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About 

(PURE) PHYSICS

(TOPICAL)

About Thinking Process

When solving problems, we first analyse the questions and then gather relevant information until we are able to determine the answers. But for presentation reason, we need to organise, rearrange and then present ONLY the required workings and solutions.

Thinking process reveals the extra but relevant information which is not required as part of the solutions.

About MCQ with HELPs

Explanations are given so that students know exactly why the answer is the right one.

period	2013 to 2024
contents	June & November, Paper 1 & 2, Worked Solutions
form	Topic By Topic
compiled for	O Levels
special features	Thinking Process, MCQ with HELPs

Tel No: 042-35201010

Mobile No: 0300-8447654

E-Mail: info@redspot.com.pk

Website: www.redspot.pk

Address: P.O. Box 5041, Model Town, Lahore, Pakistan.

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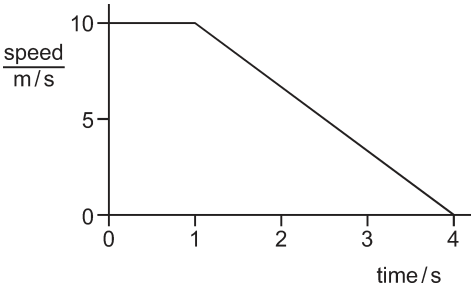
Topic 2 *Motion*

MCQ Section

1. The diagram shows the speed-time graph of the motion of a car for four seconds.



What is the distance travelled by the car in the four seconds?

A 15 m **B** 25 m

C 30 m **D** 40 m

[J13/P1/Q4]

2. An object moves from P to Q in 10 s with uniform acceleration.

velocity at P = 5 m/s

velocity at Q = 12 m/s

What is the acceleration?

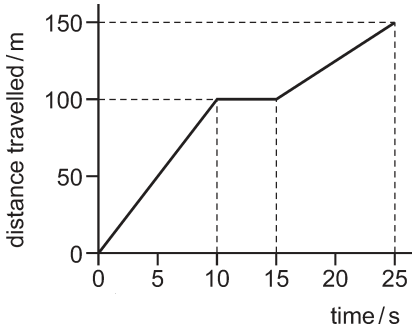
A 0.5 m/s^2 **B** 0.7 m/s^2

C 1.2 m/s^2 **D** 1.7 m/s^2

[N13/P1/Q2]

3. A cyclist takes a ride lasting 25 s.

The diagram shows how her distance travelled from the starting position varies with time.



What is her average speed for the whole ride?

A 6.0 m/s **B** 7.5 m/s

C 10.0 m/s **D** 11.0 m/s

[J15/P1/Q3]

4. A car begins to move. It speeds up until it reaches a constant speed. It continues to travel at this constant speed for the rest of the journey.

What happens to the acceleration and what happens to the velocity of the car during the journey?

A Both the acceleration and the velocity change.

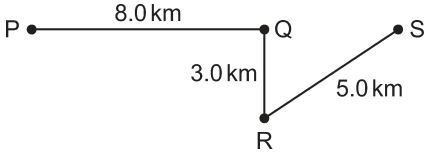
B Only the acceleration changes.

C Only the velocity changes.

D Neither the acceleration nor the velocity changes.

[J15/P1/Q4]

5. A lorry takes 15 minutes to travel along the path PQRS.



What is the average speed of the lorry?

A 4.0 km/h

B 22 km/h

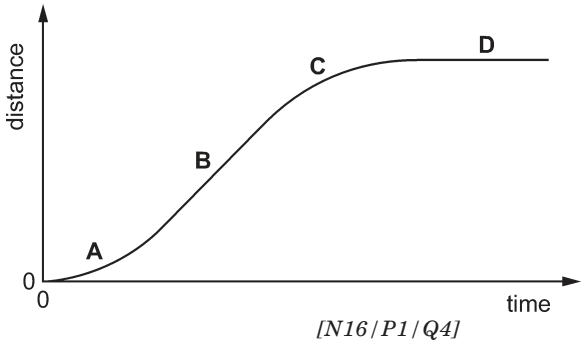
C 48 km/h

D 64 km/h

[N15/P1/Q4]

6. The graph shows a distance-time graph for a car travelling in a straight line.

In which region is the car decelerating?



[N16/P1/Q4]

1. B Distance travelled = area under the graph (trapezium)

$= \frac{1}{2} \times 10 \times (1+4)$

$= 25\,\text{m}$

2. B $a = \frac{v-u}{t}$

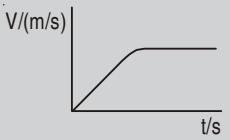
$= \frac{12-5}{10}$

$= 0.7\,\text{m/s}^2$

3. A Average speed $= \frac{\text{total distance}}{\text{total time}}$

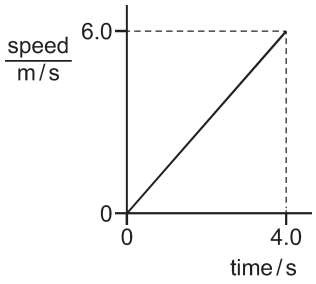
$= \frac{150}{25} = 6.0$ m/s.

4. A The graph shows the motion of a car.



It shows that the speed increases from zero to maximum value and the acceleration decreases from the maximum value to zero.

7. The diagram shows a speed-time graph for an object moving with uniform acceleration.

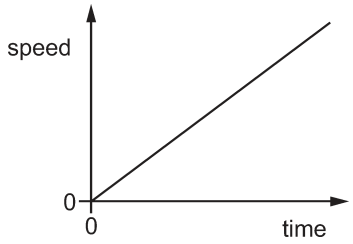


What is the distance travelled in the first 4.0 s?

A 0.67 m **B** 1.5 m
C 12 m **D** 24 m

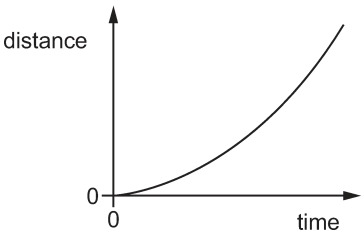
[J17/P1/Q5]

8. The speed-time graph represents a short journey.

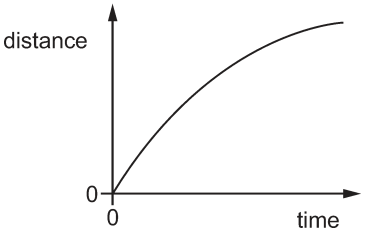


Which distance-time graph represents the same journey?

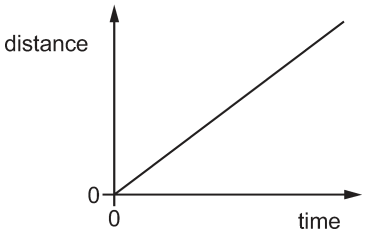
A



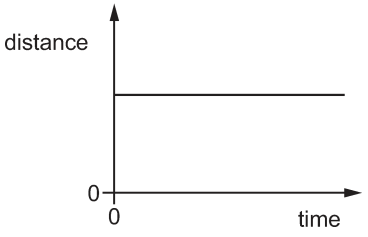
B



C



D



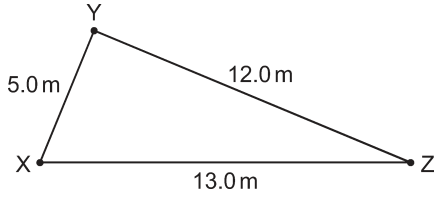
[N17/P1/Q3]

9. The table shows how the speeds of four bodies, **A**, **B**, **C** and **D**, change with time.
Which body has an acceleration that is **not** constant?

time / s	speed of **A** / m/s	speed of **B** / m/s	speed of **C** / m/s	speed of **D** / m/s
0	0	0	0	5.5
1	1.0	2.0	3.0	6.5
2	3.0	4.0	6.0	7.5
3	6.0	6.0	9.0	8.5

[N18/P1/Q2]

10. Paths are laid as shown between points X, Y and Z.



A person walks along the paths from X to Y to Z and then back to X.
What is the value of the total displacement and of the total distance travelled?

	total displacement / m	total distance travelled / m
A	0	0
B	0	30
C	30	0
D	30	30

[N18/P1/Q9]

MCQ Answers

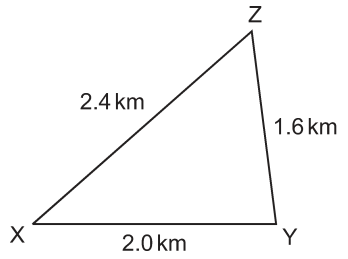
5. **D** Average speed
$= \frac{\text{total distance}}{\text{total time}}$
$= \frac{16\text{ km}}{0.25\text{ hour}} = 64\text{ km/h}$

6. **C** The gradient (slope) of a distance-time graph gives the speed.
At **A**, the slope is increasing, so the car is accelerating. At **B** the slope is constant, so the speed is uniform. At **C**, the slope is decreasing, so the speed is decreasing. Thus the car is decelerating in the region **C**. In region **D**, the slope is zero, so the speed is zero.

7. **C** Distance travelled = Area under the *v*-*t* graph.
$= \frac{1}{2} \times 6 \times 4$
$= 12\text{ m}.$

8. **A** The graph in the question shows a journey with increasing speed. A distance-time graph with increasing gradient also shows increasing speed. Thus, the graph A represents the same journey as shown by the graph in the question.

11. A woman runs 2.0 km from X to Y in 20 minutes and then rests at Y for 10 minutes. She then takes 10 minutes to run 1.6 km from Y to Z.



What is the size of her average velocity for the journey from X to Z?

A 0.060 km / minute
B 0.080 km / minute
C 0.090 km / minute
D 0.130 km / minute

[J19/P1/Q2]

12. A cyclist travelling in a straight line at 8.0 m/s accelerates to 12 m/s in a time of 6.0 s.

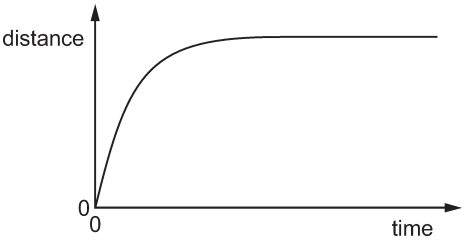
Which expression gives the cyclist's acceleration?

A $\frac{6}{12-8}$ **B** $\frac{8}{12-6}$

C $\frac{12-6}{8}$ **D** $\frac{12-8}{6}$

[J19/P1/Q3]

13. The diagram shows the distance-time graph for a moving object.



What is the moving object?

A a ball thrown vertically upwards and falling back to the thrower
B a car, starting from rest, speeding up as it moves away from a traffic signal
C a rock dropped from a high cliff, falling into the sea below
D a train braking to a halt as it stops at a station

[J19/P1/Q4]

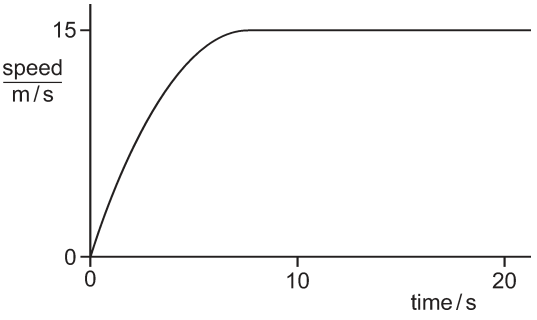
14. Part of a speed–time graph for two runners is shown. They are running along the same track.

Which statement **must** be correct?

A Both runners started at the same moment.
B Runner 1 has a greater acceleration than runner 2.
C Runner 1 is moving faster than runner 2.
D The distance between the two runners stays constant.

[N19/P1/Q5]

15. The graph shows how the speed of a car varies with time.



Which statement about the acceleration of the car between the times 10 s and 20 s is correct?

A The acceleration decreases.
B The acceleration increases.
C The acceleration is constant, but not zero.
D The acceleration is zero.

[N19/P1/Q6]

16. In which descent is the acceleration equal to the acceleration of free fall g at all times?

A a bungee jumper leaping from a bridge
B a feather falling in a vertical tube that contains a vacuum

MCQ Answers

9. A The rate of change of speed of body **A** is not constant. Whereas the other three bodies show a constant increase in their speeds.

10. B As the person starts from X and returns back to X, his total displacement = 0.

While the total distance travelled by the person
= 5.0 + 12.0 + 13.0
= 30 m.

11. A Velocity

$$= \frac{\text{total displacement}}{\text{total time}}$$

$$= \frac{2.4 \text{ km}}{40 \text{ minute}}$$

$$= 0.060 \text{ km/minute}$$

12. D Acceleration is given by:

$$a = \frac{v-u}{t}$$

hence, $a = \frac{12-8}{6}$

13. D The graph shows the motion of a train which is braking to a halt and stops at a station.

On braking, the speed of the train decreases and its rate of distance moved also decreases which finally becomes zero as the train stops at the station.

C a hailstone travelling to Earth at terminal velocity

D a sky-diver dropping from an aircraft towards the ground

[N19/P1/Q7]

17. Two cameras are a known distance apart. The exact time that a vehicle passes each of the cameras is recorded.

What can be obtained from the information?

A average acceleration of the vehicle

B average speed of the vehicle

C maximum acceleration of the vehicle

D maximum speed of the vehicle

[J20/P1/Q5]

18. A car begins to move. It speeds up until it reaches a constant speed. It continues to travel at this constant speed for the rest of the journey.

What happens to the acceleration and what happens to the velocity of the car during the journey?

A Both the acceleration and the velocity change.

B Only the acceleration changes.

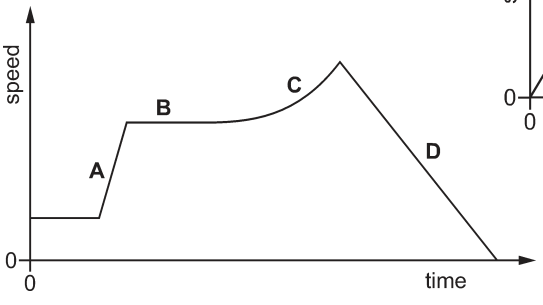
C Only the velocity changes.

D Neither the acceleration nor the velocity changes.

[N20/P1/Q2]

19. The speed–time graph for a car's journey is shown.

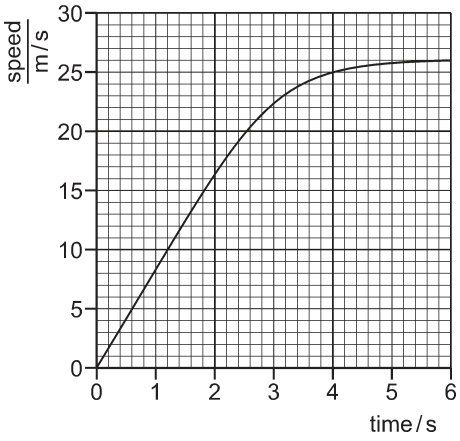
During which part of the journey is the car moving with non-uniform acceleration?



[N20/P1/Q3]

20. A skier slides down a slope.

The diagram shows how his speed varies with time.



What is his average acceleration during the 6.0 s?

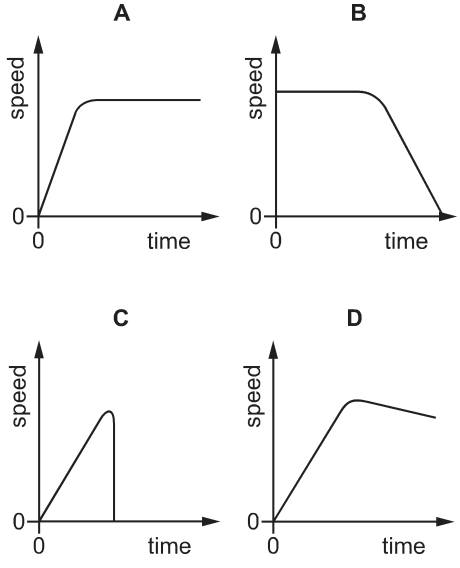
A 2.2 m / s^2 **B** 4.3 m / s^2

C 8.0 m / s^2 **D** 13.0 m / s^2

[N21/P1/Q3]

21. A ball starts from rest and rolls down a steep slope. The ball then rolls along rough horizontal ground.

Which graph shows the speed of the ball at different times?



[N22/P1/Q5]

Thinking Process

MCQ Answers

14. C The graph shows that the two runners are running at two different but constant speeds whereas the speed of the runner 1 is greater than the speed of the runner 2.

15. D Since the gradient of the speed-time graph between 10 second and 20 second is zero, thus acceleration is zero.

16. B A feather falling in a vacuum is the correct example of a free-fall as the only force acting on it is the force of gravity whereas in the other three options, air-resistance is hindering their motion.

17. B Only the average speed can be depicted by these two sets of information since speed is defined as distance travelled over time taken.

18. A Since the car starts from rest, increases its speed and then attains a constant speed, there is a change in velocity throughout its journey. Due to change of this velocity, there is a change in its acceleration as well.

19. C Acceleration can be defined by the gradient of a speed time graph. Gradient of Section **A** & **D** are constant while gradient of section **B** is zero. Only section **C** has a changing (or non-uniform) gradient.

20. B $a = \frac{v_f - v_i}{t}$

$= \frac{26 - 0}{6}$

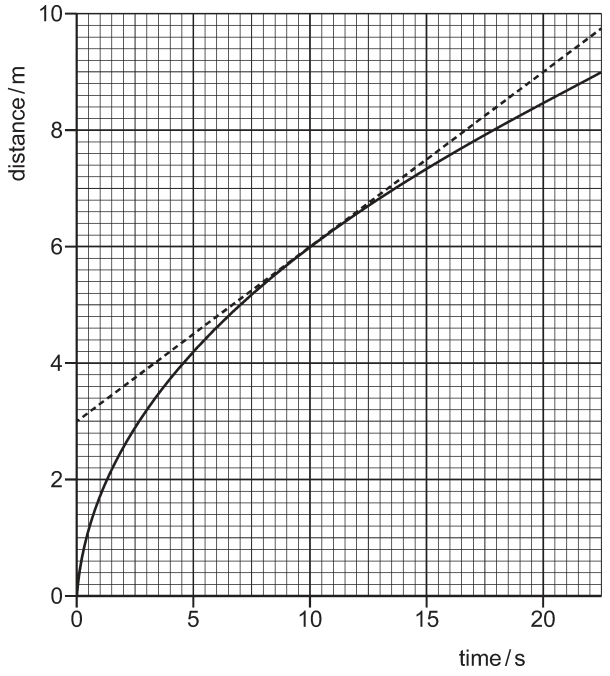
$= 4.3 \text{ m/s}^2$

22. Which row describes acceleration, displacement, distance and speed?

	acceleration	displacement	distance	speed
A	scalar	scalar	vector	scalar
B	scalar	vector	scalar	vector
C	vector	scalar	vector	vector
D	vector	vector	scalar	scalar

[J23 / P1 / Q2]

23. The curved line on the distance–time graph shows the motion of a toy car. The straight line is the tangent to the curve at 10 s.



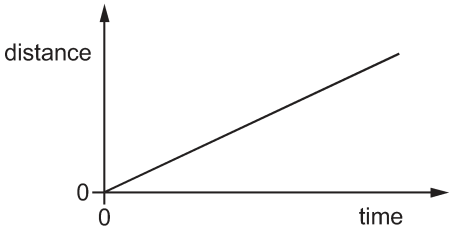
What is the speed of the toy car at 10 s?

A 0.3 m / s **B** 0.6 m / s

C 1.7 m / s **D** 3.3 m / s

[J23 / P1 / Q4]

24. The diagram shows the distance-time graph of a car.



The car is travelling along a straight road up a hill.

Which quantity for the car is constant and greater than zero?

A acceleration

B displacement

C gravitational potential energy

D kinetic energy

[N23 / P1 / Q2]

25. A distance–time graph and a speed-time graph show the motion of an object.

How are the speed and the acceleration of the object determined from these graphs?

	speed	acceleration
A	area under the distance–time graph	area under the speed–time graph
B	area under the distance–time graph	gradient of the speed–time graph
C	gradient of the distance–time graph	area under the speed–time graph
D	gradient of the distance–time graph	gradient of the speed–time graph

[N23 / P1 / Q3]

MCQ Answers

21. D The graph **D** translates the motion of the ball as its speed increases while rolling down the steep slope and then the decrease in its speed when it moves on the rough horizontal surface.

22. D It is a fact that acceleration and displacement are vector quantities as they both have a direction. Whereas distance and speed are scalar quantities as they only have magnitude but no direction.

23. A On a distance-time graph, the gradient of the tangent to the curve gives the speed.

24. D The graph shows that the car is moving at a constant speed. As, the kinetic energy is directly proportional to speed, so the kinetic energy of the car remains constant during its motion. Whereas, the acceleration is zero and the displacement is increasing as it is moving forward in a straight-line. Also, the gravitational potential energy is also increasing as the car is moving up a hill.

25. D It is true that the gradient of a distance-time graph gives the speed and the gradient of a speed-time graph gives the acceleration.

Topic 2 *Motion*

THEORY Section

Question 1

A ball rolls down a slope, as shown in Fig. 1.1.

The metre rule shows the position of the ball at times $t = 0$, 1.0 s, 2.0 s and 3.0 s.

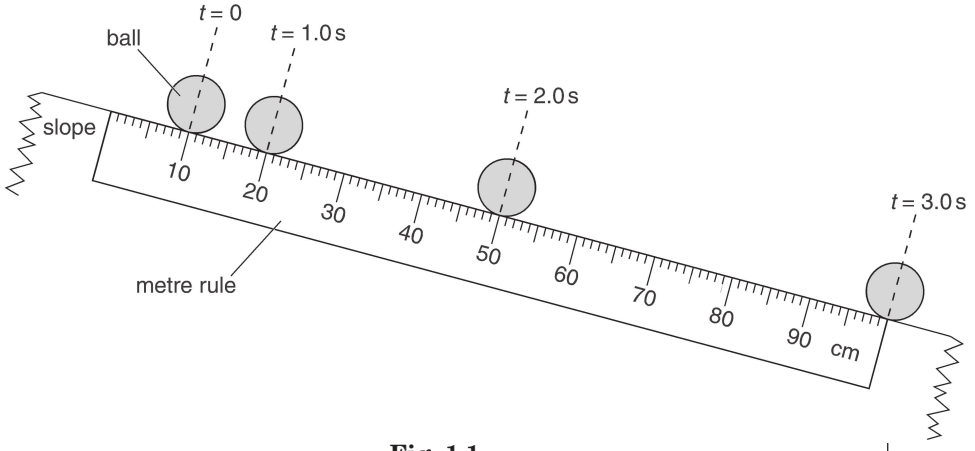


Fig. 1.1

(a) Explain how Fig. 1.1 shows that the ball is accelerating. [1]

(b) Calculate the average speed of the ball between t = 1.0 s and 3.0 s. [2]

(c) Two of the forces that act on the ball are air resistance and weight.
State what, if anything, happens to these forces as the ball accelerates. [2]

(d) Explain why, if the slope is long enough, the ball eventually reaches a constant speed. [1]

[J13/P2/Q1]

Solution

(a) A greater distance is covered by the ball in each second. Which means that the velocity of the ball is increasing every second.

(b) $$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$
$$= \frac{80}{2.0}$$
$$= 40 \text{ cm/s or } 0.40 \text{ m/s}$$

(c) **air resistance:** It increases due to the increase in the speed of the ball.
weight: It remains constant.

(d) The backward and forward forces become equal. The resultant force becomes zero, so the speed becomes constant.

COMMENT on **ANSWER**

❝ **(a)** *Alternative Answer:*
The ball travels further in each second.

(d) As the ball accelerates, its speed increases. As a result the air resistance acting on the ball also increases and becomes equal to the forward force .
The resultant force then becomes zero and the ball then reaches a constant speed. ❞

Question 2

A children's ride consists of a steel cable that runs between two posts of different heights, as shown in Fig. 9.1.

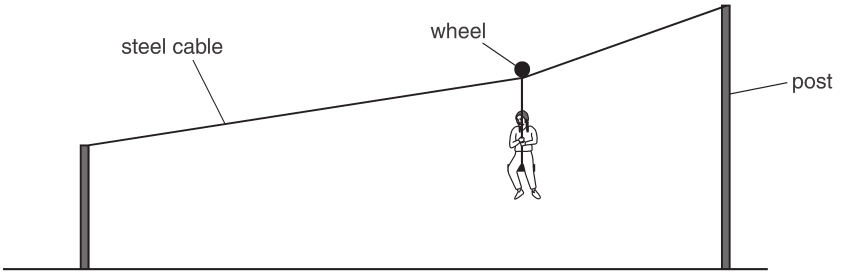
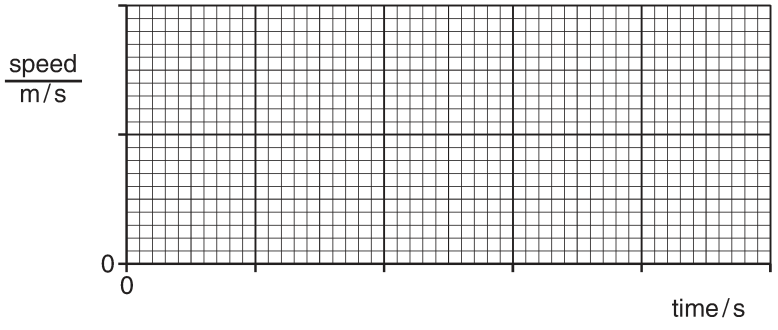


Fig. 9.1

A girl starts and finishes the ride at rest. Her horizontal motion can be taken as

- an initial uniform acceleration for 3.0 s, followed by
- a constant speed of 2.4 m/s for a further 5.0 s and
- a final uniform deceleration that lasts for 1.0 s.

(a) On Fig. 9.2, draw a speed-time graph of the horizontal motion.



[3]

(b) Explain what is meant by *uniform acceleration*. [2]

(c) The final deceleration is larger in size than the initial acceleration.
Explain how the data shows this. [1]

(d) Calculate the horizontal distance travelled by the girl in the first 8.0 s. [3]

(e) (i) The girl has a mass of 30 kg and falls a vertical distance of 1.6 m during the ride.
The gravitational field strength g is 10 N/kg.
Calculate the decrease in gravitational potential energy of the girl. [2]

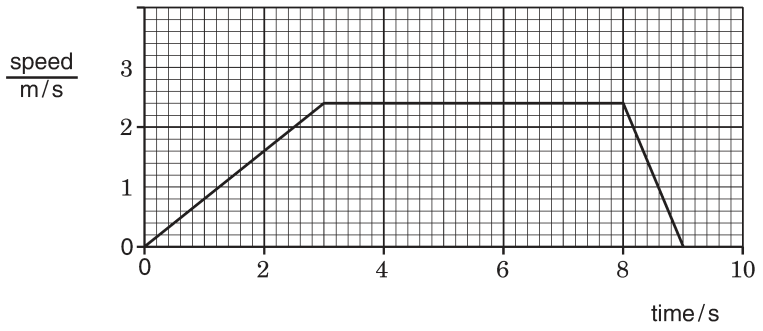
(ii) The gain in kinetic energy of the girl is less than the decrease in her potential energy.
Suggest one reason for this. [1]

(f) A group of pupils make measurements to show that the girl's speed is constant during the middle section of the ride.
Suggest what measurements are made and how they show that the speed is constant. [3]

[J14/P2/Q9]

Solution

(a)



(b) Uniform acceleration refers to a constant increase in velocity per unit time.

(c) Accelerating upto 2.4 m/s took three seconds whereas decelerating from 2.4 m/s to 0 m/s took just one second.

(d) Distance travelled = aea of trapezium

$$= \frac{1}{2} \times 2.4 \times (5+8) = 15.6 \text{ m.}$$

(e) (i) Decrease in potential energy = mgh

$$= 30 \times 10 \times 1.6 = 480 \text{ J}$$

(ii) Some energy may have been lost as thermal energy due to work done against air resistance.

(f) The middle section of the ride is marked, on the ground, at equal distances of 1 meter each. Using a stopwatch, time is recorded as the girl passes each of these marks. A distance-time graph is then plotted. A constant slope of the distance-time graph would indicate that the speed of the girl is constant during the middle section of the ride.

Question 3

A bungee jumper falls from a bridge above a river, as shown in Fig. 11.1.

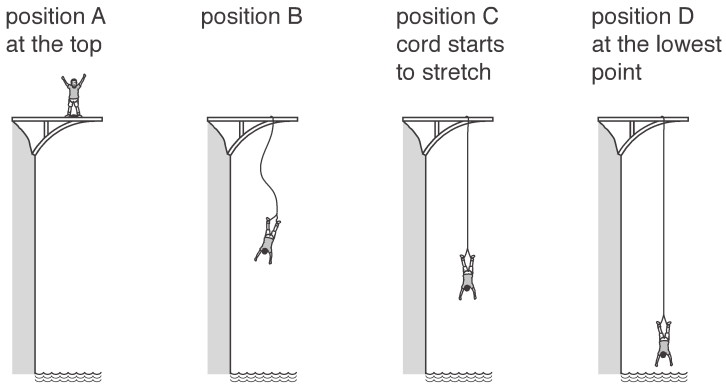


Fig. 11.1 (not to scale)

The man starts from position A in Fig. 11.1. The elastic cord starts to stretch at position C and he stops for the first time at position D. He continues to rise and fall.

Fig. 11.2 shows how the velocity of the man varies with time t.

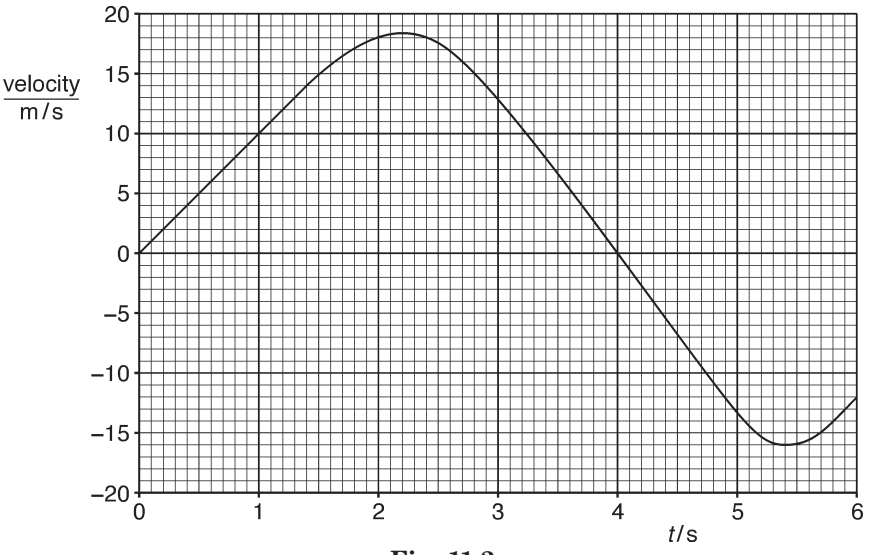


Fig. 11.2

(a) (i) State what is meant by *velocity*. [2]

(ii) State the difference between a positive velocity and a negative velocity. [1]

(iii) In the first 1.4 s the acceleration is uniform.

1. Using values from Fig. 11.2, determine the acceleration of the man in the first 1.4 s. [3]
2. Comment on your value of acceleration. [1]

(iv) 1. State the value of t when the man is at position D. [1]

2. Explain, in terms of the forces acting, why the man is accelerating upwards at D. [3]

(b) Fig. 11.3 shows the values for the gravitational potential energy of the man, the kinetic energy of the man and the elastic potential energy in the cord at A, C and D.

You may ignore the effect of air resistance in this question.

	gravitational potential energy / J	kinetic energy / J	elastic potential energy / J
position A	20 000	0	0
position C	15 000		0
position D	0	0	

Fig. 11.3

(i) Complete Fig. 11.3 to show the kinetic energy of the man at C and the elastic potential energy in the cord at D. [2]

(ii) The man has a mass of 50 kg.

The gravitational field strength g is 10 N / kg.

Using values from Fig. 11.3, calculate the vertical distance between A and C. [2]

[J15 / P2 / Q11]

Solution

(a) (i) The rate of change of displacement is called velocity.

(ii) The only difference between a positive velocity and a negative velocity is of their opposite direction.

(iii) 1. Acceleration, $a = \dfrac{v-u}{t}$

$$= \frac{14-0}{1.4-0} = 10 \text{ m/s}^2$$

2. This value is the same as the acceleration due to gravity.

(iv) 1. $t = 4.0$ s.

2. At position D, a downward force of gravity (weight) and an upward elastic force in the cord (tension) act on the man. But as this upward tension in the cord is greater than the downward force of gravity on the man, the resultant force is in the upward direction, so he accelerates upwards.

(b) (i)

	gravitational potential energy / J	kinetic energy / J	elastic potential energy / J
position A	20 000	0	0
position C	15 000	**5 000**	0
position D	0	0	**20 000**

(ii) P.E. $= mgh$

$5000 = 50 \times 10 \times h$

$h = 10$ m

COMMENT on **ANSWER**

"**(a)** **(i)** The velocity is also defined as:
— distance travelled per second in a given direction,
— displacement / time
— change in displacement per unit time,

(iii) *Alternatively:*
Acceleration in first 1.4 second = gradient of graph in first 1.4 seconds.

$a = \dfrac{14-0}{1.4-0}$

$= 10 \text{ m/s}^2$ "

Question 4

Fig. 1.1 shows the speed-time graph for a car travelling along a horizontal road.

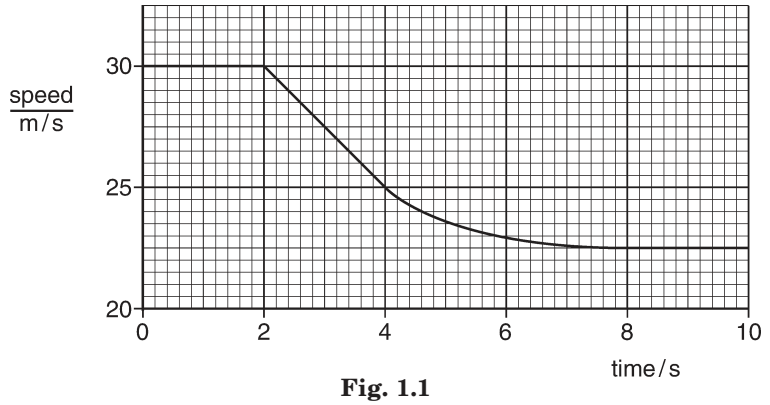


Fig. 1.1

(a) On Fig. 1.1, mark and label a point where the car has a non-uniform deceleration. [1]

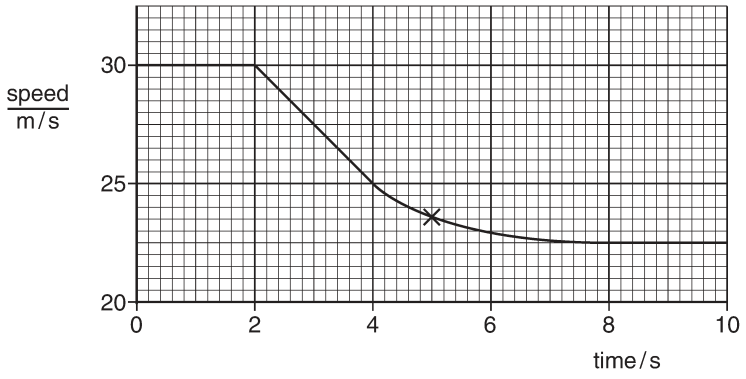
(b) Calculate the deceleration of the car at $t = 3.0$ s. [2]

(c) Explain, in terms of the horizontal forces that act on the car, why its speed is constant at $t = 1.0$ s. [2]

[J16 / P2 / Q1]

Solution

(a)



(b) $a = \dfrac{v-u}{t} = \dfrac{25-30}{4-2} = -2.5 \text{ m/s}^2$

(c) The forward force of the engine is equal to the backward force of air resistance. The resultant force acting on the car is zero. So the acceleration is zero and the car moves at a constant speed.

Question 5

A skier sets off from rest and accelerates uniformly at 3.4 m/s^2 in a straight line for 5.0 s.

(a) Calculate the speed of the skier after 5.0 s. [2]

(b) At 5.0 s, the skier stops accelerating and travels on for a further 10.0 s at a constant speed.

(i) State the size of the resultant force acting on the skier during these 10.0 s. [1]

(ii) On Fig. 1.1, sketch a speed-time graph for the skier during the whole 15.0 s. [3]

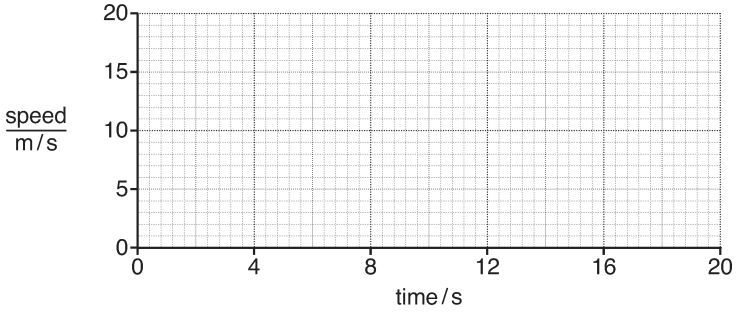


Fig. 1.1

(iii) State how the distance travelled by the skier can be determined using the speed-time graph. [1]

[N16/P2/Q1]

COMMENT on **ANSWER**

❝ **(a)** The curved part of the graph between 4 seconds and 7 seconds shows the non-uniform deceleration of the car, so put the required mark at any point on this curved part of the graph.

(b) ***Alternatively:*** *a* = gradient of the graph at *t* = 3.0 s.

(c) ***Alternative Answer:***

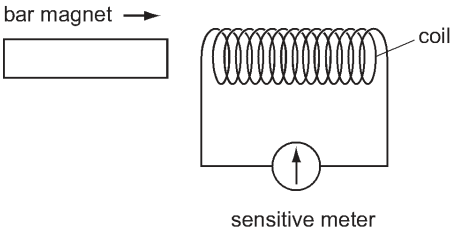
— The backward force balances the forward force acting on the car.

— The forward force of the engine and the backward force of friction acting on the car are in equilibrium. ❞

Topic 25 *Electromagnetic Induction*

MCQ Section

1. A bar magnet is pushed into one end of a long coil connected to a sensitive meter.



Which of the following affects the **magnitude** of the deflection of the meter?

A the direction in which the coil is wound

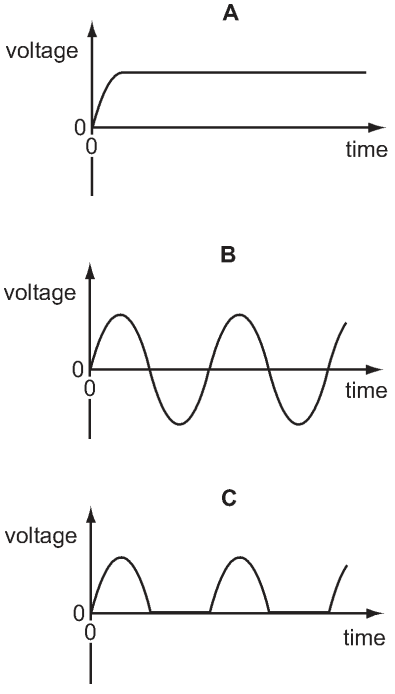
B the speed with which the magnet enters the coil

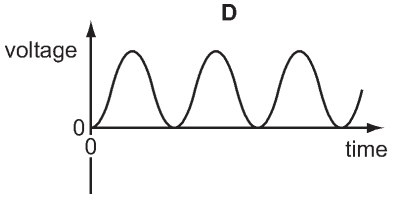
C which end of the coil is used

D which pole of the magnet enters first

[J12/P1/Q35]

2. Which graph represents the voltage output of a simple a.c. generator?





[J12/P1/Q36]

3. A magnet is moved towards a coil of insulated wire. A voltmeter connected across the coil shows a positive reading.

What produces a higher reading on the voltmeter?

A moving the magnet away from the coil at the same speed

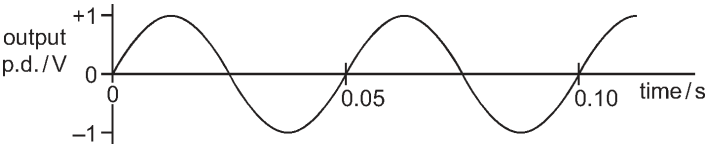
B moving the magnet away from the coil at a slower speed

C moving the magnet towards the coil at a faster speed

D moving the magnet towards the coil at a slower speed

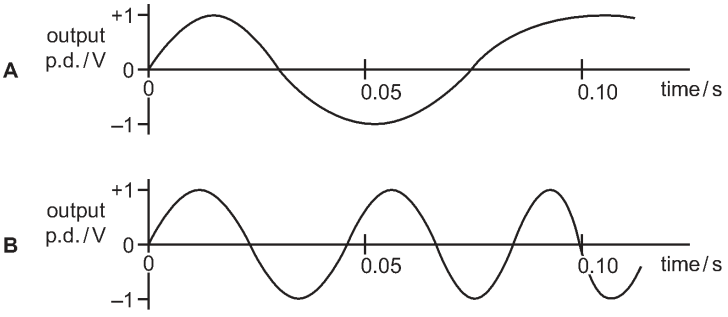
[N12/P1/Q35]

4. The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.



The speed of rotation of the coil steadily increases.

Which graph best shows how the output changes?

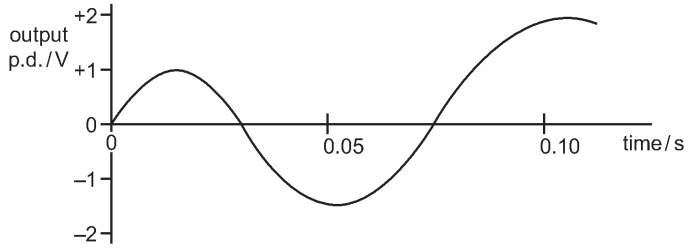


1. B The following factors only affect the EMF produced in the coil and the magnitude of the deflection of the meter?
— the no. of turns in the coil.
— the strength of the magnet.
— the speed of motion of the magnet.
— the soft iron core in the coil.

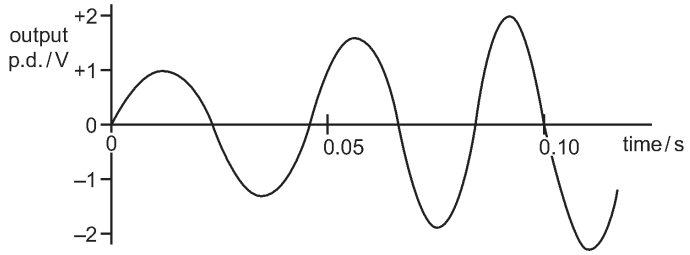
2. B Fact

3. C The magnitude of the EMF induced in the coil depends on:
— the no. of turns in the coil.
— the strength of the bar magnet.
— the speed of the magnet.

C



D



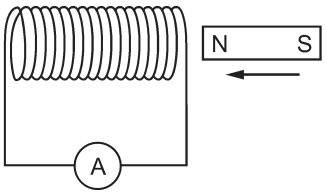
[N13/P1/Q33]

5. Which device uses the force experienced by a current in a magnetic field when in normal use?

A cathode-ray oscilloscope
B electrostatic precipitator
C loudspeaker
D transformer

[J14/P1/Q34]

6. As a magnet is moved into the coil of wire as shown, there is a small reading on the sensitive ammeter.

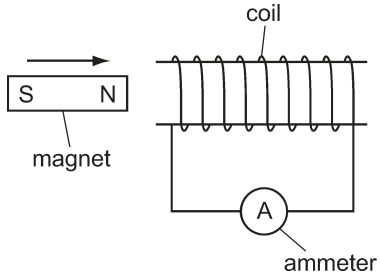


Which change increases the size of the reading?

A moving the opposite pole into the coil
B pulling the magnet out of the coil
C pushing the magnet in faster
D unwinding some of the turns of wire

[J14/P1/Q36]

7. A student moves a magnet into a coil of wire as shown in the diagram. The coil of wire is connected to a sensitive ammeter.

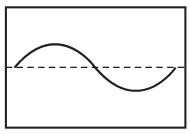


Which change does **not** produce an increase in the reading?

A increasing the number of turns on the coil
B increasing the resistance of the ammeter
C increasing the speed of the magnet
D increasing the strength of the magnet

[N14/P1/Q33]

8. The coil of an a.c. generator is rotated and the output is displayed on the screen of a cathode-ray oscilloscope (c.r.o.).
The diagram shows the trace on the screen.



4. D A steadily increasing speed of rotations of the coil of the generator will result in the steadily increasing output voltage of the generator and decreasing its time period.

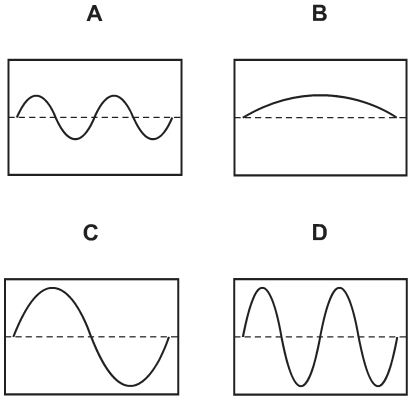
5. C The diaphragm in the loudspeaker vibrates as a result of changing current in a fixed magnetic field.

6. C Fact. If the magnet moves faster, a larger current will flow into the coil.

7. B Increasing the resistance of the ammeter would decrease the current in the coil and hence the ammeter reading.

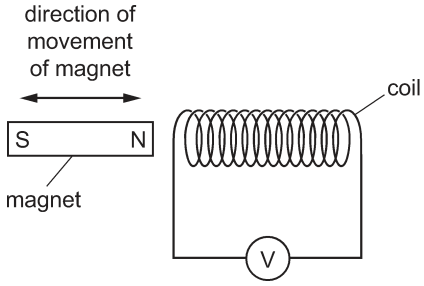
8. D Doubling the speed of rotation of the generator's coil doubles the output voltage produced by the generator, as well as the number of waves produced on the screen. Therefore, the amplitude and the frequency of the waves both double.

Which trace appears on the screen when the speed of rotation of the coil is doubled but the settings on the c.r.o. are unaltered?



[N14/P1/Q34]

9. A teacher moves a magnet into and out of a coil of wire, as shown, in order to demonstrate electromagnetic induction.



Which statement is correct?

A As the magnet is moved into the coil the left-hand end of the coil becomes a S-pole.

B As the magnet is taken out of the coil the left-hand end of the coil becomes a N-pole.

C Increasing the speed at which the magnet enters the coil, increases the induced voltage.

D Increasing the speed at which the magnet leaves the coil decreases the induced voltage.

[J15/P1/Q36]

10. A transformer consists of two coils which are wound on to a metallic core.

Which type of voltage is supplied to the transformer and which metal is used to make the core?

	supply voltage	metal
A	alternating	iron
B	alternating	steel
C	direct	iron
D	direct	steel

[J15/P1/Q37]

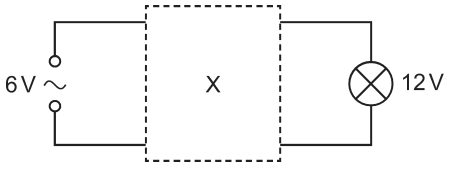
11. Electric power cables transmit electrical energy over large distances using high-voltage, alternating current.

What are the advantages of using a high voltage and of using an alternating current?

	advantage of using a high voltage	advantage of using an alternating current
A	high current is produced in the cable	the resistance of the cable is reduced
B	high current is produced in the cable	the voltage can be changed using a transformer
C	less energy is wasted in the cable	the resistance of the cable is reduced
D	less energy is wasted in the cable	the voltage can be changed using a transformer

[N15/P1/Q35]

12. The diagram shows an electrical device X connected between a 6 V a.c. supply and a 12 V lamp



The lamp is seen to glow with normal brightness.

What is X?

A a capacitor

B a potential divider

C a relay

D a transformer

[N15/P1/Q37]

13. Electrical power is transmitted by cables over long distances at very high voltages.

What are the effects of using a high voltage transmission system?

MCQ Answers

9. C Fact.

10. A A transformer can only work on alternating voltage supply and its two coils are wound on a soft-iron core.

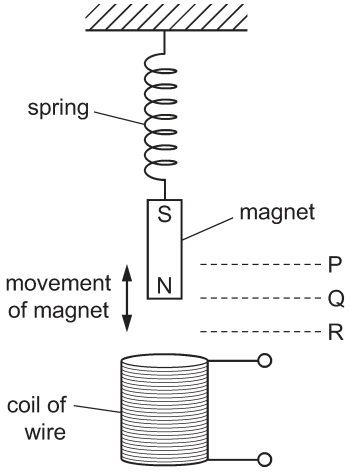
11. D The value of the voltage can be easily changed by a transformer. Also, by transmitting electrical power at high voltage, a smaller current flows through transmission cables which in turn reduces energy losses produced due to heating.

12. D A step-up transformer is used to change 6 V a.c. supply to 12 V a.c. to let the lamp glow with normal brightness.

	power loss in the cables	current in the cables
A	high	high
B	high	low
C	low	high
D	low	low

[J16/P1/Q34]

14. A magnet moves up and down above a coil of wire.



The bottom of the magnet moves up and down between P and R.

Where is the bottom of the magnet when there is no induced electromotive force (e.m.f.) in the coil?

A at P and at Q

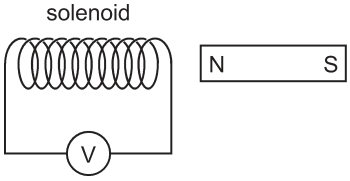
B at P and at R

C at Q only

D at R only

[N16/P1/Q37]

15. The N-pole of a magnet is moved into a solenoid and an e.m.f. is induced.



What causes an increase in the induced e.m.f.?

A moving the magnet more quickly

B moving the magnet more slowly

C pulling the magnet out instead of pushing it in

D using the S-pole of the magnet instead of the N-pole

[J17/P1/Q37]

16. Which material is used for the core of a transformer?

A copper **B** iron

C plastic **D** steel

[J17/P1/Q38]

17. A step-down transformer has a primary coil and a secondary coil wound on a soft-iron core.

The primary coil is connected to a 6.0 V direct current (d.c.) supply.

Which statement about the transformer is correct?

A The output voltage is equal to 6.0 V.

B The output voltage is greater than 6.0 V.

C The output voltage is less than 6.0 V but more than zero.

D There is no output voltage.

[J18/P1/Q36]

18. Which method of producing electricity does **not** use an a.c. generator?

A geothermal power station

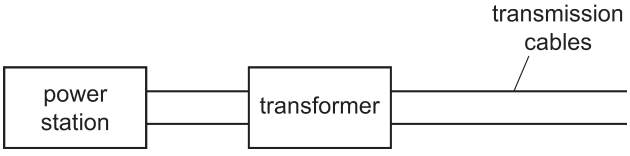
B solar panels

C wave-energy generators

D wind turbine

[J19/P1/Q18]

19. Transformers are used to transmit electrical energy between power stations and transmission cables, as shown.



What is the purpose of the transformer in the diagram?

A to decrease the current and the potential difference from the power station

B to decrease the current and increase the potential difference from the power station

C to increase the current and the potential difference from the power station

D to increase the current and decrease the potential difference from the power station

[N19/P1/Q37]

13. D The electric power, $P = V \times I$.
As the electric power is transmitted at very high voltage a very low current passes through the transmission cables. As a result the power loss due to the heating effect of current is reduced.

14. B At P and R the magnet comes to rest for a fraction of a second before reversing its direction of motion. As there is no change in the magnetic flux, so, no emf is induced in the coil.

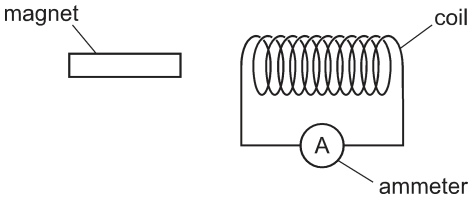
15. A Fact.

16. B The iron core is used in a transformer as it provides quick magnetic reversals due to the use of alternating current. Also, the lamination of the soft iron core reduces heat loss due to induced eddy currents.

17. D A transformer works on the principle that a changing magnetic flux in one coil induces a voltage in a second coil.
With a d.c. Input at primary coil, there will be no changing magnetic field so, no output voltage at the secondary coil.

18. B Fact.

20. The diagram shows a coil connected to a very sensitive ammeter.
A magnet is next to the coil.



Which action results in a zero reading on the ammeter?

A moving the coil and the magnet at the same speed in opposite directions

B moving the coil and the magnet at the same speed in the same direction

C moving the coil away from the stationary magnet

D moving the magnet towards the stationary coil

[J20/P1/Q40]

21. What is used with a magnet to create an induced electromotive force (e.m.f.) in a simple a.c. generator?

A a battery **B** a coil of wire

C a voltmeter **D** a relay

[N20/P1/Q34]

22. A transformer has 4800 turns on its primary coil and 480 turns on its secondary coil.

The primary coil is connected to a 240 V a.c. supply. The secondary coil is connected to a lamp.

How does the output current in the lamp compare with the input current?

A higher frequency a.c.

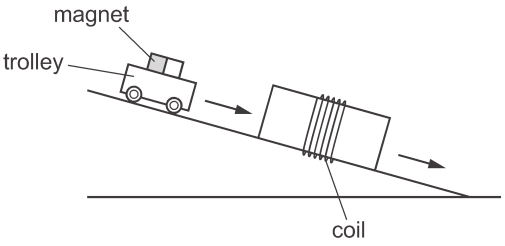
B lower frequency a.c.

C current in one direction only

D the same frequency a.c.

[N20/P1/Q36]

23. A trolley carrying a strong magnet rolls down a ramp at constant speed. It passes through a coil as shown.

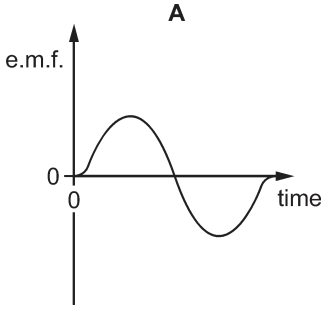


An electromotive force (e.m.f.) is induced in the coil. A graph of the e.m.f. against time is plotted.

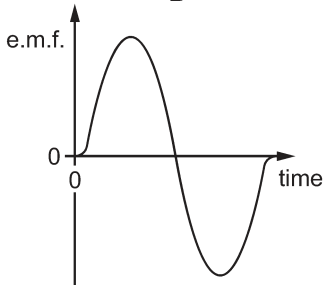
The experiment is repeated with different coils and with a steeper ramp. The trolley moves at a greater constant speed on the steeper ramp.

Which graph is produced using the coil with the least number of turns and the steepest ramp? All graphs are drawn to the same scale.

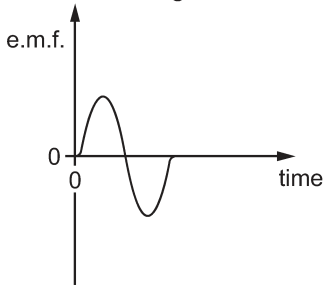
A



B



C



19. B Transformers are used to transmit electrical energy at low current and high voltage in order to reduce the energy losses.

20. B Moving the coil and the magnet at same speed and in the same direction does not cut any magnetic flux. Therefore, no current is induced in the coil.

21. B The basic form of a.c. generator makes use of a rotating coil of wire and a magnet. It is based on the principle of electromagnetic induction.

22. D Transformers only transforms voltage without changing the current's frequency.

23. C When the trolley, along with the magnets, passes through the coil, a change in the magnetic flux linked with the coil occurs, which induces an alternating e.m.f. in the coil. Due to the least number of turns on the coil, the least e.m.f. is induced.

Whereas, due to the greater constant speed, the trolley passes quickly through the coil causing a quick change in the magnetic flux acting on the coil, so the cycle of induced alternating e.m.f. is of a shorter time period.

Topic 25 *Electromagnetic Induction*

THEORY Section

Question 1

Fig. 8.1 shows a simple a.c. generator. The coil is turning and an e.m.f. is induced in the coil.

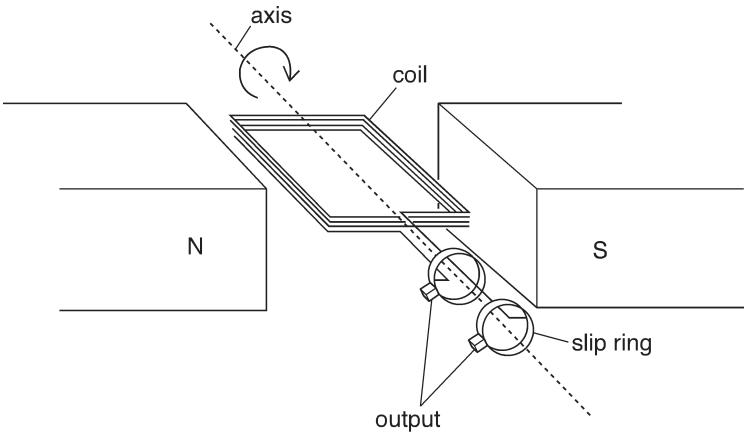


Fig. 8.1

(a) The generator contains a permanent magnet. State the name of a metal used in a permanent magnet. [1]

(b) At the instant shown in Fig. 8.1, the induced e.m.f. is a maximum.

(i) Explain why the induced e.m.f. is a maximum. [2]

(ii) State the position of the coil where there is no induced e.m.f. [1]

[J13/P2/Q8 Either]

Solution

(a) Steel

(b) (i) At the instant shown, the rate of cutting of magnetic flux is maximum as the coil is passing through the horizontal position, so a maximum e.m.f is induced in the coil.

(ii) Vertical position

COMMENT on **ANSWER**

"**(a)** Alternative answers:

— magnetite

— alnico

— magnadur

(b) (i) According to the law of electromagnetic induction

" The magnitude of the emf induced is directly proportional to the rate of change of magnetic flux."

(ii) When the coil is passing through the vertical position, its sides do not cut any magnetic flux, hence no e.m.f. is induced. "

Question 2

Fig. 8.1 shows the structure of a simple alternating current (a.c.) generator.

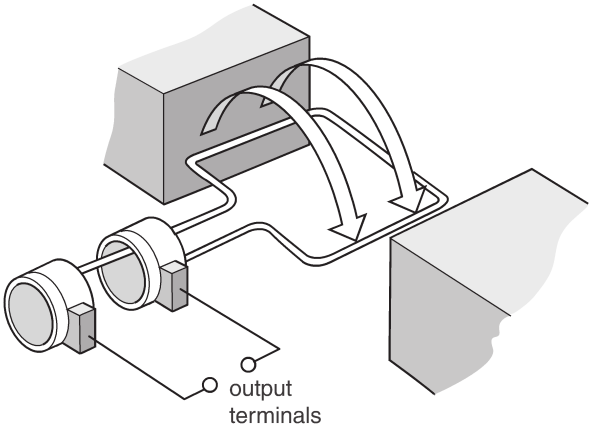


Fig. 8.1

(a) On Fig. 8.1, label

- the coil of the generator with the letter C,
- a slip ring with the letter S,
- a carbon brush with the letter B. [2]

(b) The a.c. generator is operating and the arrows on Fig. 8.1 show the direction of rotation.

Explain why there is an electromotive force (e.m.f.) between the two output terminals. [3]

(c) The output terminals of the a.c. generator are connected to a cathode-ray oscilloscope (c.r.o.). Fig. 8.2 shows the trace on the screen of the c.r.o.

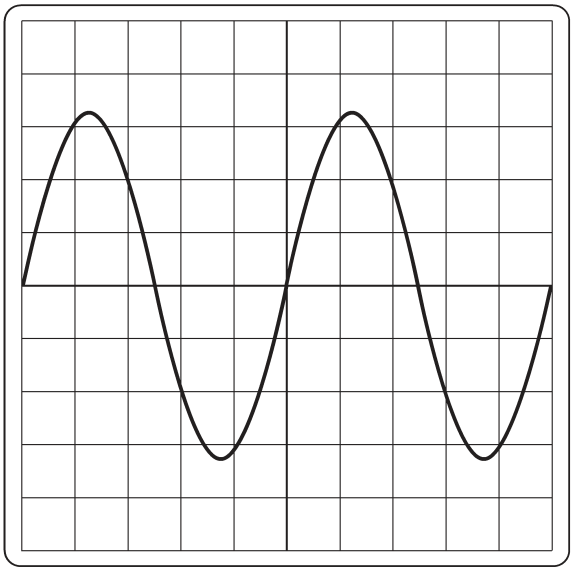


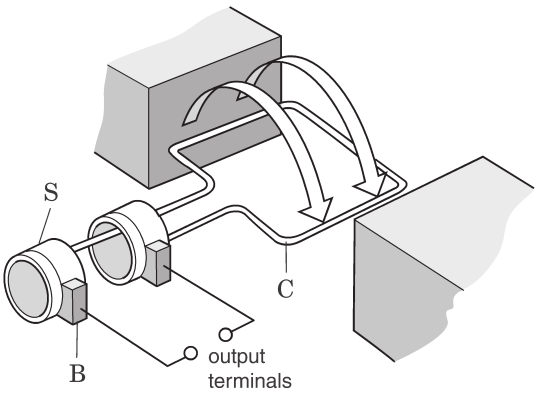
Fig. 8.2

Describe how the trace and a setting on the c.r.o. are used to find the time for one revolution of the coil of the a.c. generator. You may draw on Fig. 8.2 if you wish. [2]

[N14/P2/Q8]

Solution

(a)



(b) As the coil rotates, it cuts the magnetic field between the magnetic poles of the field magnets. A change in the magnetic flux takes place, and as a result an e.m.f. is induced in the coil according to the law of electromagnetic induction.

(c) One wavelength corresponds to one revolution of the coil. To find the time for one revolution, count the number of horizontal divisions occupied by one complete wavelength and multiply it with the time-base setting.

Question 3

Fig. 6.1 shows a simple a.c. generator.

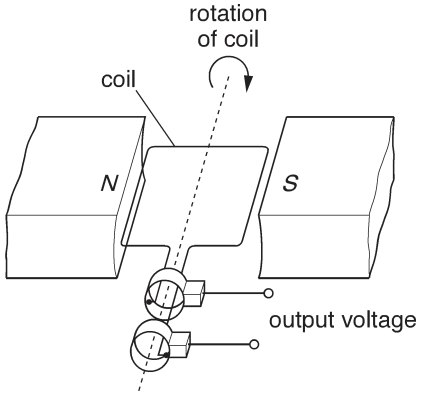


Fig. 6.1

(a) The coil rotates and an alternating electromotive force (e.m.f.) is induced in the coil.

Fig. 6.2 shows how the alternating e.m.f. varies with time as the coil rotates.

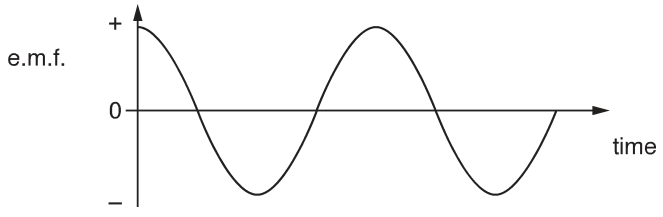


Fig. 6.2

Explain

(i) why an e.m.f. is induced, [2]

(ii) why the e.m.f. is sometimes positive and sometimes negative. [1]

(b) Changes are made to the a.c. generator, one at a time:

- stronger magnets are used
- more turns are wound on the coil
- the coil is turned faster.

Complete the table in Fig. 6.3 to show what happens to the maximum value of the e.m.f. and to the frequency of the alternating e.m.f.

changes made	what happens to the maximum value of the e.m.f.	what happens to the frequency of the e.m.f.
stronger magnets		
more turns on the coil		
the coil is turned faster		

Fig. 6.3

[3]

[J15/P2/Q6]

Solution

(a) (i) As the coil rotates, its sides cut the magnetic flux between the N-poles and S-poles of the field magnets. Due to this change in the magnetic field, an e.m.f. is induced in the coil.

(ii) When the coil rotates, its one side cuts the field line in one direction and then the same side cuts the field line in the reverse direction which causes the reversal in the output e.m.f. from positive to negative or negative to positive.

(b)

changes made	what happens to the maximum value of the e.m.f.	what happens to the frequency of the e.m.f.
stronger magnets	**Increases**	**No change**
more turns on the coil	**Increases**	**No change**
the coil is turned faster	**Increases**	**Increases**

COMMENT on **ANSWER**

"**(a)** **(ii)** The e.m.f is sometimes positive and sometimes negative because each one side moves one way and then the other. OR because the flux increases and then decreases. "

Question 4

Thin wire, covered in plastic insulation, is used to make a solenoid (long coil). The solenoid is connected to a sensitive ammeter. Fig. 10.1 shows the N-pole of a steel magnet placed next to the solenoid.

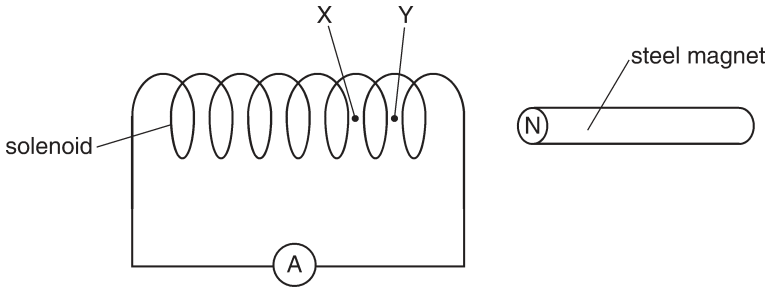


Fig. 10.1

Point X and point Y are on the axis of the solenoid.

(a) (i) Explain why plastic is an electrical insulator. [1]

(ii) Explain why the magnet is **not** made from

1. aluminium, [1]

2. iron. [1]

(b) In one experiment, the magnet in Fig. 10.1 is moved to the left and passes into the solenoid. The N-pole of the magnet travels from Y to X at a constant speed. As it moves, the ammeter shows a small current.

(i) Explain why there is a current in the solenoid when the magnet is moving. [3]

(ii) The N-pole travels from Y to X in 0.14 s. As it moves, the current shown on the ammeter is 0.045 mA. The resistance of the solenoid is 1.2 Ω.

Calculate

1. the potential difference (p.d.) across the solenoid, [2]

2. the charge that passes through the solenoid as the N-pole moves from Y to X. [2]

(c) In a second experiment, the speed of the N-pole is greater than its speed in the first experiment. It now takes only 0.070 s to travel from Y to X. A current in the same direction is shown on the ammeter.

(i) State and explain how the size of this current compares with the size of the current in the first experiment. [2]

(ii) The same quantity of charge passes through the coil in both the first and second experiments.

Explain why this is the case. [1]

(d) State two ways in which the equipment shown in Fig. 10.1 can be used to produce a current in the solenoid that is in the opposite direction. [2]

[N15/P2/Q10]

Solution

(a) (i) Plastic is an electrical insulator because it does not contain free electrons and thus cannot conduct electricity.

(ii) 1. Aluminium is not a magnetic material.

2. Iron is a soft magnetic material and can be magnetised only temporarily.

COMMENT on **ANSWER**

❝ **(a) (ii)** *Alternatively,* Iron cannot be made a permanent magnet. ❞

(b) (i) When the N-Pole enters into the solenoid and moves from Y to X, its magnetic flux is cut by the coil. Due to this change in the magnetic flux, a brief EMF and hence a small current is induced in the solenoid and the ammeter shows a small momentary deflection.

(ii) 1. Potential difference, $V = IR$

$$= \frac{0.045}{1000} \times 1.2$$

$$= 5.4 \times 10^{-5} \text{ V}$$

2. Charge, $Q = It$

$$= \frac{0.045}{1000} \times 0.14$$

$$= 6.3 \times 10^{-6} \text{ C.}$$

COMMENT on **ANSWER**

"**(b) (ii)** Do not forget to change the value of current in milliamperes to amperes. "

(c) (i) As the magnet moves faster and takes half of the previous time to move from Y to X, the rate of change of magnetic flux is doubled. Hence, the current induced is doubled.

(ii) Since in the second experiment, the current is doubled and the time is halved, the product of I and t gives the same result i.e. the same charge Q, as in the first experiment.

(d) 1. Insert S-Pole at the same end of the solenoid.

2. Insert N-Pole at the other end of the solenoid.

Question 5

A transformer and a diode are used to charge a battery.

Fig. 8.1 shows the transformer, which contains a soft-iron core and two coils.

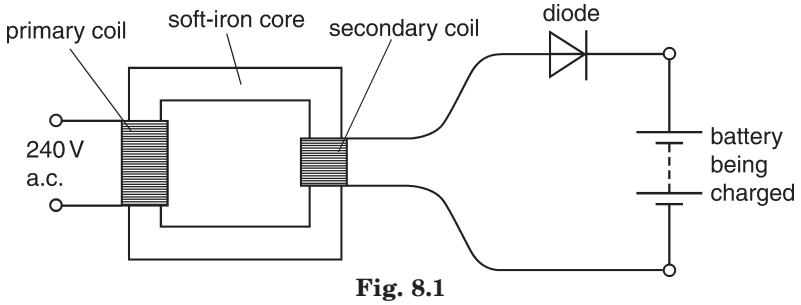


Fig. 8.1

The primary coil is connected to the 240 V a.c. mains supply. The secondary coil is connected in series with the diode and the battery.

(a) Explain why an electromotive force (e.m.f.) is induced in the secondary coil. [2]

(b) The e.m.f. induced in the secondary coil is less than 240 V. Suggest why. [1]

(c) Suggest why steel is not used as the core of a transformer. [1]

(d) Describe the action of the diode. [1]

[J16/P2/Q8]

COMMENT on **ANSWER**

"**(a)** ***Alternatively:***

The alternating current in the primary coil magnetises the soft iron core with a varying magnetic field. When this changing magnetic field acts on the secondary coil, an e.m.f is induced in the secondary coil. "

Solution

(a) The flow of the alternating current sets up a varying magnetic field in the primary coil. The soft-iron core links this changing magnetic field with the secondary coil, which in turn induces an e.m.f in the secondary coil.

(b) As the secondary coil has less number of turns than the primary coil, hence less e.m.f is induced at the secondary coil than the voltage applied at the primary coil.

(c) Steel is a hard magnetic material and it is difficult to magnetise or de-magnetise it.

(d) A diode allows current to pass through it in one direction only and therefore it is used to convert A.C. into D.C.

COMMENT on **ANSWER**

"**(c)** Steel being a hard magnetic material can not transfer the magnetic reversals from the primary coil to the secondary coil, whereas iron being a soft magnetic material can easily do it. "

Question 6

The metals in the list below have many different uses.

aluminium copper iron silver steel

(a) State which metal from the list is used for

(i) a compass needle,

(ii) magnetic screening,

(iii) the core of a transformer. [2]

(b) (i) Describe one use for a transformer. [2]

(ii) An a.c. generator supplies an input voltage of 220 V to a transformer.

1. In the space below, sketch a graph of the output voltage against time for the a.c. generator. [2]
2. The transformer has 1700 turns on the primary coil and 85 turns on the secondary coil.

   Calculate the output voltage of the transformer. [2]

(c) Fig. 11.1 shows a magnet next to one end of a solenoid.

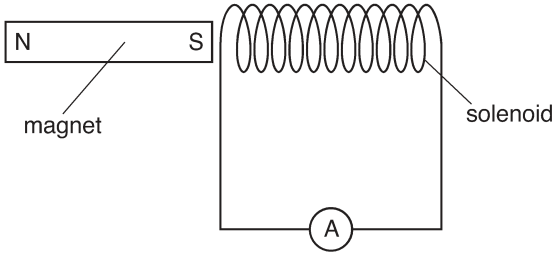


Fig. 11.1

The terminals of the solenoid are connected to a very sensitive ammeter.

(i) The magnet is moved to the right at a constant speed and a reading is observed on the ammeter.

1. Explain why there is a current in the ammeter. [3]
2. Explain how the current in the ammeter opposes the change producing it. [2]

(ii) The magnet stops when the S-pole reaches the middle of the solenoid.

The reading on the ammeter is observed when the magnet is moved to the left at a constant speed that is less than its speed in **(c)(i)**.

State two ways in which the reading on the ammeter differs from the reading observed in **(c)(i)** as the magnet moves to the left. [2]

[N17/P2/Q11]

Solution

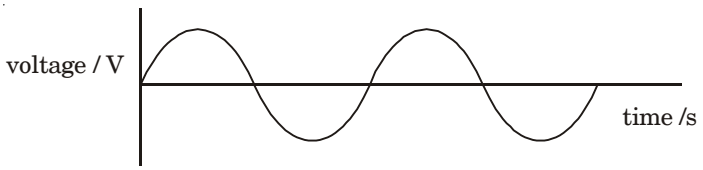
(a) (i) Steel.

(ii) Iron.

(iii) Iron.

(b) (i) A transformer is used to increase or decrease a given alternating voltage in order to reduce the energy losses during the transmission and distribution of electric power.

(ii) 1.



2.
$$\frac{V_S}{N_S} = \frac{V_P}{N_P}$$
$$\frac{V_S}{85} = \frac{220}{1700} \Rightarrow V_S = 11 \text{ V}$$
$\therefore$ output voltage = 11 V.

(c) (i) 1. As the magnet moves into the coil, the magnetic flux of the magnet linked with the coil increases. This change in the magnetic flux linked with the coil induces an e.m.f in the coil. As a result an induced current is produced in the coil which is shown by the reading on the ammeter.

2. The induced current in the coil magnetises the solenoid and produces a S-pole at the left end of the coil. The S-pole of the solenoid repels the magnet and opposes its motion towards the coil, hence opposes the change produced in the magnetic flux.

(ii) 1. A smaller reading is shown on the ammeter.

2. The ammeter now shows a reading in the opposite direction.

Question 7

Fig. 7.1 shows the structure of a transformer.

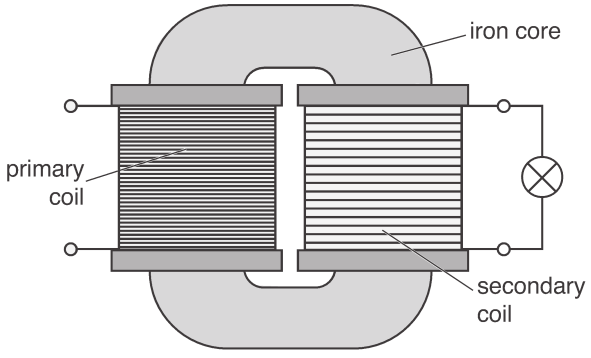


Fig. 7.1

A lamp is connected to the secondary coil.

(a) Explain why the core of the transformer is made from iron. [2]