QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

"A learner drops a ball from the top of a building."

USE THIS INFORMATION TO ANSWER QUESTIONS 1.1 to 1.2

1.1   The graph for the motion is shown below.
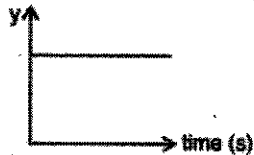
Which ONE of the following physical quantities could be represented on the y-axis of the graph below, indicating the ball is in the air?

A   Momentum

B   Acceleration

C   Displacement

D   Potential energy   (2)

1.2   After falling a certain distance d, the ball's kinetic energy is proportional to ...

A d

B d^2

C $\sqrt{d}$

D $\dfrac{1}{d^2}$ (2)

1.3 Which action stated below requires NO work to be done on that specific object?

   (A)   Lifting an object from the floor to the ceiling.

   (B)   Moving an object along the floor against friction.

   (C)   Decreasing the speed of an object until it comes to rest.

   (D)   Holding an object stationary above the ground.   (2)

1.4 A toy gun is fixed to a small cart and both move to the right with speed v along a straight track, as shown below. When the gun fires a bullet, the cart with the gun is brought to rest. If M is the mass of the cart and gun combined, and m is the mass of the bullet, what is the speed of the bullet immediately after it is fired?

   (A) $\dfrac{Mv}{m}$

   (B) $\dfrac{mv}{M-m}$

   (C) $\dfrac{(M+m)v}{m}$

   (D) $\dfrac{(M-m)v}{m}$ (2)
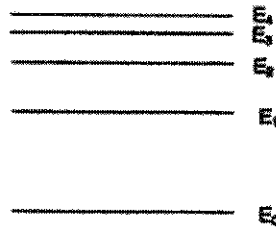
1.5   The diagrams show the motions of a source of sound S relative to an observer O. Which one of the options below correctly represents the effect of this motion on the frequency heard by the observer?

	Motion of S and O	Frequency
(A)	stationary ←———•S •O	Increases
(B)	stationary ←———•S •O	Decreases
(C)	stationary S • O•———→	Increases
(D)	stationary •S O•———→	No change

(2)

1.6   Some of the energy levels of an excited hydrogen atom are shown below.

$$\begin{array}{l}\underline{\hspace{6cm}}\quad E_4 \\ \underline{\hspace{6cm}}\quad E_3 \\ \underline{\hspace{6cm}}\quad E_2 \\ \\ \underline{\hspace{6cm}}\quad E_1 \\ \\ \\ \underline{\hspace{6cm}}\quad E_0 \end{array}$$

Which transition would be caused by the absorption of the lowest frequency of radiation?

(A) E_0 to E_4

(B) E_4 to E_0

(C) E_3 to E_4

(D) E_4 to E_3

(2)

1.7   Which ONE of the statements below about an AC motor is CORRECT?

(A)   It has slip rings and carbon brushes.

(B)   It has slip rings, but no carbon brushes.

(C)   It has a split ring commutator and carbon brushes.

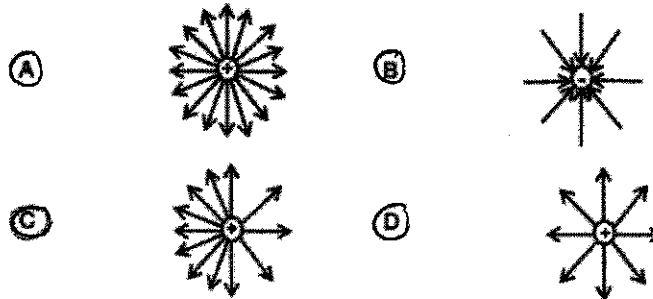(D)   It has a split ring commutator, but no carbon brushes.

(2)

1.8   Three charged spheres are placed horizontally along a straight line. Spheres X and Y have identical charges of +Q. What charge on sphere Z will result in a net force of 0 N on sphere Y?

     (A)   -4 Q

     (B)   +4 Q

     (C) $-\frac{1}{4}Q$

     (D) $+\frac{1}{4}Q$ (2)

1.9   Which ONE of the diagrams below is NOT the correct electric field pattern due to an isolated point charge?

           (2)

1.10   The heat produced in a current carrying wire is X joules in 1 s.
The same amount of current is passed through a second wire having the same thickness but HALF the resistance.
The heat produced in the second wire in 2 s will be ...

     (A)   X

     (B)   ½ X

     (C)   ¼ X

     (D)   2X   (2)

           [20]

QUESTION 2 (Start on a new page.)

Two wooden blocks of masses 2 kg and 3 kg respectively are placed on a rough horizontal surface. They are connected by a string. A constant horizontal force of 10 N is applied to the second string attached to the 3 kg mass as shown in the diagram below. Assume that both strings are light and inextensible.

The system moves towards the right with a *constant velocity*.

2.1	Define the term *kinetic frictional force*.	(2)
2.2	What is the magnitude of the net force acting on the system?	(1)
2.3	Draw a labelled free-body diagram showing ALL the forces acting on the 3 kg block as it moves toward the right.	(5)
2.4	Calculate the coefficient of kinetic friction between the surface of the table and the two wooden blocks.	(4)

The 10 N force is increased to 30 N so that the system now accelerates.

|		
2.5	Calculate the acceleration of system.	(5)
		[17]

QUESTION 3 (Start on a new page.)

A stone is dropped from the roof of a tall building. After it has fallen a distance of x metres, it passes a window which is 3,05 m high in 0,1 s.
Refer to the diagram below.
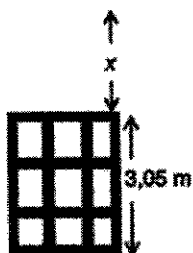
3.1   Define the term *free fall*.   (2)

3.2   In which direction is the stone accelerating as it passes the window?
      Write down only UPWARDS, DOWNWARDS.   (1)

3.3   Prove that the distance of x metres, between the roof and the top of the
      window is 45,95 m.   (6)

3.4   Sketch a velocity-time graph from the instant the stone is dropped to the
      time it reaches the top of the window.
      Indicate the velocity when it reaches the top of the window.   (3)
                                                                                   [12]

QUESTION 4 (Start on a new page.)

Truck A of mass 2 000 kg moving eastwards collides with truck B of mass 1 500 kg. The graph (not drawn to scale) shows how the momentum of each of the trucks varies with time.
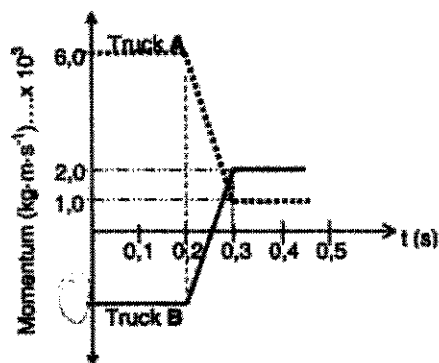

4.1	Write down the principle of conservation of linear momentum.	(2)
4.2	Write down the initial momentum of truck A.	(1)
4.3	Determine the magnitude and direction of the velocity of truck B before the collision.	(5)
4.4	Is the collision between the trucks ELASTIC or INELASTIC? Show how you arrived at the answer by means of calculations.	(5)
		[13]

QUESTION 5 (Start on a new page.)

A 20 kg box initially at rest, is pulled 5 m along a rough horizontal floor. A constant force of 130 N is applied at an angle of θ to the horizontal. The coefficient of kinetic friction between the box and the floor is 0,3.
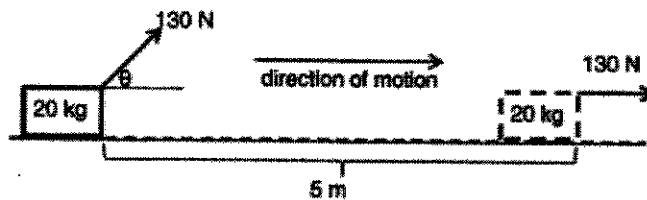
5.1 Calculate the value of angle θ if the work done by the applied force is 325 J. (3)

5.2 Calculate the work done by the kinetic frictional force. (5)

5.3 Using the WORK-ENERGY principle and calculate the speed of the box after moving through 5m. (4)

After the first 5 m, the same force is now applied horizontally and parallel to the floor over a further 5 m.

5.4 Will the magnitude of the kinetic frictional force INCREASES, DECREASES or REMAIN THE SAME? Give a reason for your answer. (3)

[15]

QUESTION 6 (Start on a new page.)

A sound source, moving at constant speed, approaches and then passes a stationary detector. The minimum and maximum frequencies detected are 749 Hz and 751 Hz. The speed of sound in air is 340 m·s⁻¹.

6.1 Write down the Doppler effect in words. (2)

6.2 At what stage was the frequency of sound recorded equal to 749 Hz? While the sound source was moving ... (Write MOVING TOWARDS or MOVING AWAY FROM the detector.) (1)

6.3 Is the wave length detected at a frequency of 751 Hz, GREATER THAN, LESSER THAN or EQUAL TO the wave length of the sound produced by the source? (1)

6.4 Determine the speed of the sound source. (6)

[10]

QUESTION 7 (Start on a new page.)

Two identical metal spheres each of mass 10 kg are placed on an insulated surface as shown.

7.1 Write down Coulomb's law in words. (2)

7.2 Calculate how much charge of equal magnitude each sphere must have if the electrostatic force must be exactly equal to the gravitational force exerted by one sphere on the other? (5)

7.3 Two point charges q_1 and q_2 are placed 50 cm apart. Charge q_1 carries +20 nC and q_2 carries -80 nC. Point **X, Y** and **Z** along a straight line are positions in the electric field surrounding the charges. Refer to the diagram below.

7.3.1 In which position (**X, Y** or **Z**) can the electric field be zero? (1)

7.3.2 Point **Z** is 70 cm from point charge q_1. Calculate the net electric field at **Z**. (6)

[14]

QUESTION 8 (Start on a new page.)

Learners perform an experiment to determine the internal resistance of a battery using the circuit diagram below.
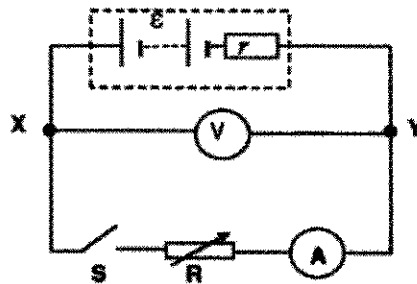
The readings obtained from the experiment are shown in the table below.

R (Ω)	0	2	4	6	8
$\frac{1}{I}$ (A⁻¹)	0,14	0,26	0,38	0,5	0,62

8.1 The equation used by the learners is:

$$R = \frac{\varepsilon}{I} - r$$

Use the data from the table to draw a graph of R verses $\frac{1}{I}$ ON THE GRAPH SHEET provided. (3)

8.2 What is the physical quantity represented by the slope of the graph? (1)

8.3 Use information from the graph to determine the value of the:
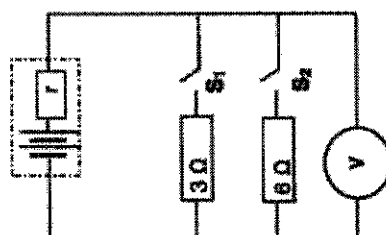
8.3.1 emf of the battery (3)

8.3.2 internal resistance of the battery (2)

8.4 The voltmeter across XY is replaced by a connecting wire of negligible resistance. Determine the current in the battery. (2)

[11]

QUESTION 9 (Start on a new page.)

In the circuit below, two resistors are connected in parallel, to a battery with an internal resistance r and a high resistance voltmeter.
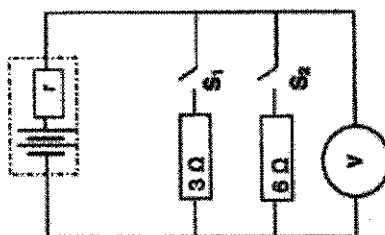

When S_2 is open and S_1 closed, the voltmeter reading is 12 V.
When S_2 is closed and S_1 open, the voltmeter reading is 16 V.

9.1   Write down Ohm's law in words.   (2)

9.2   Calculate the voltmeter reading when both switches:

        9.2.1 S_1 and S_2 are open   (5)

        9.2.2 S_1 and S_2 are closed   (6)
                                                                                          [13]

QUESTION 9 (Start on a new page.)

In the circuit below, two resistors are connected in parallel, to a battery with an internal resistance r and a high resistance voltmeter.
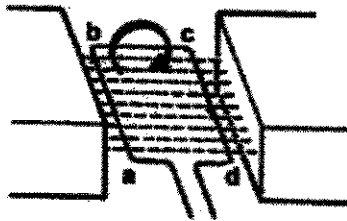

When S_2 is open and S_1 closed, the voltmeter reading is 12 V.
When S_2 is closed and S_1 open, the voltmeter reading is 16 V.

9.1   Write down Ohm's law in words.   (2)

9.2   Calculate the voltmeter reading when both switches:

      9.2.1 S_1 and S_2 are open   (5)

      9.2.2 S_1 and S_2 are closed   (6)
   **[13]**

QUESTION 10 (Start on a new page.)

Consider the following simplified diagram of a portion of an AC generator.

10.1 What is the direction of the magnetic field if the direction of the current is as shown in the diagram? Write from LEFT TO RIGHT or RIGHT TO LEFT. (1)

10.2 How will the magnitude of the induced current in the coil change when the speed of rotation of the coil in the magnetic field is increased? Write INCREASES, DECREASES or STAYS THE SAME. (1)

10.3 What type of energy conversion takes place in the electric generator? (1)

The following figures (1, 2, 3, 4 and 5) represents one full clockwise rotation of the coil:
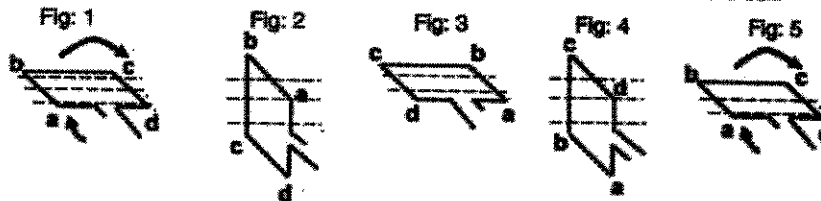
10.4 Draw a sketch graph of current verses time for one complete rotation of the coil. Show the position of the coil corresponding to the current values of 1, 2, 3, 4 and 5. (3)

10.5 A lamp of average power 20 W is connected to the output terminals of the generator mentioned above. The peak voltage produced by the generator is 12 V. Calculate the peak current through the lamp. (5)

[11]