B Heat to mechanical.
- C Mechanical to electrical.
- D Electrical to mechanical.

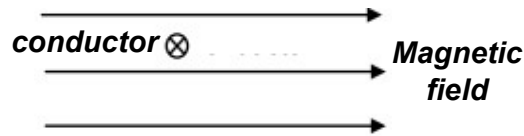
1.7) A single conducting loop is in a region of magnetic field as shown in the diagram. An anticlockwise current is induced in the loop because the magnetic flux is decreasing.



Which of the following changes to the situation would make the induced current larger?

- A The magnetic field is increased in magnitude.
 - B Increase the rate at which the magnetic flux is decreasing.
 - C Use a loop with a bigger diameter.
 - D Move the loop sideways, but keep it in the magnetic field.
- 1.8) Which ONE of the following changes may lead to an increase in the emf of an AC generator without changing its frequency?
- A Decrease the resistance of the coil.
 - B Increase the area of the coil.
 - C Increase the resistance of the coil.
 - D Decrease the speed of rotation.

- 1.9) The diagram below shows a current-carrying conductor lying in a uniform magnetic field directed to the right. The current flows into the page.



Which ONE of the following arrows shows the direction of the force experienced by the conductor due to the magnetic field?

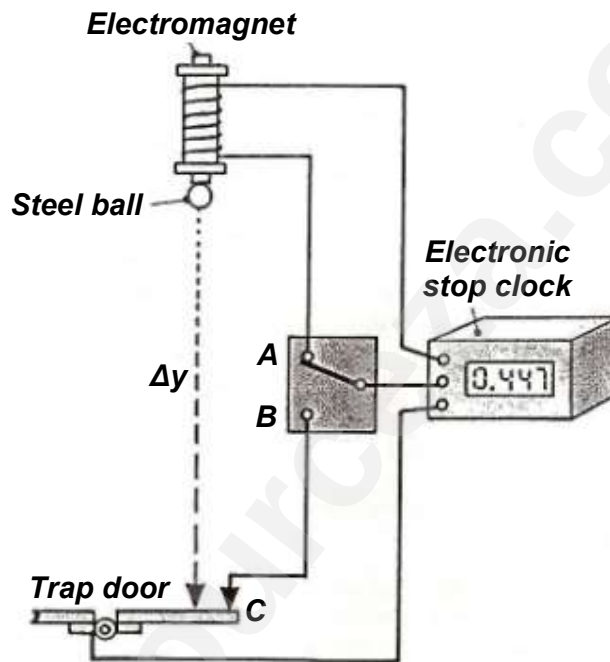
- A →
- B ↑
- C ↓
- D ←

- 1.10) A metal ring lies on a table. When the south pole of a magnet moves down towards the ring, a current is induced. Which combination in the table below correctly describes the change in flux and the direction of induced current in the metal ring, when viewed from above.

	<i>Direction of current (I)</i>	<i>Change in flux ($\Delta\Phi$)</i>
A	Clockwise	Increasing
B	Clockwise	Decreasing
C	Anticlockwise	Increasing
D	Anticlockwise	Decreasing

QUESTION 2**TOTAL: /25**

A student sets up the following apparatus in a laboratory to study the motion of a steel ball as it falls from a set height (Δy). The ball is released when the switch is flicked from A to B turning on the electromagnet. It then creates a circuit, which starts the stop-clock. When the ball hits the trap door the circuit is broken stopping the timer. The experiment was repeated three times at each set height.



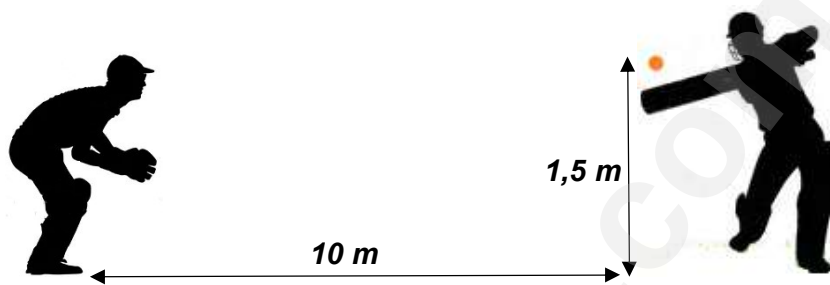
The following data was collected:

Height, Δy (m)	Time, t (s)				t^2 (s ²)
	1	2	3	Average	
0,10	0,144	0,145	0,145	0,145	0,021
0,20	0,200	0,205	0,202	0,202	0,041
0,30	0,248	0,249	0,255	0,251	0,063
0,40	0,295	0,290	0,293	0,293	0,086
0,61	0,370	0,370	0,372	0,371	0,138
0,79	0,426	0,425	0,430	0,427	0,182
0,95	0,473	0,457	0,475	0,468	0,219

- 2.1) Suggest a suitable hypothesis for the experiment. (2)
- 2.2) On the graph paper provided, plot a graph of height, Δy (**y-axis**) against t^2 (**x-axis**). Draw a line of best fit. (7)
- 2.3) Calculate the gradient of your line of best fit. Clearly show the co-ordinates used on your graph. (4)
- 2.4) Using a suitable equation of motion from your data sheet and your calculated gradient in **2.3**), determine the acceleration of the steel ball. (4)
- 2.5) Calculate the percentage error in your acceleration value from **2.4**) compared to the actual acceleration due to gravity, g . (2)
- 2.6) Suggest a possible reason for the data measured for larger values of height, Δy , being less reliable. (2)
- 2.7) The experiment is now done on a different planet to Earth. The new planet has a mass twice the mass and three times the radius of Earth. On your graph, draw a line to represent how the line of best fit would look different. Show an appropriate calculation as to how you arrived at your answer. (4)

QUESTION 3**TOTAL: /20**

At a cricket match, a batsman plays a cut shot against a short ball and the ball takes the top edge and rises vertically at $14,5 \text{ m.s}^{-1}$ into the sky. The batsman makes contact with the ball at a height of $1,5 \text{ m}$ above the ground. (Diagram not to scale.)



3.1) Define *acceleration*. (2)

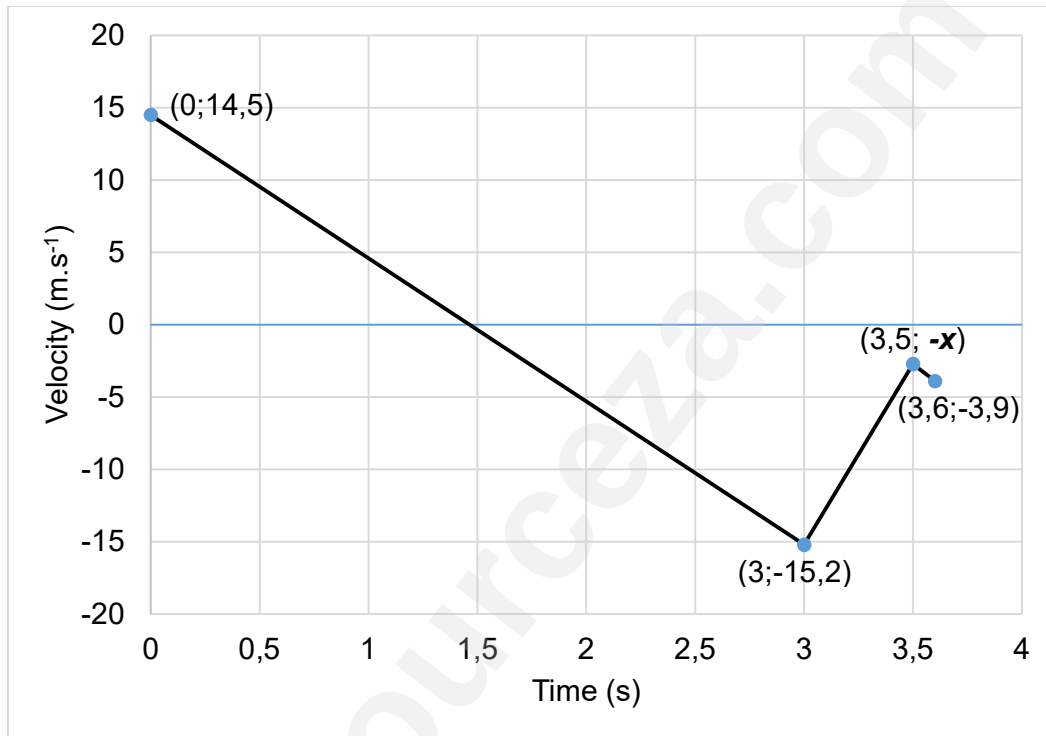
3.2) Calculate the highest point above the ground that the cricket ball reaches. (4)

A fielder standing 10 m away from the batsman was alert and was walking towards the batsman in a straight line at 2 m.s^{-1} . In order for the fielder to make a successful catch, he must reach the ball at least 40 cm above the ground.

3.3) Determine the time taken for the ball to be at 40 cm above the ground. (3)

3.4) Does the fielder make a successful catch if he accelerates to a velocity of $4,75 \text{ m.s}^{-1}$? Motivate your answer with appropriate calculations. (3)

As the fielder gets to the ball, it bursts through his hands and hits the ground coming to rest. The following velocity /time graph shows the entire motion of the ball from the moment that it leaves the bat to when it reaches the ground. Ignore the effects of friction



3.5) Explain what is meant by the term “free fall”? (2)

3.6) Identify the time when...

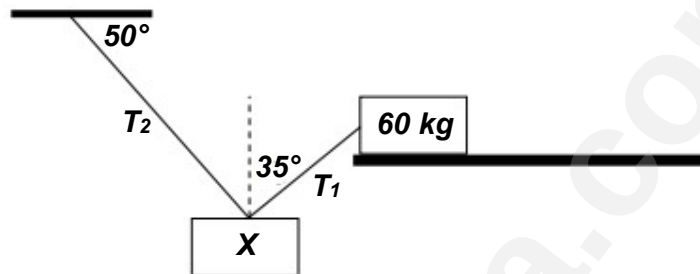
3.6.1) the ball reached the maximum height. (1)

3.6.2) the ball struck the fielder’s hand. (1)

3.7) Using values from the graph above, determine the value for x and state the physical variable that x represents. (4)

QUESTION 4**TOTAL: /20**

A 60 kg block, which is at rest on a horizontal rough surface, is used as an anchor to hold block **X**, with an unknown mass, in the air at a certain height above the ground. The two blocks are connected with a rope, which makes an angle of 35° with the vertical. Block **X** is suspended from the ceiling making an angle of 50° . Refer to the diagram below.



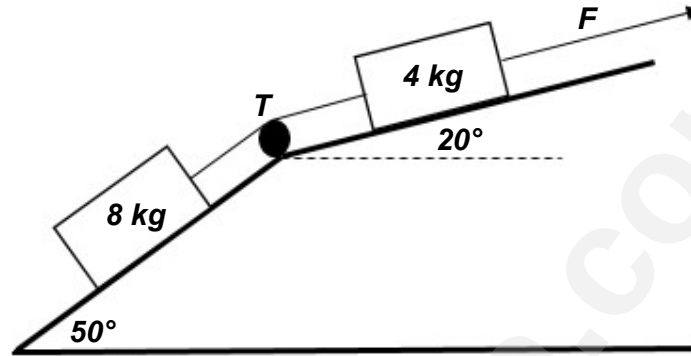
The 60 kg block experiences a maximum static frictional force of magnitude 200 N. The system is in **equilibrium**.

- 4.1) What does “the system is in equilibrium” mean? (2)
- 4.2) Draw a labelled free-body diagram of all the forces acting on 60 kg block. (4)
- 4.3) Calculate the vertical component of T_1 . (3)
- 4.4) Calculate the co-efficient of static friction between the 60 kg block and the Surface. (3)
- 4.5) If a 80 kg block replaced the 60 kg block, the system would still be in equilibrium. Would the maximum static friction change assuming that the co-efficient of maximum static friction remains constant.? Explain your answer. (3)
- 4.6) Determine the mass of **X**. (5)

QUESTION 5

TOTAL: /25

- 5.1) The following two body system with two blocks of 4 kg and 8 kg held together by a frictionless pulley is accelerated up the slope at $4,5 \text{ m.s}^{-2}$.

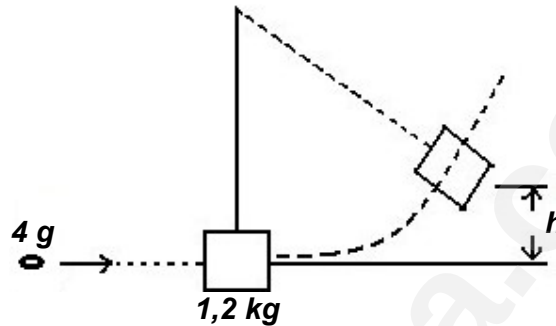


Both blocks experience friction, with the co-efficient of kinetic friction being 0,3.

- 5.1.1) State Newton's 2nd law. (2)
- 5.1.2) Determine the force of kinetic friction on the 8 kg block. (4)
- 5.1.3) Draw a labelled free body diagram for the 4 kg block. (5)
- 5.1.4) Find the tension, T , between the 4 kg block and the 8 kg block. (4)
- 5.1.5) Calculate the force, F . (4)
- 5.2) Different guns use different bullets. For example a rifle uses a smaller lighter calibre bullet while a shotgun of similar length uses a heavier bullet. Once the bullets leave the guns they have the same inertia.
- 5.2.1) Define *inertia*. (2)
- 5.2.2) Which gun would "recoil" with greater force if the bullets leave the muzzle at the same velocity? Use two Newton's laws to explain your answer. (4)

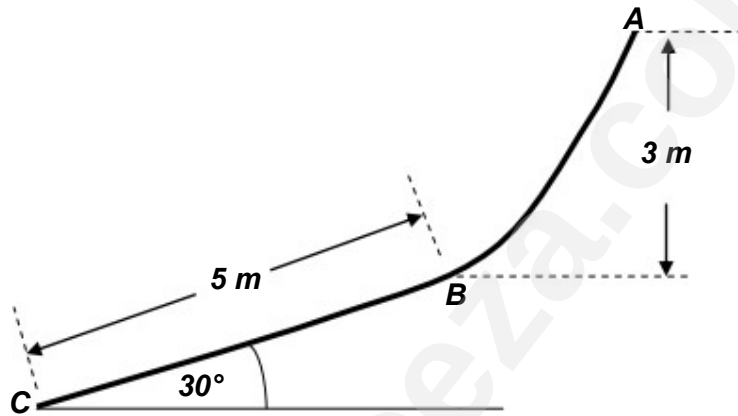
QUESTION 6**TOTAL: /30**

- 6.1) A rifle bullet with a mass of 4 g is fired horizontally with a speed of 600 m.s^{-1} into a ballistic pendulum with a mass, 1,2 kg. The bullet goes through the pendulum and leaves it with a speed of 100 m.s^{-1} . Ignore all frictional forces.



- 6.1.1) State the conservation law of linear momentum. (2)
- 6.1.2) Assuming that the ballistic pendulum does not lose mass as the bullet exits, calculate the height, h , above the rest position at which the pendulum block stops. (7)
- 6.1.3) Define *impulse*. (2)
- 6.1.4) If the bullet took 0,01 s to pass through the pendulum block, find the the magnitude of the constant force that slows down the bullet inside the pendulum block. (3)

- 6.2) A slide, **ABC**, at an amusement park consists of a curved frictionless section, **AB**, and a section, **BC**, which is rough, straight and inclined at 30° to the horizontal. The starting point, **A**, is 3 m above point **B**. The straight section, **BC**, is 5 m long. A learner, with mass 50 kg, starting from rest at **A**, slides down section **AB**, then continues down the straight section, **BC** arriving at **C** with a velocity of 2 m.s^{-1} .



- 6.2.1) Define *gravitational potential energy*. (2)
- 6.2.2) Calculate the speed of the learner at **B**. (5)
- 6.2.3) State the *work energy theorem*. (2)
- 6.2.4) Using **energy principles**, determine the magnitude of frictional force acting on the learner along **BC**. (7)

QUESTION 7

TOTAL: /16

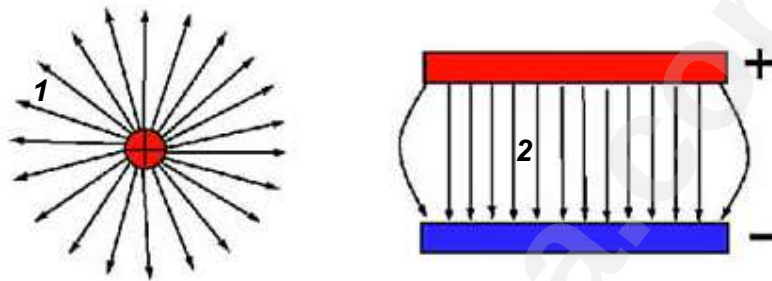
The mass of the sun is $2,0 \times 10^{30}$ kg and is $1,5 \times 10^8$ km away from the earth's surface. The earth has a mass of $6,0 \times 10^{24}$ kg and a radius of 6371 km.



- 7.1) State Newton's law of universal gravitation. (2)
- 7.2) Determine the magnitude of the force the sun exerts on an object with a mass of 80.0 kg if that object is on the earth. (4)
- 7.3) Define *gravitational field strength*. (2)
- 7.4) If the gravitational field strength at the top of Mount Everest is 9.772 N.kg^{-1} , approximately how tall is the mountain? (5)
- 7.5) Is it correct that there is zero gravitational force in space? Explain your answer. (3)

QUESTION 8**TOTAL: /14**

The diagrams below illustrates two systems of electric fields. One is the field around a positive point charge, $+2 \mu\text{C}$ and the other is of a field between two oppositely charged parallel plates. The electric field strength between the plates is $12\,000 \text{ N}\cdot\text{C}^{-1}$. An electron is placed in two positions as indicated on the diagrams below.

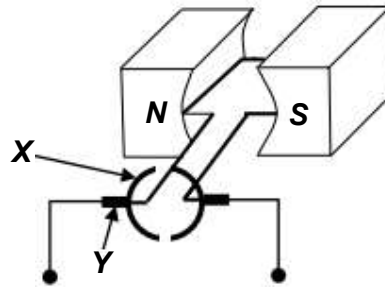


- 8.1) Define *electric field strength*. (2)
- 8.2) Calculate the force that the electron would experience at position **2**. (4)
- 8.3) If the distance between the negative point charge and the electron at position **1** is 8 mm. Determine the force that the electron would experience at this position. (5)
- 8.4) At which position, **1** or **2**, would you expect the acceleration of the electron to be constant. Explain your answer. (3)

QUESTION 9

TOTAL: /30

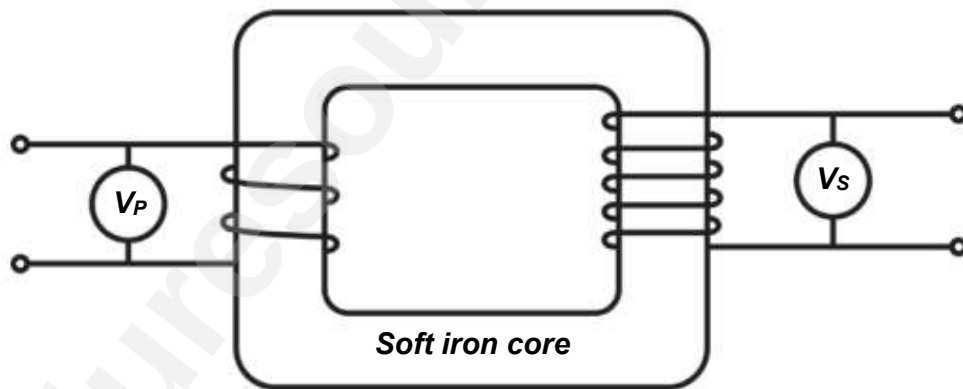
9.1) A diagram of a motor is illustrated below.



9.1.1) Identify components **X** and **Y**. (2)

9.1.2) Explain why the armature experiences a magnetic force when current is passed through it. (2)

9.2) The diagram below represents a simple step-up transformer. An alternating current is supplied to the primary (input) coil.



9.2.1) State Lenz's law. (2)

9.2.2) Explain why alternating current is necessary at the primary coil in order for a transformer to work. (3)

9.2.3) Use the equation for Faraday's law to explain how this transformer steps up the voltage. (3)

9.3) Power stations produce electricity at 25 000 V. Electricity is sent through the national grid cables at 400 000 V. Transformers are used to step-up the voltage from the power stations to the cables of the national grid.

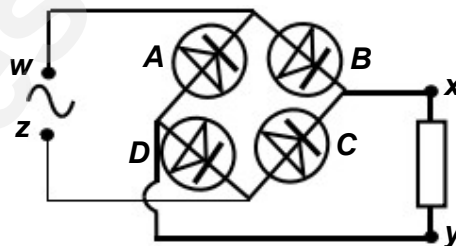
9.3.1) If the number of turns on the primary coil is 500 then how many turns are required on the secondary coil? (3)

9.3.2) Use scientific principles to explain why it is an economic advantage to transmit electrical energy through the national grid at high voltages and low currents. Use a suitable formula to assist your explanation. No calculation is required. (3)

9.4) A fridge can also be connected via a transformer and rectifier to a 240 V a.c. source as shown in the simplified flow chart in the diagram below.



The rectifier consists of a combination of diodes connected as shown in the diagram below.



9.4.1) What is a diode? (2)

9.4.2) What is the function of the rectifier? (2)

9.4.3) For the cycle when **w** is positive, which diodes (**A**, **B**, **C**, **D**) will conventional current flow through? (2)

9.4.4) For the cycle when ω is positive, in what direction will conventional current flow through the load (x to y or y to x)? (1)

9.4.5) What type of transformer (step-up or step-down) is required for the fridge? (1)

Ignoring actual values of emf and time, draw sketch graphs to represent the change in emf with time...

9.4.6) immediately before the current passes through the rectifier (position **1** on the flow chart). (2)

9.4.7) immediately after the current passes through the rectifier (position **2** on the flow chart). (2)