



eduresourceza.com

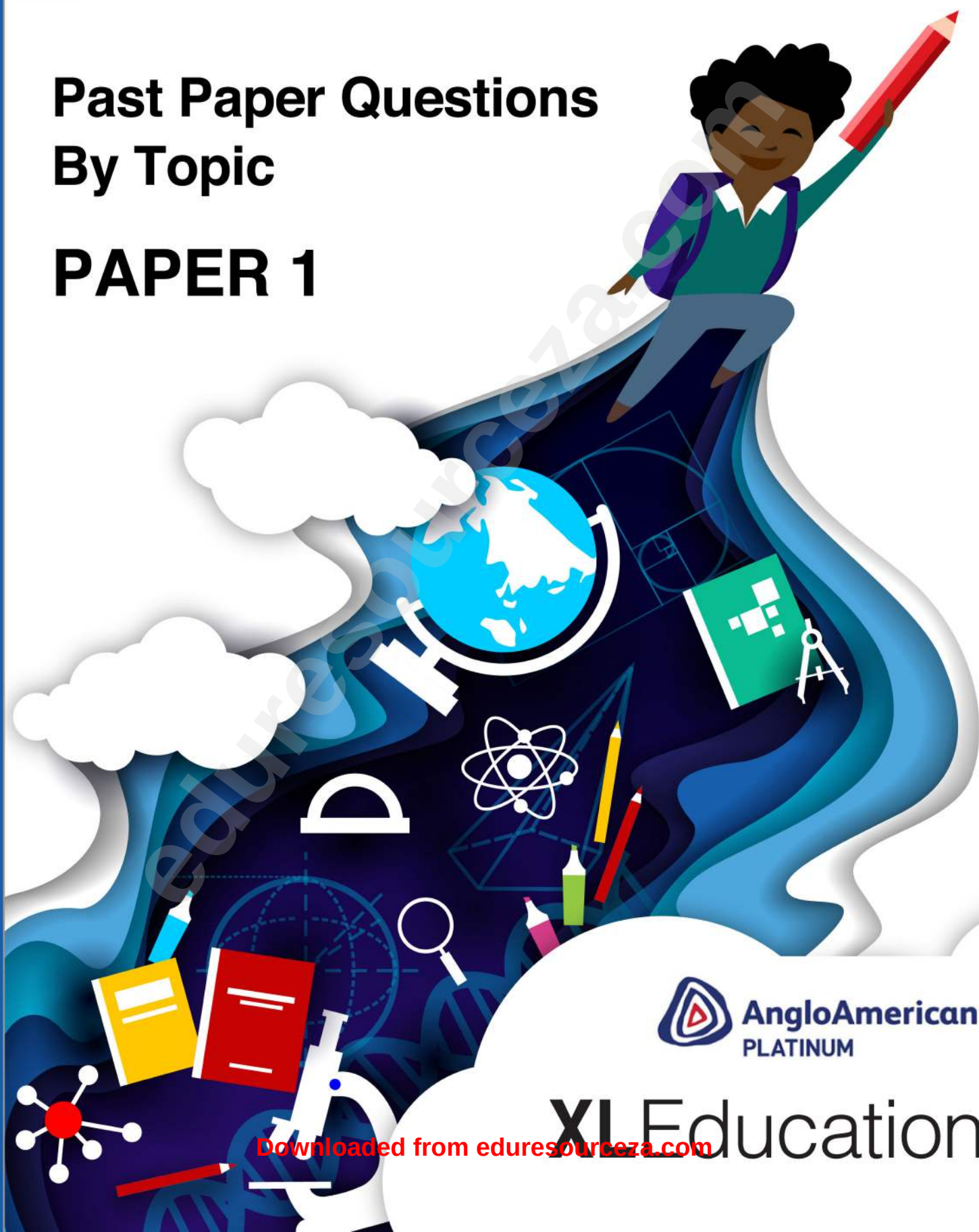
DBE

PHYSICAL SCIENCE

PAST PAPER BOOKLET 2020

**Past Paper Questions
By Topic**

PAPER 1



**AngloAmerican
PLATINUM**

XL Education

PAPER 1 QUESTIONS

Physical Science Past Paper Revision By Topic

Data Sheet

Exam Guidelines

- 1 Forces & Newton's Laws
- 10 Vertical Projectile Motion
- 17 Momentum & Impulse
- 23 Work, Energy & Power
- 30 Doppler Effect
- 34 Electrostatics
- 43 Electric Circuits
- 53 Electrodynamics
- 61 Optical Phenomena

Downloaded from eduresourceza.com
DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	$9,8 \text{ m} \cdot \text{s}^{-2}$
Universal gravitational constant <i>Universele gravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-2}$
Radius of the Earth <i>Radius van die Aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$
Mass of the Earth <i>Massa van die Aarde</i>	M_E	$5,98 \times 10^{24} \text{ kg}$
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Planck's constant <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J} \cdot \text{s}$
Coulomb's constant <i>Coulomb se konstante</i>	k	$9,0 \times 10^9 \text{ N} \cdot \text{m}^2 \cdot \text{C}^{-2}$
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$

Downloaded from eduresourceza.com

TABLE 2: FORMULAE/TABEL 2: FORMULES

MOTION/BEWEGING

$v_f = v_i + a \Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ or/of $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$

FORCE/KRAG

$F_{\text{net}} = ma$	$p = mv$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = F \Delta x \cos \theta$	$U = mgh$ or/of $E_p = mgh$
$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{ave}} = F v_{\text{ave}}$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_o + E_k$ where/waar $E = hf$ and/en $W_o = hf_o$ and/en $E_k = \frac{1}{2} mv^2$	

Downloaded from eduresourceza.com

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

$R = \frac{V}{I}$	emf (ϵ) = I(R + r) emk (ϵ) = I(R + r)
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/WISSELSTROOM

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{average} = V_{rms} I_{rms}$ / $P_{gemiddeld} = V_{wgk} I_{wgk}$ $P_{average} = I_{rms}^2 R$ / $P_{gemiddeld} = I_{wgk}^2 R$ $P_{average} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$
--	---

Downloaded from eduresourceza.com

3. ELABORATION OF THE CONTENT FOR GRADE 12 (CAPS)

The final examination in Physical Sciences will cover the topics outlined below.

3.1 Paper 1: Physics

Newton's laws and application of Newton's laws

(This section must be read in conjunction with the CAPS, p. 62–66.)

Different kinds of forces: weight, normal force, frictional force, applied force (push, pull), tension (strings or cables)

- Define *normal force*, N , as the force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface.
- Define *frictional force*, f , as the force that opposes the motion of an object and which acts parallel to the surface.
Define *static frictional force*, f_s , as the force that opposes the tendency of motion of a stationary object relative to a surface.
Define *kinetic frictional force*, f_k , as the force that opposes the motion of a moving object relative to a surface.
Know that a frictional force:
 - Is proportional to the normal force
 - Is independent of the area of contact
 - Is independent of the velocity of motion
- Solve problems using $f_s^{\max} = \mu_s N$ where $f_s^{\max}$ is the maximum static frictional force and μ_s is the coefficient of static friction.
NOTE:
 - If a force, F , applied to a body parallel to the surface does not cause the object to move, F is equal in magnitude to the static frictional force.
 - The static frictional force is a maximum ($f_s^{\max}$) just before the object starts to move across the surface.
 - If the applied force exceeds $f_s^{\max}$, a resultant (net) force accelerates the object.
- Solve problems using $f_k = \mu_k N$, where f_k is the kinetic frictional force and μ_k the coefficient of kinetic friction.

Force diagrams, free-body diagrams

- Draw force diagrams.
- Draw free-body diagrams. (This is a diagram that shows the relative magnitudes and directions of forces acting on a body/particle that has been isolated from its surroundings)
- Resolve a two-dimensional force (such as the weight of an object on an inclined plane) into its parallel (x) and perpendicular (y) components.
- Determine the resultant/net force of two or more forces.

Newton's first, second and third laws of motion

- State Newton's first law of motion: A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it.
- Discuss why it is important to wear seatbelts using Newton's first law of motion.
- State Newton's second law of motion: When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force and inversely proportional to the mass of the object.
- Draw force diagrams and free-body diagrams for objects that are in equilibrium or accelerating.

Downloaded from eduresourceza.com

- Apply Newton's laws of motion to a variety of equilibrium and non-equilibrium problems including:
 - A single object:
 - Moving on a horizontal plane with or without friction
 - Moving on an inclined plane with or without friction
 - Moving in the vertical plane (lifts, rockets, etc.)
 - Two-body systems (joined by a light inextensible string):
 - Both on a flat horizontal plane with or without friction
 - One on a horizontal plane with or without friction, and a second hanging vertically from a string over a frictionless pulley
 - Both on an inclined plane with or without friction
 - Both hanging vertically from a string over a frictionless pulley
- State Newton's third law of motion: When one body exerts a force on a second body, the second body exerts a force of equal magnitude in the opposite direction on the first body.
- Identify action-reaction pairs.
- List the properties of action-reaction pairs.

Newton's Law of Universal Gravitation

- State Newton's Law of Universal Gravitation: Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.
- Solve problems using $F = \frac{Gm_1m_2}{r^2}$.
- Calculate acceleration due to gravity on a planet using $g = \frac{Gm}{r^2}$.
- Describe *weight* as the gravitational force the Earth exerts on any object on or near its surface.
- Calculate weight using the expression $w = mg$.
- Calculate the weight of an object on other planets with different values of gravitational acceleration.
- Distinguish between *mass* and *weight*.
- Explain *weightlessness*.

Downloaded from eduresourceza.com

Momentum and Impulse

(This section must be read in conjunction with the CAPS, p. 99–101.)

Momentum

- Define *momentum* as the product of an object's mass and its velocity.
- Describe the *linear momentum* of an object as a vector quantity with the same direction as the velocity of the object.
- Calculate the momentum of a moving object using $p = mv$.
- Describe the *vector nature of momentum* and illustrate it with some simple examples.
- Draw vector diagrams to illustrate the relationship between the initial momentum, the final momentum and the change in momentum for each of the above examples.

Newton's second law of motion in terms of momentum

- State Newton's second law of motion in terms of momentum: The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.
- Express Newton's second law of motion in symbols: $F_{\text{net}} = \frac{\Delta p}{\Delta t}$.
- Calculate the change in momentum when a resultant/net force acts on an object and its velocity:
 - Increases in the direction of motion, e.g. 2nd stage rocket engine fires
 - Decreases, e.g. brakes are applied
 - Reverses its direction of motion, e.g. a soccer ball kicked back in the direction it came from

Impulse

- Define *impulse* as the product of the resultant/net force acting on an object and the time the resultant/net force acts on the object.
- Deduce the impulse-momentum theorem: $F_{\text{net}}\Delta t = m\Delta v$.
- Use the impulse-momentum theorem to calculate the force exerted, the time for which the force is applied and the change in momentum for a variety of situations involving the motion of an object in one dimension.
- Explain how the concept of impulse applies to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds.

Conservation of momentum and elastic and inelastic collisions

- Explain what is meant by a *closed/an isolated system* (in Physics), i.e. a system on which the resultant/net external force is zero.
A closed/an isolated system excludes external forces that originate outside the colliding bodies, e.g. friction. Only internal forces, e.g. contact forces between the colliding objects, are considered.
- State the principle of conservation of linear momentum: The total linear momentum of a closed system remains constant (is conserved).
- Apply the conservation of momentum to the collision of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention.
- Distinguish between *elastic collisions* and *inelastic collisions* by calculation.

Vertical Projectile Motion Downloaded from eduresourceza.com

(This section must be read in conjunction with the CAPS, p. 102–103.)

- Explain what is meant by a *projectile*, i.e. an object upon which the only force acting is the force of gravity.
- Use equations of motion to determine the position, velocity and displacement of a projectile at any given time.
- Sketch position versus time (x vs. t), velocity versus time (v vs. t) and acceleration versus time (a vs. t) graphs for:
 - A free-falling object
 - An object thrown vertically upwards
 - An object thrown vertically downwards
 - Bouncing objects (restricted to balls)
- For a given x vs. t , v vs. t or a vs. t graph, determine:
 - Position
 - Displacement
 - Velocity or acceleration at any time t
- For a given x vs. t , v vs. t or a vs. t graph, describe the motion of the object:
 - Bouncing
 - Thrown vertically upwards
 - Thrown vertically downward

Work, Energy and Power

(This section must be read in conjunction with the CAPS, p. 117–120.)

Work

- Define the work done on an object by a constant force F as $F \Delta x \cos \theta$, where F is the magnitude of the force, Δx the magnitude of the displacement and θ the angle between the force and the displacement. (Work is done by a force on an object – the use of 'work is done against a force', e.g. work done against friction, should be avoided.)
- Draw a force diagram and free-body diagrams.
- Calculate the net/total work done on an object.
- Distinguish between *positive net/total work done* and *negative net/total work done* on the system.

Work-energy theorem

- State the work-energy theorem: The net/total work done on an object is equal to the change in the object's kinetic energy OR the work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.
In symbols: $W_{\text{net}} = \Delta K = K_f - K_i$.
- Apply the work-energy theorem to objects on horizontal, vertical and inclined planes (for both frictionless and rough surfaces).

Conservation of energy with non-conservative forces present

- Define a *conservative force* as a force for which the work done in moving an object between two points is independent of the path taken. Examples are gravitational force, the elastic force in a spring and electrostatic forces (coulomb forces).
- Define a *non-conservative force* as a force for which the work done in moving an object between two points depends on the path taken. Examples are frictional force, air resistance, tension in a chord, etc.
- State the principle of conservation of mechanical energy: The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. (A system is isolated when the resultant/net external force acting on the system is zero.)
- Solve conservation of energy problems using the equation: $W_{\text{nc}} = \Delta E_k + \Delta E_p$
- Use the relationship above to show that in the absence of non-conservative forces, mechanical energy is conserved.

Power

Downloaded from eduresourceza.com

- Define *power* as the rate at which work is done or energy is expended.
In symbols: $P = \frac{W}{\Delta t}$
- Calculate the power involved when work is done.
- Perform calculations using $P_{\text{ave}} = Fv_{\text{ave}}$ when an object moves at a constant speed along a rough horizontal surface or a rough inclined plane.
- Calculate the power output for a pump lifting a mass (e.g. lifting water through a height at constant speed).

Doppler Effect (relative motion between source and observer)

(This section must be read in conjunction with the CAPS, p. 121–122.)

With sound and ultrasound

- State the Doppler effect as the change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation.
- Explain (using appropriate illustrations) the change in pitch observed when a source moves toward or away from a listener.
- Solve problems using the equation $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ when EITHER the source or the listener is moving.
- State applications of the Doppler effect.

With light – red shifts in the universe (evidence for the expanding universe)

- Explain *red shifts* and *blue shifts* using the Doppler Effect.
- Use the Doppler effect to explain why we conclude that the universe is expanding.

Electrostatics

(This section must be read in conjunction with the CAPS, p. 84–85.)

Coulomb's law

- State Coulomb's law: The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them:
- Solve problems using the equation $F = \frac{kQ_1Q_2}{r^2}$ for charges in one dimension (1D) (restrict to three charges).
- Solve problems using the equation $F = \frac{kQ_1Q_2}{r^2}$ for charges in two dimensions (2D) – for three charges in a right-angled formation (limit to charges at the 'vertices of a right-angled triangle').

Electric field

- Describe an *electric field* as a region of space in which an electric charge experiences a force. The direction of the electric field at a point is the direction that a positive test charge would move if placed at that point.
- Draw electric field patterns for the following configurations:
 - A single point charge
 - Two point charges (one negative, one positive OR both positive OR both negative)
 - A charged sphere

NOTE: Restrict to situations in which the charges are identical in magnitude.

- Define the *electric field* as a vector field in which a positive charge experiences an electrostatic force experienced per unit positive charge placed at that point. In symbols: $E = \frac{F}{q}$.
- Solve problems using the equation $E = \frac{F}{q}$.
- Calculate the electric field at a point due to a number of point charges, using the equation $E = \frac{kQ}{r^2}$ to determine the contribution to the field due to each charge. Restrict to three charges in a straight line.

Electric Circuits

(This section must be read in conjunction with the CAPS, p. 88–89 & 121.)

Ohm's law

- State Ohm's law in words: The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.
- Determine the relationship between current, potential difference and resistance at constant temperature using a simple circuit.
- State the difference between *ohmic conductors* and *non-ohmic conductors* and give an example of each.
- Solve problems using $R = \frac{V}{I}$ for series and parallel circuits (maximum four resistors).

Power, energy

- Define *power* as the rate at which work is done.
- Solve problems using $P = \frac{W}{\Delta t}$.
- Solve problems using $P = VI$, $P = I^2R$ or $P = \frac{V^2}{R}$.
- Solve circuit problems involving the concepts of power and electrical energy.
- Deduce that the kilowatt hour (kWh) refers to the use of 1 kilowatt of electricity for 1 hour.
- Calculate the cost of electricity usage given the power specifications of the appliances used, the duration and the cost of 1 kWh.

Internal resistance, series and parallel networks

- Solve problems involving current, voltage and resistance for circuits containing arrangements of resistors in series and in parallel (maximum four resistors).
- Explain the term *internal resistance*.
- Solve circuit problems using $\varepsilon = V_{\text{load}} + V_{\text{internal resistance}}$ or $\varepsilon = IR_{\text{ext}} + Ir$.
- Solve circuit problems, with internal resistance, involving series-parallel networks of resistors (maximum four resistors).

Electrodynamics

(This section must be read in conjunction with the CAPS, p. 130–131.)

Electrical machines (generators, motors)

- State the energy conversion in generators.
- Use the principle of electromagnetic induction to explain how a generator works.
- Explain the functions of the components of an AC and a DC generator.
- State examples of the uses of AC and DC generators.
- State the energy conversion in motors.

- Use the motor effect to explain how a motor works.
- Explain the functions of the components of a motor.
- State examples of the use of motors.

Alternating current

- State the advantages of alternating current over direct current.
- Sketch graphs of voltage versus time and current versus time for an AC circuit.
- Define the term *rms* for an alternating voltage or an alternating current. The rms value of AC is the DC potential difference/current which dissipates the same amount of energy as AC.
- Solve problems using $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$, $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$.
- Solve problems using $P_{\text{ave}} = I_{\text{rms}} V_{\text{rms}} = \frac{1}{2} I_{\text{max}} V_{\text{max}}$ (for a purely resistive circuit),
 $P_{\text{ave}} = I_{\text{rms}}^2 R$ and $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$.

Optical Phenomena and Properties of Materials

(This section must be read in conjunction with the CAPS, p. 132–133.)

Photo-electric effect

- Describe the *photoelectric effect* as the process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface.
- State the significance of the photoelectric effect.
- Define *threshold frequency*, f_0 , as the minimum frequency of light needed to emit electrons from a certain metal surface.
- Define *work function*, W_0 , as the minimum energy that an electron in the metal needs to be emitted from the metal surface.
- Perform calculations using the photoelectric equation:
 $E = W_0 + K_{\text{max}}$, where $E = hf$ and $W_0 = hf_0$ and $K_{\text{max}} = \frac{1}{2}mv_{\text{max}}^2$
- Explain the effect of intensity and frequency on the photoelectric effect.

Emission and absorption spectra

- Explain the *formation of atomic spectra* by referring to energy transition.
- Explain the difference between *atomic absorption spectra* and *atomic emission spectra*.
 An atomic absorption spectrum is formed when certain frequencies of electromagnetic radiation that passes through a medium, e.g. a cold gas, is absorbed.
 An atomic emission spectrum is formed when certain frequencies of electromagnetic radiation are emitted due to an atom's electrons making a transition from a high-energy state to a lower energy state.

Newton's Laws

Downloaded from eduresourceza.com

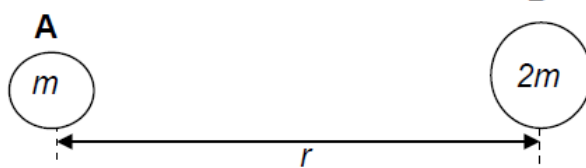
Multiple Choice Questions

- 1.1 Which ONE of the following physical quantities is a measure of the inertia of a body?
- A Mass
 - B Energy
 - C Velocity
 - D Acceleration
- (Nov 2014) (2)
- 1.2 The magnitude of the gravitational force exerted by one body on another body is F . When the distance between the centres of the two bodies is doubled, the magnitude of the gravitational force, in terms of F , will now be ...
- A $\frac{1}{4}F$
 - B $\frac{1}{2}F$
 - C $2F$
 - D $4F$
- (Nov 2014) (2)
- 1.3 Two balls, **P** and **Q**, are dropped simultaneously from the same height. Ball **P** has TWICE the mass of ball **Q**. Ignore the effects of air friction.
- Just before the balls hit the ground, the kinetic energy of ball **P** is x . The kinetic energy of ball **Q**, in terms of x , will be ...
- A $\frac{1}{4}x$
 - B $\frac{1}{2}x$
 - C x
 - D $2x$
- (Nov 2014) (2)
- 1.4 Which ONE of the following forces always acts perpendicular to the surface on which a body is placed?
- A Normal force
 - B Frictional force
 - C Gravitational force
 - D Tension force
- (Feb 2015) (2)

Downloaded from eduresourceza.com

- 1.5 Two isolated bodies, **A** and **B**, having masses m and $2m$ respectively, are placed a distance r apart.

Downloaded from eduresourceza.com



Consider the following statements regarding the gravitational force exerted by the bodies on each other.

- (i) The force exerted by **B** on body **A** is half that exerted by **A** on body **B**.
- (ii) The force exerted on the bodies is independent of the masses of the bodies.
- (iii) The force exerted on body **A** by **B** is equal but opposite to that exerted on body **B** by **A**.
- (iv) The forces will always be attractive.

Which of the statements above is/are TRUE?

- A (i), (ii) and (iv) only
- B (ii), (iii) and (iv) only
- C (iii) and (iv) only
- D (iv) only

(Feb 2015) (2)

- 1.6 A person stands on a bathroom scale that is calibrated in newton, in a stationary elevator. The reading on the bathroom scale is W .

The elevator now moves with a constant upward acceleration of $\frac{1}{4}g$, where g is the gravitational acceleration.

What will the reading on the bathroom scale be now?

- A $\frac{1}{4}W$
- B $\frac{3}{4}W$
- C W
- D $\frac{5}{4}W$

(Nov 2015) (2)

Downloaded from eduresourceza.com

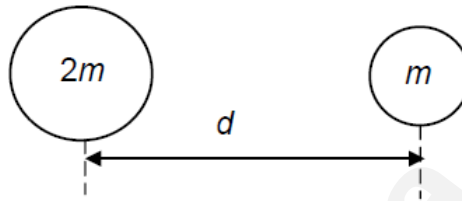
Newton's Laws

- 1.7 A net force $\mathbf{F}$ which acts on a body of mass m causes an acceleration a . If the same net force $\mathbf{F}$ is applied to a body of mass $2m$, the acceleration of the body will be ..**Downloaded from eduresourceza.com**

A $\frac{1}{4}a$
B $\frac{1}{2}a$
C $2a$
D $4a$

(Feb 2016) (2)

- 1.8 Two objects of masses $2m$ and m are arranged as shown in the diagram below.

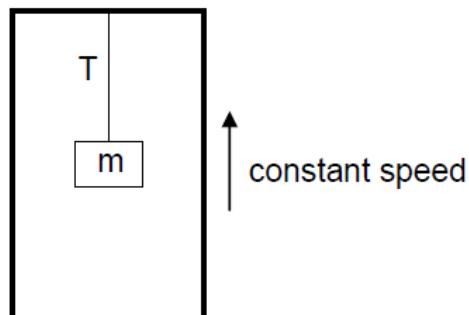


Which ONE of the changes below will produce the GREATEST increase in the gravitational force exerted by the one mass on the other?

A Double the larger mass.
B Halve the smaller mass.
C Double the distance between the masses.
D Halve the distance between the masses.

(Feb 2016) (2)

- 1.9 An object, of mass m , hangs at the end of a string from the ceiling of a lift cage. The lift is moving upward at CONSTANT SPEED. The acceleration due to gravity is g .



Which ONE of the following statements regarding the tension (T) in the string is CORRECT?

Downloaded from eduresourceza.com

The tension T ...

- A will be equal to mg .
 - B will be less than mg .
 - C will be greater than mg .
 - D cannot be determined without knowing the speed of the lift cage. (2)
- (June 2016)

- 1.10 Two hypothetical planets, X and Y, have the same mass. The diameter of planet Y is twice that of planet X.

If the acceleration due to gravity on the surface of planet X is g , then the acceleration due to gravity on the surface of planet Y will be ...

- A $\frac{g}{16}$
- B $\frac{g}{4}$
- C $\frac{g}{2}$
- D $2g$ (June 2016) (2)

- 1.11 The tendency of an object to remain at rest or to continue in its uniform motion in a straight line is known as ...

- A inertia.
- B acceleration.
- C Newton's Third Law.
- D Newton's Second Law. (Nov 2016) (2)

- 1.12 The mass of an astronaut on Earth is M . At a height equal to twice the radius of the Earth, the **mass** of the astronaut will be ...

- A $\frac{1}{4}M$
- B $\frac{1}{9}M$
- C M
- D $2M$ (Nov 2016) (2)

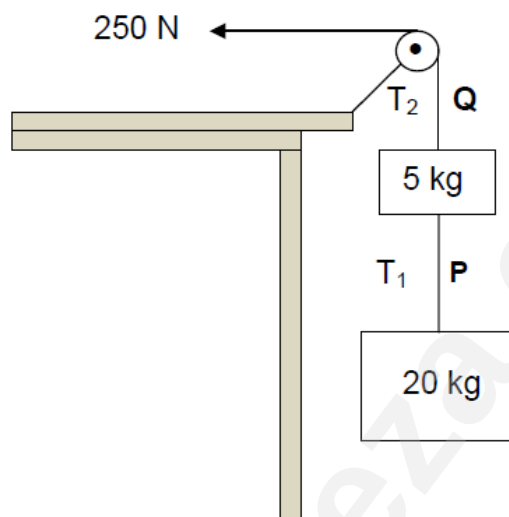
Downloaded from eduresourceza.com

Long Questions

QUESTION 2 (Start on a new page.)

(Nov 2014)

Two blocks of masses 20 kg and 5 kg respectively are connected by a light inextensible string, **P**. A second light inextensible string, **Q**, attached to the 5 kg block, runs over a light frictionless pulley. A constant horizontal force of 250 N pulls the second string as shown in the diagram below. The magnitudes of the tensions in **P** and **Q** are T_1 and T_2 respectively. Ignore the effects of air friction.



- 2.1 State Newton's Second Law of Motion in words. (2)
- 2.2 Draw a labelled free-body diagram indicating ALL the forces acting on the 5 kg block. (3)
- 2.3 Calculate the magnitude of the tension T_1 in string **P**. (6)
- 2.4 When the 250 N force is replaced by a sharp pull on the string, one of the two strings break. (1)

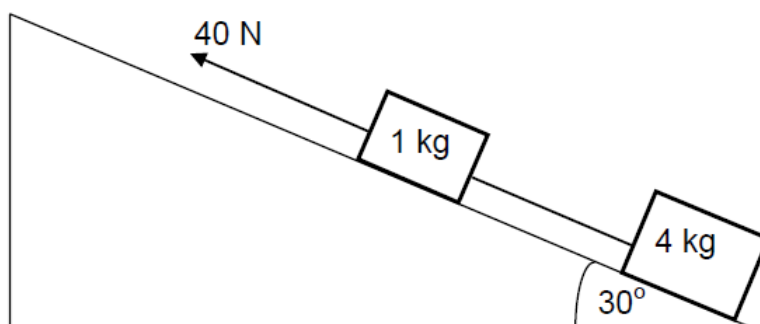
Which ONE of the two strings, **P** or **Q**, will break?

(1)
[12]

QUESTION 2 (Start on a new page.)

(Feb 2015)

A block of mass 1 kg is connected to another block of mass 4 kg by a light inextensible string. The system is pulled up a rough plane inclined at 30° to the horizontal, by means of a constant 40 N force parallel to the plane as shown in the diagram below.



Downloaded from eduresourceza.com

Newton's Laws

The magnitude of the kinetic frictional force between the surface and the 4 kg block is 10 N. The coefficient of kinetic friction between the 1 kg block and the surface is 0,29.

Downloaded from eduresourceza.com

2.1 State Newton's third law in words. (2)

2.2 Draw a labelled free-body diagram showing ALL the forces acting on the 1 kg block as it moves up the incline. (5)

2.3 Calculate the magnitude of the:

2.3.1 Kinetic frictional force between the 1 kg block and the surface (3)

2.3.2 Tension in the string connecting the two blocks (6)

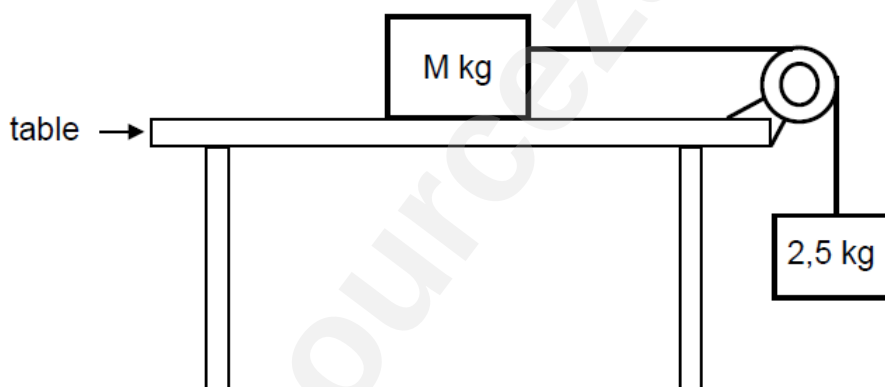
[16]

QUESTION 2 (Start on a new page.)

(Nov 2015)

2.1 Two blocks of mass M kg and 2,5 kg respectively are connected by a light, inextensible string. The string runs over a light, frictionless pulley, as shown in the diagram below.

The blocks are **stationary**.



2.1.1 State Newton's THIRD law in words. (2)

2.1.2 Calculate the tension in the string. (3)

The coefficient of static friction (μ_s) between the unknown mass M and the surface of the table is 0,2.

2.1.3 Calculate the minimum value of M that will prevent the blocks from moving. (5)

The block of unknown mass M is now replaced with a block of mass 5 kg. The 2,5 kg block now accelerates downwards. The coefficient of kinetic friction (μ_k) between the 5 kg block and the surface of the table is 0,15.

2.1.4 Calculate the magnitude of the acceleration of the 5 kg block. (5)

2.2 A small hypothetical planet X has a mass of $6,5 \times 10^{20}$ kg and a radius of 550 km.

Calculate the gravitational force (weight) that planet X exerts on a 90 kg rock on this planet's surface.

Downloaded from eduresourceza.com

(4)

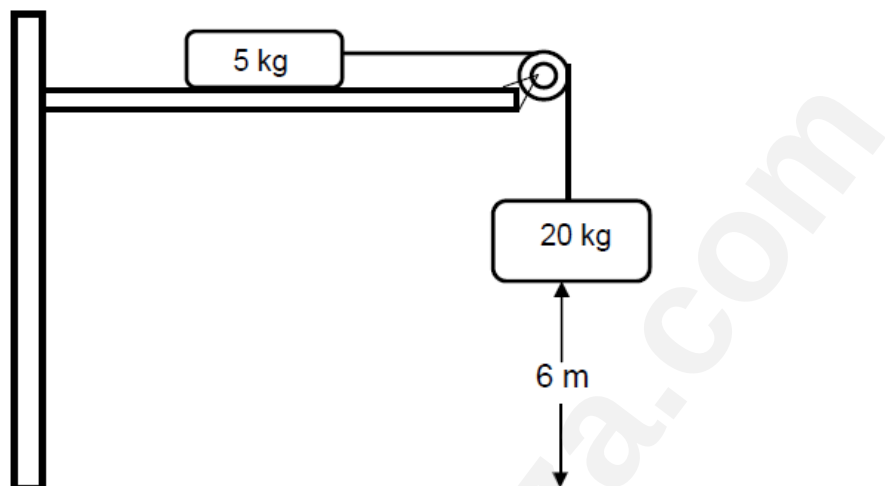
[19]

QUESTION 2 (Start on a new page.)

(Feb 2016)

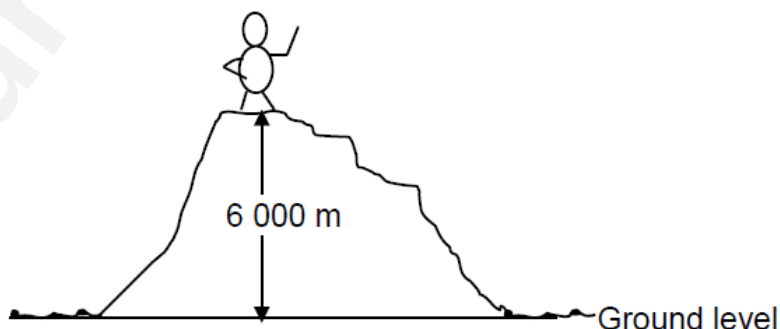
- 2.1 A 5 kg mass and a 20 kg mass are connected by a light inextensible string which passes over a light frictionless pulley. Initially, the 5 kg mass is held stationary on a horizontal surface, while the 20 kg mass hangs vertically downwards, 6 m above the ground, as shown in the diagram below.

The diagram is not drawn to scale.



When the *stationary* 5 kg mass is released, the two masses begin to move. The coefficient of kinetic friction, μ_k , between the 5 kg mass and the horizontal surface is 0,4. Ignore the effects of air friction.

- 2.1.1 Calculate the acceleration of the 20 kg mass. (5)
- 2.1.2 Calculate the speed of the 20 kg mass as it strikes the ground. (4)
- 2.1.3 At what minimum distance from the pulley should the 5 kg mass be placed initially, so that the 20 kg mass just strikes the ground? (1)
- 2.2 A person of mass 60 kg climbs to the top of a mountain which is 6 000 m above ground level.



- 2.2.1 State Newton's Law of Universal Gravitation in words. (2)
- 2.2.2 Calculate the *difference* in the weight of the climber at the top of the mountain and at ground level. (6)

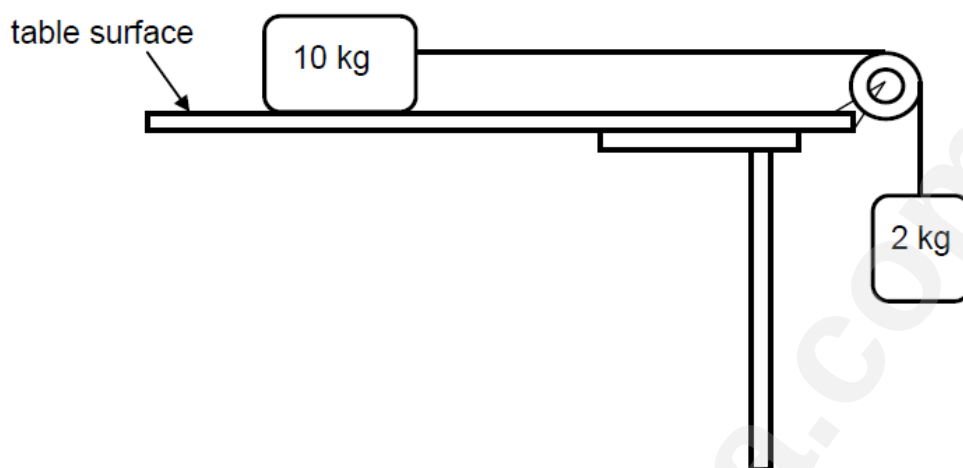
[18]

QUESTION 2 (Start on a new page.)

(June 2016)

The diagram below shows a 10 kg block lying on a horizontal surface of a table. The block is connected by a light, inextensible string to a 2 kg block hanging over the side of the table. The string runs over a light, frictionless pulley.

The blocks are **stationary**.



- 2.1 State Newton's FIRST law in words. (2)
- 2.2 Write down the magnitude of the NET force acting on the 10 kg block. (1)

When a 15 N force is applied vertically downwards on the 2 kg block, the 10 kg block accelerates to the right at $1,2 \text{ m} \cdot \text{s}^{-2}$.

- 2.3 Draw a free-body diagram for the 2 kg block when the 15 N force is applied to it. (3)
- 2.4 Calculate the coefficient of kinetic friction between the 10 kg block and the surface of the table. (7)
- 2.5 How does the value, calculated in QUESTION 2.4, compare with the value of the coefficient of STATIC friction for the 10 kg block and the table? Write down only LARGER THAN, SMALLER THAN or EQUAL TO. (1)
- 2.6 If the 10 kg block had a larger surface area in contact with the surface of the table, how would this affect the coefficient of kinetic friction calculated in QUESTION 2.4? Assume that the rest of the system remains unchanged. Write down only INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)

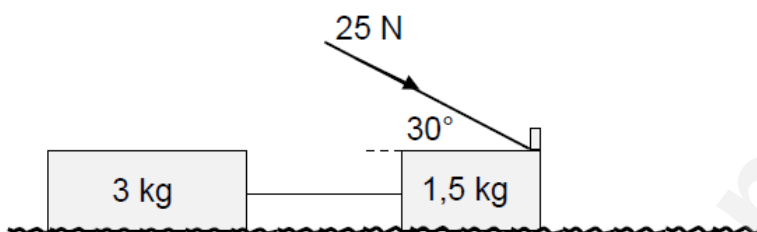
[16]

QUESTION 2 (Start on a new page.)

(Nov 2016)

A learner constructs a push toy using two blocks with masses 1,5 kg and 3 kg respectively. The blocks are connected by a massless, inextensible cord.

The learner then applies a force of 25 N at an angle of 30° to the 1,5 kg block by means of a light rigid rod, causing the toy to move across a flat, rough, horizontal surface, as shown in the diagram below.



The coefficient of kinetic friction (μ_k) between the surface and each block is 0,15.

- 2.1 State Newton's Second Law of Motion in words. (2)
- 2.2 Calculate the magnitude of the kinetic frictional force acting on the 3 kg block. (3)
- 2.3 Draw a labelled free-body diagram showing ALL the forces acting on the 1,5 kg block. (5)
- 2.4 Calculate the magnitude of the:
 - 2.4.1 Kinetic frictional force acting on the 1,5 kg block (3)
 - 2.4.2 Tension in the cord connecting the two blocks (5)

[18]

Vertical Projectile Motion

Downloaded from eduresourceza.com

Multiple Choice Questions

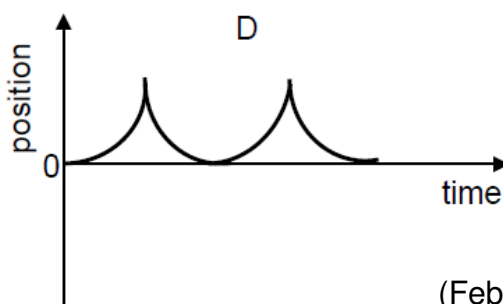
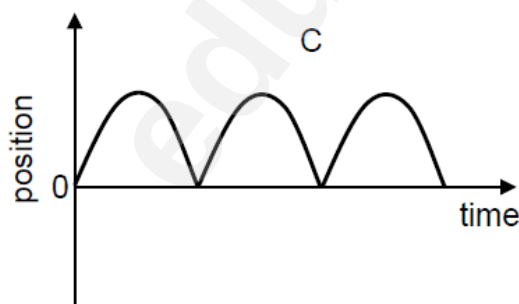
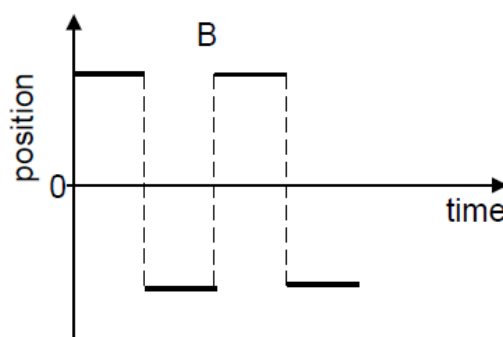
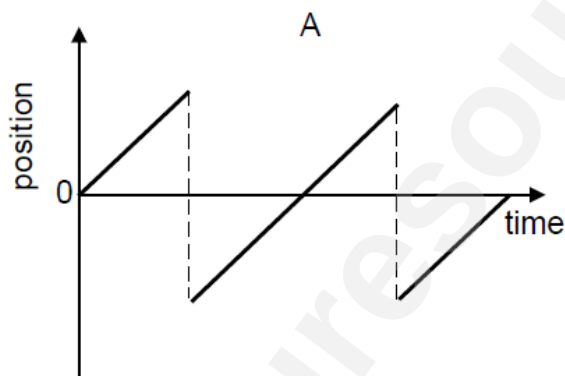
- 1.1 An object is thrown vertically upwards. Which ONE of the following regarding the object's velocity and acceleration at the highest point of its motion is CORRECT? Ignore the effects of friction.

	VELOCITY	ACCELERATION
A	Zero	Zero
B	Zero	Upwards
C	Maximum	Zero
D	Zero	Downwards

(Nov 2014) (2)

- 1.2 A ball is released from a height above the floor. The ball falls vertically and bounces off the floor a number of times. Ignore the effects of friction and assume that the collision of the ball with the floor is elastic. Take the point of release of the ball as the reference point and downward direction as positive.

Which ONE of the following is a CORRECT representation of the position-time graph for the motion of the ball?

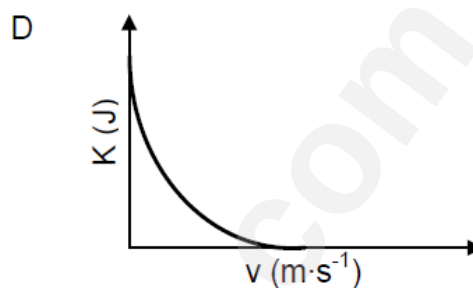
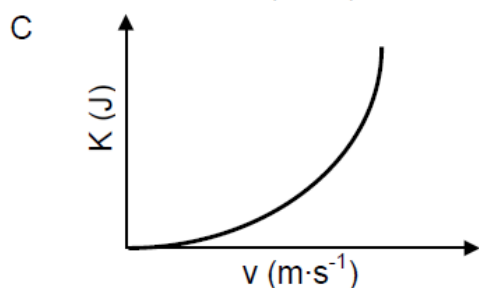
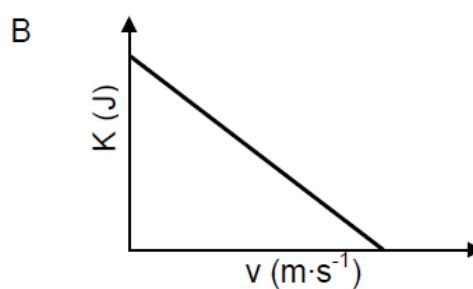
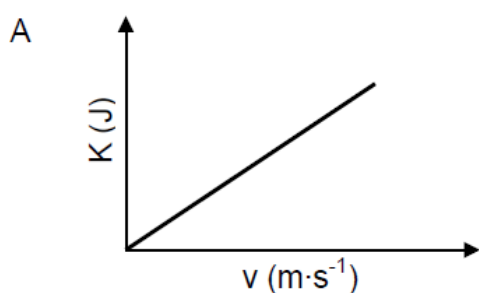


(Feb 2015) (2)

Downloaded from eduresourceza.com

Vertical Projectile Motion

- 1.3 Which ONE of the graphs below correctly represents the relationship between the kinetic energy (K) of a free-falling object and its speed (v)?



(Nov 2015) (2)

- 1.4 The statements below describe the motion of objects.

- (i) A feather falls from a certain height inside a vacuum tube.
- (ii) A box slides along a smooth horizontal surface at constant speed.
- (iii) A steel ball falls through the air in the absence of air friction.

Which of the following describes UNIFORMLY ACCELERATED motion CORRECTLY?

- A (i) and (ii) only
- B (i) and (iii) only
- C (ii) and (iii) only
- D (i), (ii) and (iii)

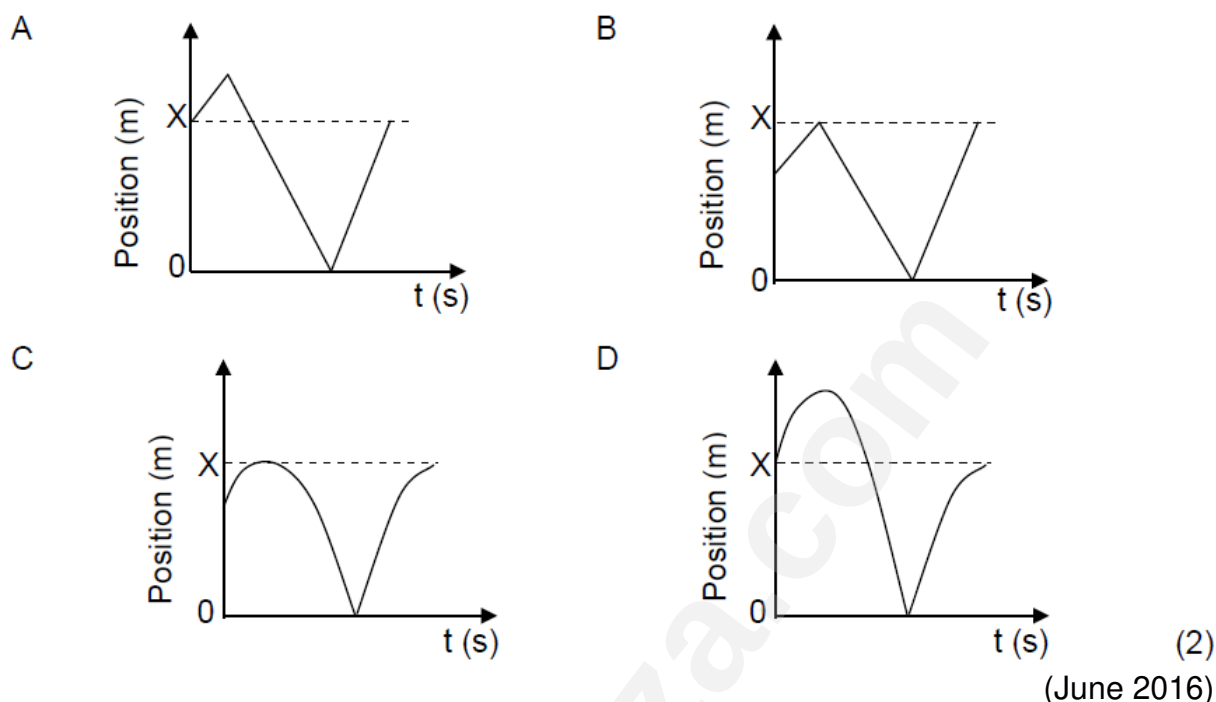
(Feb 2016) (2)

- 1.5 A ball is projected vertically upwards from a height X above the ground. After some time, the ball falls to the ground and bounces back to the same height from which it was projected. Ignore friction and assume that there is a negligible time lapse during the collision of the ball with the ground.

Vertical Projectile Motion

Which ONE of the following is the CORRECT position-time graph for the motion of the ball as described above?

Downloaded from eduresourceza.com



1.6 An object is thrown vertically upwards from the ground.

Which ONE of the following is CORRECT regarding the direction of the acceleration of the object as it moves upwards and then downwards? Ignore the effects of air resistance.

	OBJECT MOVING UPWARDS	OBJECT MOVING DOWNWARDS
A	Downwards	Upwards
B	Upwards	Downwards
C	Downwards	Downwards
D	Upwards	Upwards

(2)
(Nov 2016)

Long Questions

QUESTION 3 (Start on a new page.)

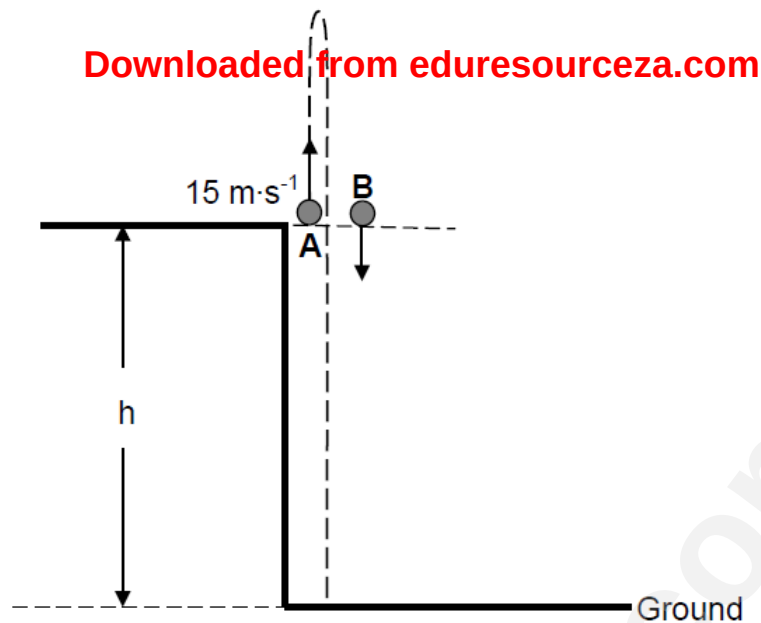
(Nov 2014)

A ball, **A**, is thrown vertically upward from a height, h , with a speed of $15 \text{ m}\cdot\text{s}^{-1}$. AT THE SAME INSTANT, a second identical ball, **B**, is dropped from the same height as ball **A** as shown in the diagram below.

Both balls undergo free fall and eventually hit the ground.

Downloaded from eduresourceza.com

Vertical Projectile Motion



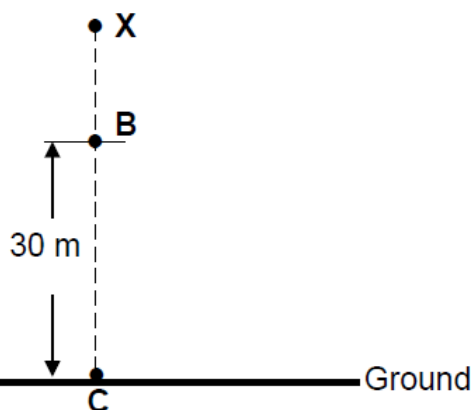
- 3.1 Explain the term *free fall*. (2)
- 3.2 Calculate the time it takes for ball **A** to return to its starting point. (4)
- 3.3 Calculate the distance between ball **A** and ball **B** when ball **A** is at its maximum height. (7)
- 3.4 Sketch a velocity-time graph in the ANSWER BOOK for the motion of ball **A** from the time it is projected until it hits the ground.
- Clearly show the following on your graph:
- The initial velocity
 - The time it takes to reach its maximum height
 - The time it takes to return to its starting point
- (4)

[17]

QUESTION 3 (Start on a new page.)

(Feb 2015)

An object is released from rest from a point **X**, above the ground as shown in the diagram below. It travels the last 30 m (**BC**) in 1,5 s before hitting the ground. Ignore the effects of air friction.



Downloaded from eduresourceza.com

Vertical Projectile Motion

- 3.1 Name the type of motion described above. (1)
- 3.2 Calculate the: **Downloaded from eduresourceza.com**
- 3.2.1 Magnitude of the velocity of the object at point **B** (4)
- 3.2.2 Height of point **X** above the ground (5)

After hitting the ground, the object bounces once and then comes to rest on the ground.

- 3.3 Sketch an acceleration-time graph for the entire motion of the object. (3)
[13]

QUESTION 3 (Start on a new page.)

(Nov 2015)

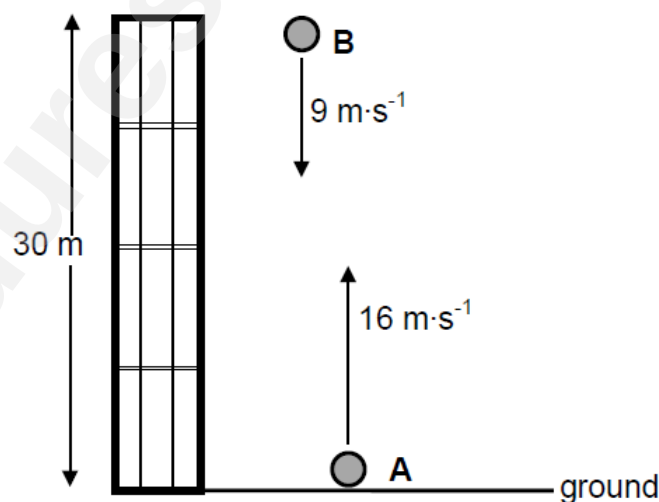
Ball **A** is projected vertically upwards at a velocity of $16 \text{ m}\cdot\text{s}^{-1}$ from the ground. Ignore the effects of air resistance. **Use the ground as zero reference.**

- 3.1 Calculate the time taken by ball **A** to return to the ground. (4)
- 3.2 Sketch a velocity-time graph for ball **A**.

Show the following on the graph:

- (a) Initial velocity of ball **A**
(b) Time taken to reach the highest point of the motion
(c) Time taken to return to the ground (3)

ONE SECOND after ball **A** is projected upwards, a second ball, **B**, is thrown vertically downwards at a velocity of $9 \text{ m}\cdot\text{s}^{-1}$ from a balcony 30 m above the ground. Refer to the diagram below.



- 3.3 Calculate how high above the ground ball **A** will be at the instant the two balls pass each other. (6)
[13]

QUESTION 3 (Start on a new page.)

(Feb 2016)

A man throws ball **A** downwards with a speed of 2 m s^{-1} from the edge of a window, 45 m above a dam of water. One second later he throws a second ball, ball **B**, downwards and observes that both balls strike the surface of the water in the dam at the same time. Ignore air friction.

3.1 Calculate the:

3.1.1 Speed with which ball **A** hits the surface of the water (3)3.1.2 Time it takes for ball **B** to hit the surface of the water (3)3.1.3 Initial velocity of ball **B** (5)3.2 On the same set of axes, sketch a velocity versus time graph for the motion of balls **A** and **B**. Clearly indicate the following on your graph:

- Initial velocities of both balls **A** and **B**
 - The time of release of ball **B**
 - The time taken by both balls to hit the surface of the water (5)
- [16]

QUESTION 3 (Start on a new page.)

(June 2016)

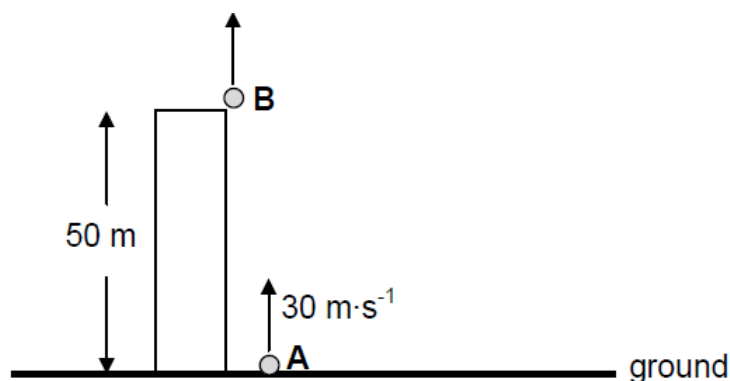
Ball **A** is projected vertically upwards from the ground, near a tall building, with a speed of 30 m s^{-1} . Ignore the effects of air friction.

3.1 Explain what is meant by a *projectile*. (2)

3.2 Calculate:

3.2.1 The total time that ball **A** will be in the air (4)3.2.2 The distance travelled by ball **A** during the last second of its fall (4)

3.3 TWO SECONDS after ball **A** is projected upwards, ball **B** is projected vertically upwards from the roof of the same building. The roof the building is 50 m above the ground. Both balls **A** and **B** reach the ground *at the same time*. Refer to the diagram below. Ignore the effects of air friction.

Calculate the speed with which ball **B** was projected upwards from the roof. (4)

Downloaded from eduresourceza.com

Vertical Projectile Motion

- 3.4 Sketch velocity-time graphs for the motion of both balls **A** and **B** on the *same* set of axes. Clearly label the graphs for balls **A** and **B** respectively.

Downloaded from eduresourceza.com

Indicate the following on the graphs:

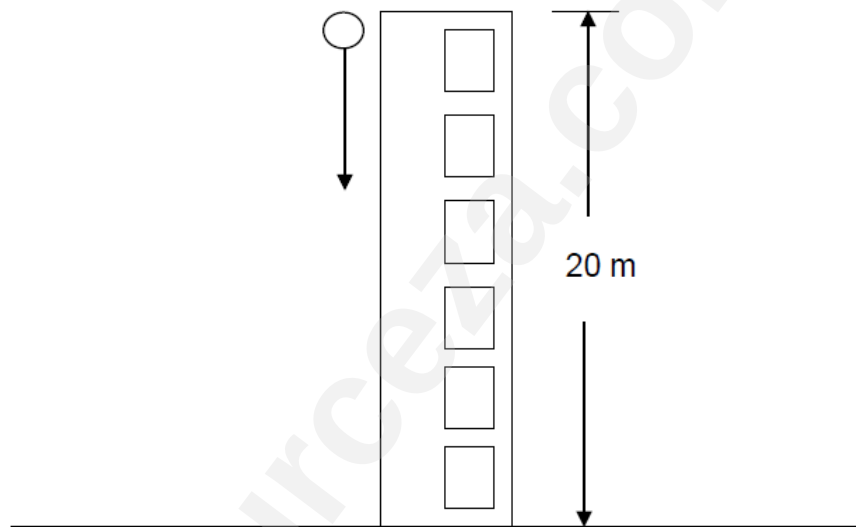
- (a) Time taken by both balls **A** and **B** to reach the ground
- (b) Time taken by ball **A** to reach its maximum height

(4)
[18]

QUESTION 3 (Start on a new page.)

(Nov 2016)

A ball is dropped from the top of a building 20 m high. Ignore the effects of air resistance.



- 3.1 Define the term *free fall*. (2)
- 3.2 Calculate the:
 - 3.2.1 Speed at which the ball hits the ground (4)
 - 3.2.2 Time it takes the ball to reach the ground (3)
- 3.3 Sketch a velocity-time graph for the motion of the ball (no values required). (2)

[11]

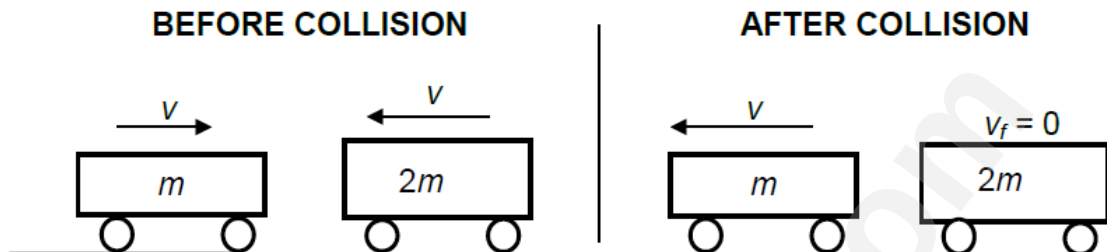
Downloaded from eduresourceza.com

Momentum and Impulse

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 An object of mass m moving at velocity v collides head-on with an object of mass $2m$ moving in the opposite direction at velocity v . Immediately after the collision the smaller mass moves at velocity v in the opposite direction and the larger mass is brought to rest. Refer to the diagram below.



Ignore the effects of friction.

Which ONE of the following is CORRECT?

	MOMENTUM	MECHANICAL ENERGY
A	Conserved	Conserved
B	Not conserved	Conserved
C	Conserved	Not conserved
D	Not conserved	Not conserved

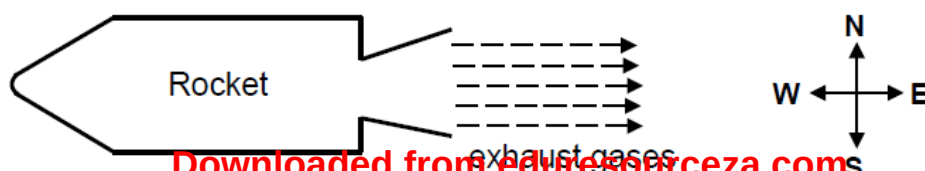
(Nov 2014) (2)

- 1.2 Two bodies undergo an INELASTIC collision in the absence of friction. Which ONE of the following combinations of momentum and kinetic energy of the system is CORRECT?

	MOMENTUM	KINETIC ENERGY
A	Not conserved	Conserved
B	Conserved	Not conserved
C	Not conserved	Not conserved
D	Conserved	Conserved

(Feb 2015) (2)

- 1.3 The simplified diagram below shows a rocket that has been fired horizontally, accelerating to the west.



Downloaded from eduresourceza.com

Momentum and Impulse

Which ONE of the statements below best explains why the rocket accelerates?

Downloaded from eduresourceza.com

- A The speed of the exhaust gases is smaller than the speed of the rocket.
- B The pressure of the atmosphere at the back of the rocket is less than at the front.
- C The air outside the rocket exerts a greater force on the back of the rocket than at the front.
- D The rocket pushes the exhaust gases to the east and the exhaust gases push the rocket to the west. (Nov 2015) (2)

1.4 Airbags in modern cars provide more safety during an accident.

The statements below are made by a learner to explain how airbags can ensure better safety in a collision.

- (i) The time of impact increases.
- (ii) The impact force decreases.
- (iii) The impulse increases.

Which of the statements above are CORRECT?

- A (i) only
- B (ii) only
- C (ii) and (iii) only
- D (i) and (ii) only (Feb 2016) (2)

1.5 Which ONE of the following statements is always TRUE for *inelastic collisions* in an isolated system?

- A Both momentum and kinetic energy are conserved.
- B Both momentum and kinetic energy are not conserved.
- C Momentum is conserved, but kinetic energy not.
- D Kinetic energy is conserved, but momentum not. (June 2016) (2)

Downloaded from eduresourceza.com

Momentum and Impulse

- 1.6 A person drops a glass bottle onto a concrete floor from a certain height and the bottle breaks. The person then drops a second, identical glass bottle from the same height onto a thick, woollen carpet, but the bottle does not break.

Which ONE of the following is CORRECT for the second bottle compared to the first bottle for the same momentum change?

	AVERAGE FORCE ON SECOND BOTTLE	TIME OF CONTACT WITH CARPET
A	Larger	Smaller
B	Smaller	Smaller
C	Larger	Larger
D	Smaller	Larger

(2)

(Nov 2016)

Long Questions

QUESTION 4 (Start on a new page.)

(Nov 2014)

Dancers have to learn many skills, including how to land correctly. A dancer of mass 50 kg leaps into the air and lands feet first on the ground. She lands on the ground with a velocity of 5 m s^{-1} . As she lands, she bends her knees and comes to a complete stop in 0,2 seconds.

- 4.1 Calculate the momentum with which the dancer reaches the ground. (3)
- 4.2 Define the term *impulse* of a force. (2)
- 4.3 Calculate the magnitude of the net force acting on the dancer as she lands. (3)

Assume that the dancer performs the same jump as before but lands without bending her knees.

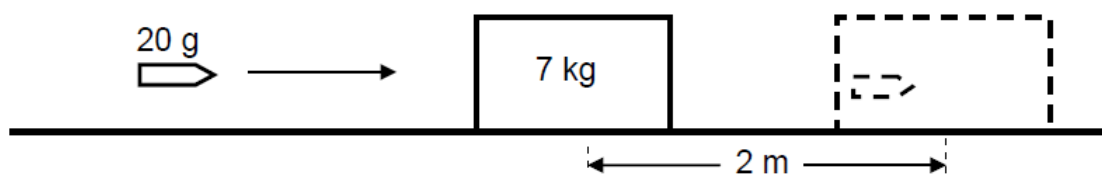
- 4.4 Will the force now be GREATER THAN, SMALLER THAN or EQUAL TO the force calculated in QUESTION 4.3? (1)
- 4.5 Give a reason for the answer to QUESTION 4.4. (3)

[12]

QUESTION 4 (Start on a new page.)

(Feb 2015)

The diagram below shows a bullet of mass 20 g that is travelling horizontally. The bullet strikes a stationary 7 kg block and becomes embedded in it. The bullet and block together travel on a rough horizontal surface a distance of 2 m before coming to a stop.



Momentum and Impulse

- 4.1 Use the work-energy theorem to calculate the magnitude of the velocity of the bullet-block system immediately after the bullet strikes the block, given that the frictional force between the block and surface is 10 N. (5)
- 4.2 State the *principle of conservation of linear momentum* in words. (2)
- 4.3 Calculate the magnitude of the velocity with which the bullet hits the block. (4)
- [11]

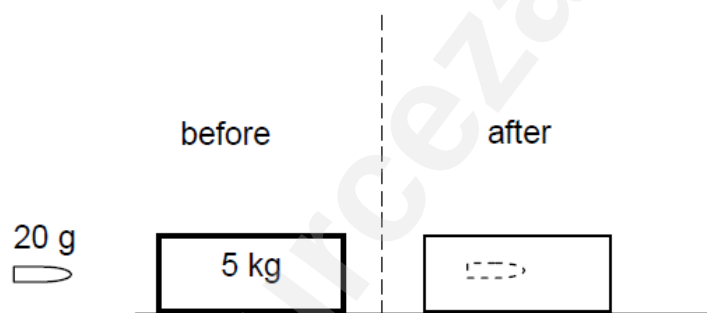
QUESTION 4 (Start on a new page.)

(Nov 2015)

A bullet of mass 20 g is fired from a stationary rifle of mass 3 kg. Assume that the bullet moves horizontally. Immediately after firing, the rifle recoils (moves back) with a velocity of $1,4 \text{ m}\cdot\text{s}^{-1}$.

- 4.1 Calculate the speed at which the bullet leaves the rifle. (4)

The bullet strikes a stationary 5 kg wooden block **fixed** to a flat, horizontal table. The bullet is brought to rest after travelling a distance of 0,4 m **into the block**. Refer to the diagram below.

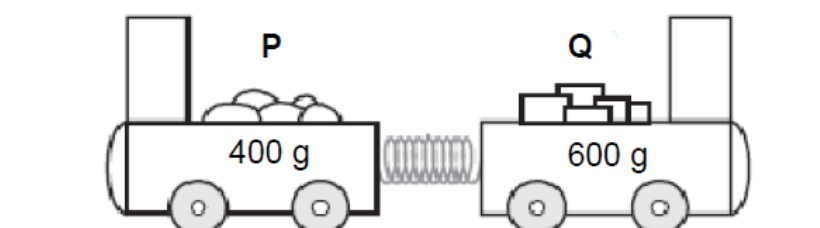


- 4.2 Calculate the magnitude of the average force exerted by the block on the bullet. (5)
- 4.3 How does the magnitude of the force calculated in QUESTION 4.2 compare to the magnitude of the force exerted by the bullet on the block? Write down only LARGER THAN, SMALLER THAN or THE SAME. (1)
- [10]

QUESTION 4 (Start on a new page.)

(Feb 2016)

The diagram below shows two trolleys, **P** and **Q**, held together by means of a compressed spring on a flat, frictionless horizontal track. The masses of **P** and **Q** are 400 g and 600 g respectively.



Momentum and Impulse

When the trolleys are released, it takes 0,3 s for the spring to unwind to its natural length. Trolley **Q** then moves to the right at $4 \text{ m}\cdot\text{s}^{-1}$.

Downloaded from eduresourceza.com

- 4.1 State the *principle of conservation of linear momentum* in words. (2)
- 4.2 Calculate the:
- 4.2.1 Velocity of trolley **P** after the trolleys are released (4)
- 4.2.2 Magnitude of the average force exerted by the spring on trolley **Q** (4)
- 4.3 Is this an elastic collision? Only answer YES or NO. (1)
- [11]

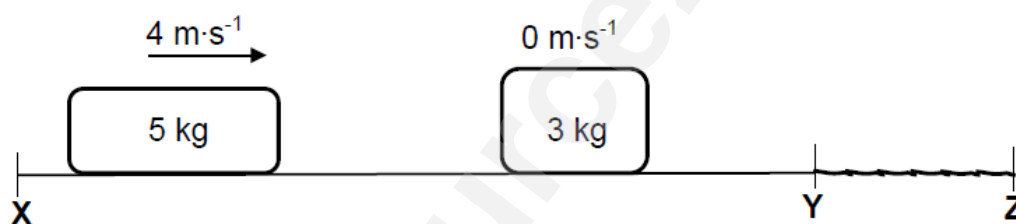
QUESTION 4 (Start on a new page.)

(June 2016)

The diagram below shows two sections, **XY** and **YZ**, of a horizontal, flat surface. Section **XY** is smooth, while section **YZ** is rough.

A 5 kg block, moving with a velocity of $4 \text{ m}\cdot\text{s}^{-1}$ to the right, collides head-on with a stationary 3 kg block. After the collision, the two blocks stick together and move to the right, past point **Y**.

The combined blocks travel for 0,3 s from point **Y** before coming to a stop at point **Z**.



- 4.1 State the *principle of conservation of linear momentum* in words. (2)
- 4.2 Calculate the magnitude of the:
- 4.2.1 Velocity of the combined blocks at point **Y** (4)
- 4.2.2 Net force acting on the combined blocks when they move through section **YZ** (4)
- [10]

Downloaded from eduresourceza.com

QUESTION 4 (Start on a new page.)

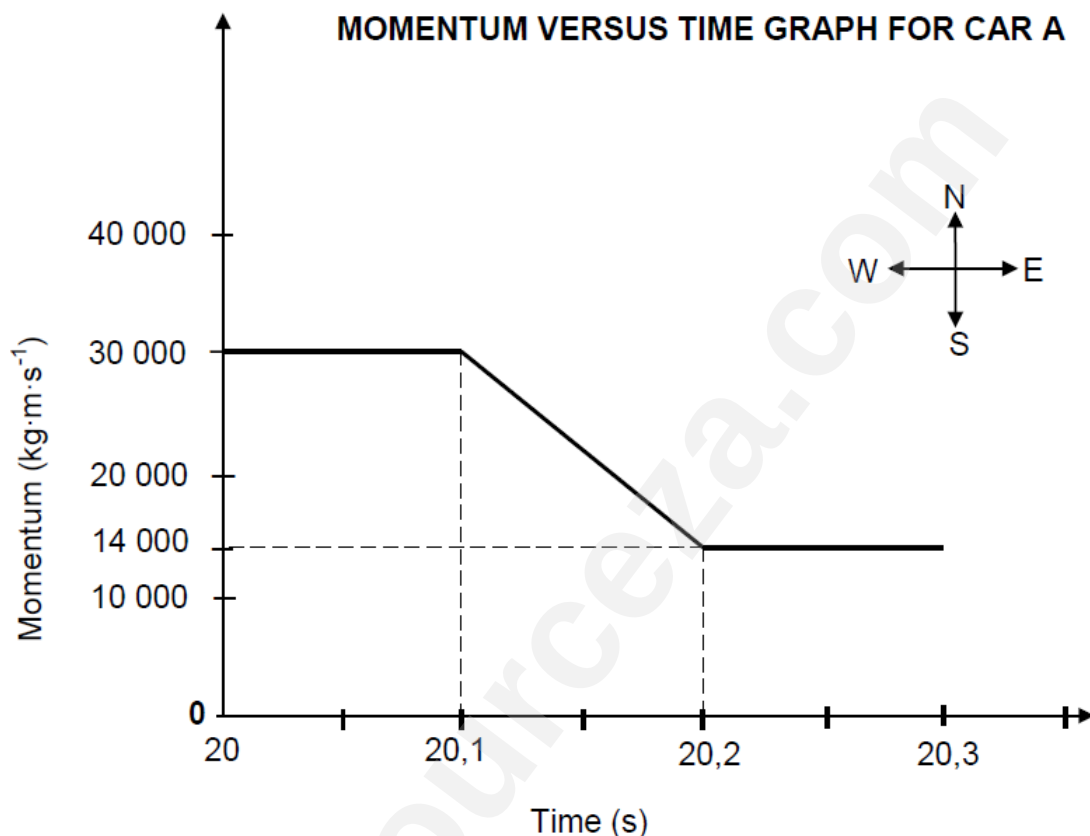
(Nov 2016)

The graph below shows how the momentum of car **A** changes with time *just before* and *just after* a head-on collision with car **B**.

Car **A** has a mass of 1 500 kg, while the mass of car **B** is 900 kg.

Car **B** was travelling at a constant velocity of $15 \text{ m}\cdot\text{s}^{-1}$ west before the collision.

Take east as positive and consider the system as isolated.



- 4.1 What do you understand by the term *isolated system* as used in physics? (1)

Use the information in the graph to answer the following questions.

- 4.2 Calculate the:

- 4.2.1 Magnitude of the velocity of car **A** just before the collision (3)
- 4.2.2 Velocity of car **B** just after the collision (5)
- 4.2.3 Magnitude of the net average force acting on car **A** during the collision (4)

[13]

Work, Energy and Power

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 Two balls, **P** and **Q**, are dropped simultaneously from the same height. Ball **P** has TWICE the mass of ball **Q**. Ignore the effects of air friction.

Just before the balls hit the ground, the kinetic energy of ball **P** is x . The kinetic energy of ball **Q**, in terms of x , will be ...

- A $\frac{1}{4}x$
- B $\frac{1}{2}x$
- C x
- D $2x$

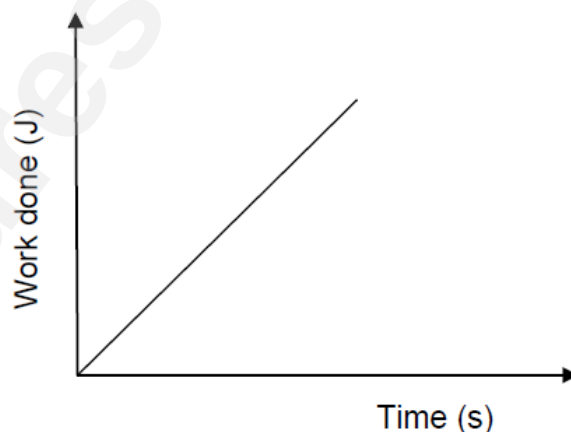
(Nov 2014) (2)

- 1.2 The speed of a bicycle increases from $2 \text{ m}\cdot\text{s}^{-1}$ to $8 \text{ m}\cdot\text{s}^{-1}$. Its kinetic energy increases by a factor of ...

- A 4.
- B 6.
- C 8.
- D 16.

(Feb 2015) (2)

- 1.3 The graph below represents the relationship between the work done on an object and the time taken for this work to be done.



The gradient of the graph represents the ...

- A power.
- B momentum.
- C kinetic energy.
- D potential energy.

Downloaded from eduresourceza.com

(Nov 2015) (2)

- 1.4 The work done by a constant force F applied to an object to increase the object's speed from v to $2v$ is W .

Downloaded from eduresourceza.com

The work done by the same force to increase the speed of the object from 0 to v will be ...

A $\frac{1}{3}W$

B $\frac{1}{2}W$

C $2W$

D $3W$

(Feb 2016) (2)

- 1.5 When the net work done on an object is positive (greater than zero), the ...

A kinetic energy of the object is zero.

B kinetic energy of the object is increasing.

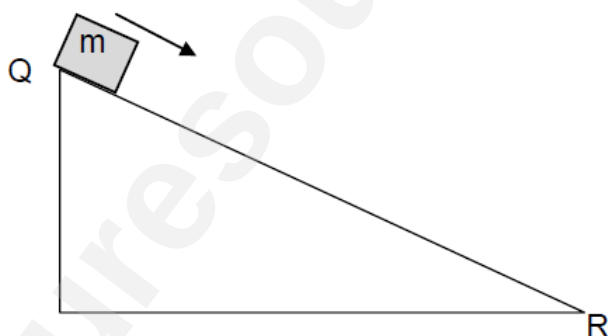
C kinetic energy of the object is decreasing.

D kinetic energy of the object remains unchanged.

(June 2016) (2)

- 1.6 A block of mass m is released from rest from the top of a frictionless inclined plane **QR**, as shown below.

The total mechanical energy of the block is E_Q at point **Q** and E_R at point **R**. The kinetic energy of the block at points **Q** and **R** is K_Q and K_R respectively.



Which ONE of the statements regarding the total mechanical energy and the kinetic energy of the block at points **Q** and **R** respectively is CORRECT?

	TOTAL MECHANICAL ENERGY E	KINETIC ENERGY K
A	$E_Q > E_R$	$K_Q = K_R$
B	$E_Q = E_R$	$K_Q < K_R$
C	$E_Q = E_R$	$K_Q = K_R$
D	$E_Q < E_R$	$K_Q > K_R$

(2)

(Nov 2016)

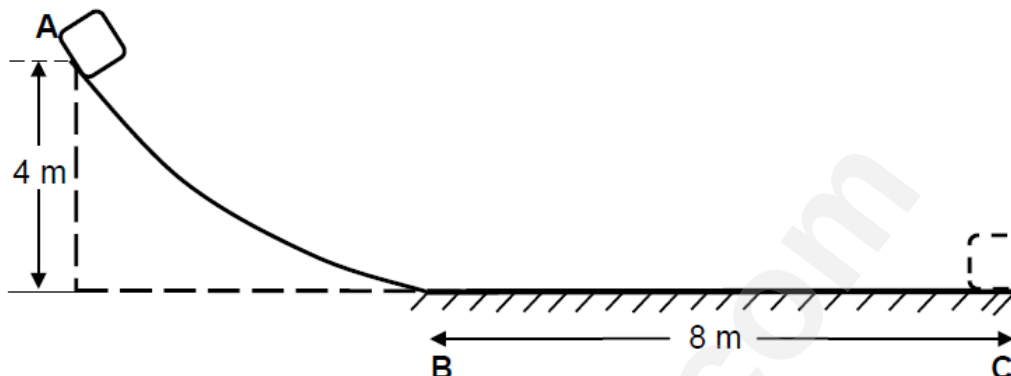
Downloaded from eduresourceza.com

Long Questions

QUESTION 5 (Start on a new page.) [Downloaded from eduresourceza.com](http://eduresourceza.com)

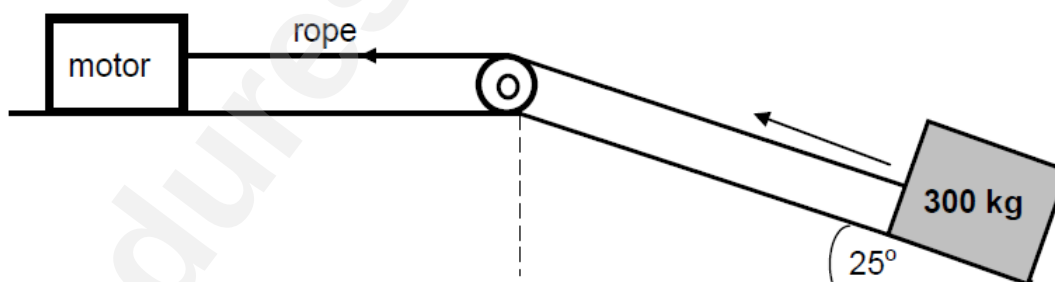
(Nov 2014)

- 5.1 The diagram below shows a track, **ABC**. The curved section, **AB**, is frictionless. The rough horizontal section, **BC**, is 8 m long.



An object of mass 10 kg is released from point **A** which is 4 m above the ground. It slides down the track and comes to rest at point **C**.

- 5.1.1 State the *principle of conservation of mechanical energy* in words. (2)
- 5.1.2 Is mechanical energy conserved as the object slides from **A** to **C**? Write only YES or NO. (1)
- 5.1.3 Using **ENERGY PRINCIPLES** only, calculate the magnitude of the frictional force exerted on the object as it moves along **BC**. (6)
- 5.2 A motor pulls a crate of mass 300 kg with a constant force by means of a light inextensible rope running over a light frictionless pulley as shown below. The coefficient of kinetic friction between the crate and the surface of the inclined plane is 0,19.



- 5.2.1 Calculate the magnitude of the frictional force acting between the crate and the surface of the inclined plane. (3)

The crate moves up the incline at a constant speed of $0,5 \text{ m} \cdot \text{s}^{-1}$.

- 5.2.2 Calculate the average power delivered by the motor while pulling the crate up the incline. (6)

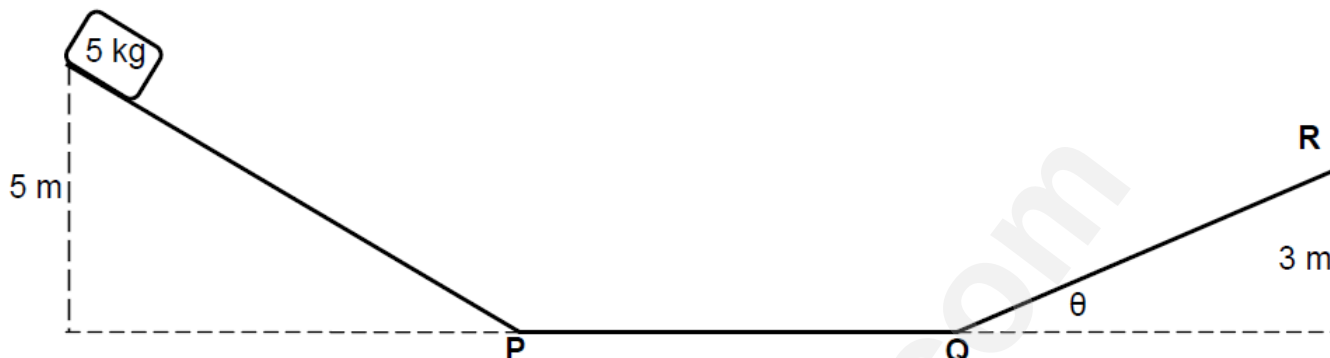
[18]

[Downloaded from eduresourceza.com](http://eduresourceza.com)

QUESTION 5 (Start on a new page.)

(Feb 2015)

A 5 kg block is released from rest from a height of 5 m and slides down a frictionless incline to point **P** as shown in the diagram below. It then moves along a frictionless horizontal portion **PQ** and finally moves up a second rough inclined plane. It comes to a stop at point **R** which is 3 m above the horizontal.



The frictional force, which is a non-conservative force, between the surface and the block is 18 N.

- 5.1 Using ENERGY PRINCIPLES only, calculate the speed of the block at point **P**. (4)
 - 5.2 Explain why the kinetic energy at point **P** is the same as that at point **Q**. (2)
 - 5.3 Explain the term *non-conservative force*. (2)
 - 5.4 Calculate the angle (θ) of the slope **QR**. (7)
- [15]**

QUESTION 5 (Start on a new page.)

(Nov 2015)

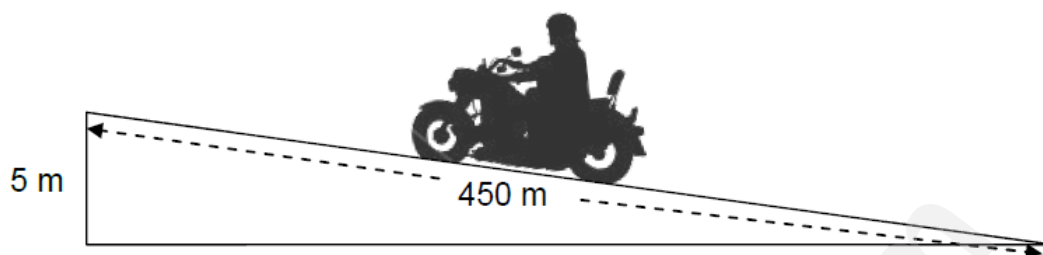
The track for a motorbike race consists of a straight, horizontal section that is 800 m long.



A participant, such as the one in the picture above, rides at a certain average speed and completes the 800 m course in 75 s. To maintain this speed, a constant driving force of 240 N acts on the motorbike.

- 5.1 Calculate the average power developed by the motorbike for this motion. (3)

Another person practises on the same motorbike on a track with an incline. Starting from rest, the person rides a distance of 450 m up the incline which has a vertical height of 5 m, as shown below.



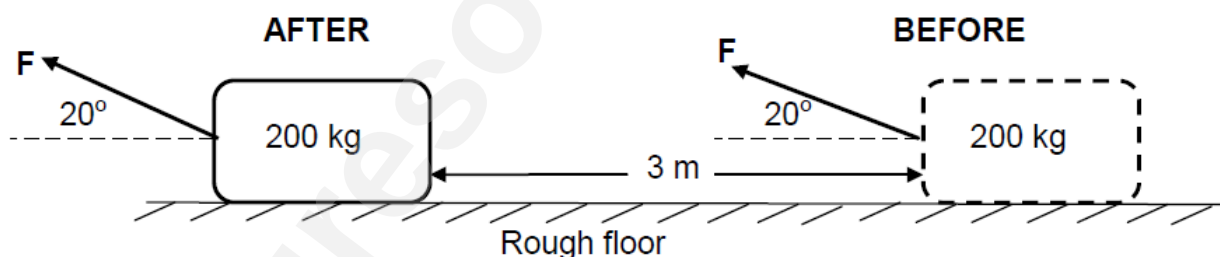
The total frictional force acting on the motorbike is 294 N. The combined mass of rider and motorbike is 300 kg. The average driving force on the motorbike as it moves up the incline is 350 N. Consider the motorbike and rider as a single system.

- 5.2 Draw a labelled free-body diagram for the motorbike-rider system on the incline. (4)
- 5.3 State the WORK-ENERGY theorem in words. (2)
- 5.4 Use energy principles to calculate the speed of the motorbike at the end of the 450 m ride. (6)
- [15]**

QUESTION 5 (Start on a new page.)

(Feb 2016)

A constant force F , applied at an angle of 20° above the horizontal, pulls a 200 kg block, over a distance of 3 m, on a rough, horizontal floor as shown in the diagram below.



The coefficient of kinetic friction, μ_k , between the floor surface and the block is 0,2.

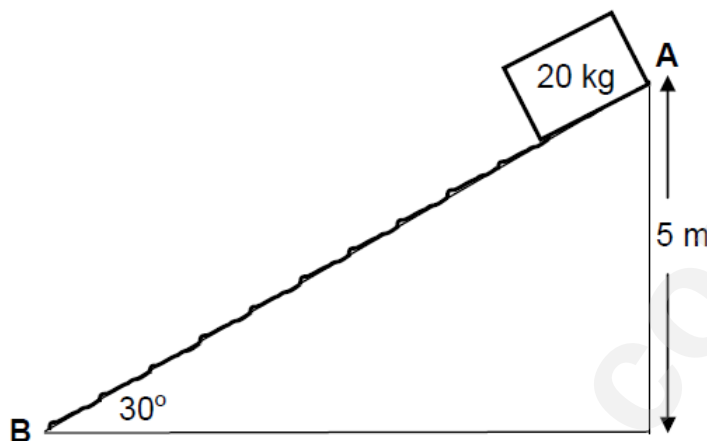
- 5.1 Give a reason why the coefficient of kinetic friction has no units. (1)
- 5.2 State the work-energy theorem in words. (2)
- 5.3 Draw a free-body diagram indicating ALL the forces acting on the block while it is being pulled. (4)
- 5.4 Show that the work done by the kinetic frictional force (W_{fk}) on the block can be written as $W_{fk} = (-1\,176 + 0,205 F)$ J. (4)
- 5.5 Calculate the magnitude of the force F that has to be applied so that the net work done by all forces on the block is zero. (4)

QUESTION 5 (Start on a new page.)

(June 2016)

A 20 kg block is released from rest from the top of a ramp at point A at a construction site as shown in the diagram below.

The ramp is inclined at an angle of 30° to the horizontal and its top is at a height of 5 m above the ground.



5.1 State the *principle of conservation of mechanical energy* in words. (2)

5.2 The kinetic frictional force between the 20 kg block and the surface of the ramp is 30 N.

Use *energy principles* to calculate the:

5.2.1 Work done by the kinetic frictional force on the block (3)

5.2.2 Speed of the block at point B at the bottom of the ramp (5)

5.3 A 100 kg object is pulled up the SAME RAMP at a constant speed of $2 \text{ m}\cdot\text{s}^{-1}$ by a small motor. The kinetic frictional force between the 100 kg object and the surface of the ramp is 25 N.

Calculate the average power delivered by the small motor in the pulling of the object up the incline.

(4)
[14]

QUESTION 5 (Start on a new page.)

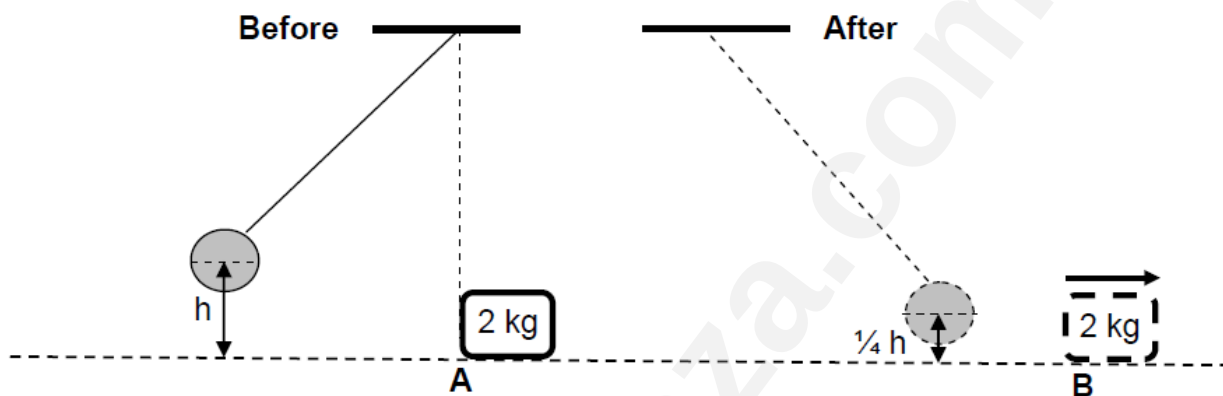
(Nov 2016)

Downloaded from eduresourceza.com

A pendulum with a bob of mass 5 kg is held stationary at a height h metres above the ground. When released, it collides with a block of mass 2 kg which is stationary at point **A**.

The bob swings past **A** and comes to rest momentarily at a position $\frac{1}{4}h$ above the ground.

The diagrams below are NOT drawn to scale.



Immediately after the collision the 2 kg block begins to move from **A** to **B** at a constant speed of $4,95 \text{ m}\cdot\text{s}^{-1}$.

Ignore frictional effects and assume that no loss of mechanical energy occurs during the collision.

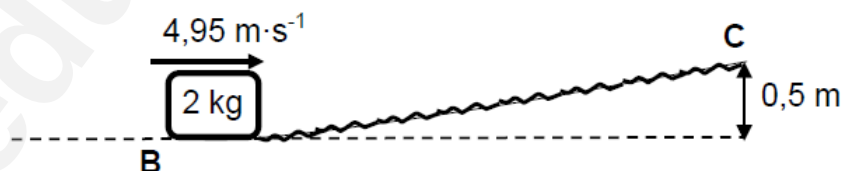
5.1 Calculate the:

5.1.1 Kinetic energy of the block immediately after the collision (3)

5.1.2 Height h (4)

The block moves from point **B** at a velocity of $4,95 \text{ m}\cdot\text{s}^{-1}$ up a rough inclined plane to point **C**. The speed of the block at point **C** is $2 \text{ m}\cdot\text{s}^{-1}$. Point **C** is 0,5 m above the horizontal, as shown in the diagram below.

During its motion from **B** to **C** a uniform frictional force acts on the block.



5.2 State the work-energy theorem in words. (2)

5.3 Use energy principles to calculate the work done by the frictional force when the 2 kg block moves from point **B** to point **C**. (4)
[13]

Downloaded from eduresourceza.com

Doppler Effect

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 Light reaching the Earth from a galaxy moving away is shifted towards ...
- A greater velocities.
 - B higher frequencies.
 - C longer wavelengths.
 - D shorter wavelengths.
- (Feb 2015) (2)

- 1.2 A police car with its siren wailing is moving away from a stationary observer at constant speed. The siren emits a sound of constant frequency.

Which of the following characteristics associated with the sound of the siren, as perceived by the observer, is/are CORRECT?

- (i) The speed remains the same.
- (ii) The frequency increases.
- (iii) The wavelength increases.
- (iv) The pitch decreases.

- A (iii) only
 - B (i), (iii) and (iv)
 - C (i) and (iii) only
 - D (i) and (ii) only
- (June 2016) (2)

- 1.3 The diagram below shows the positions of two stationary listeners, **P** and **Q**, relative to a car moving at a constant velocity towards listener **Q**. The hooter on the car emits sound. Listeners **P** and **Q** and the driver all hear the sound of the hooter.



Which ONE of the following CORRECTLY describes the frequency of the sound heard by **P** and **Q**, compared to that heard by the driver?

	FREQUENCY OF THE SOUND HEARD BY P	FREQUENCY OF THE SOUND HEARD BY Q
A	Lower	Higher
B	Higher	Higher
C	Lower	Lower
D	Higher	Lower

Downloaded from eduresourceza.com

(2)

Long Questions

Downloaded from eduresourceza.com

QUESTION 6 (Start on a new page.)

(Nov 2014)

- 6.1 The siren of a stationary ambulance emits a note of frequency 1 130 Hz. When the ambulance moves at a constant speed, a stationary observer detects a frequency that is 70 Hz **higher** than that emitted by the siren.

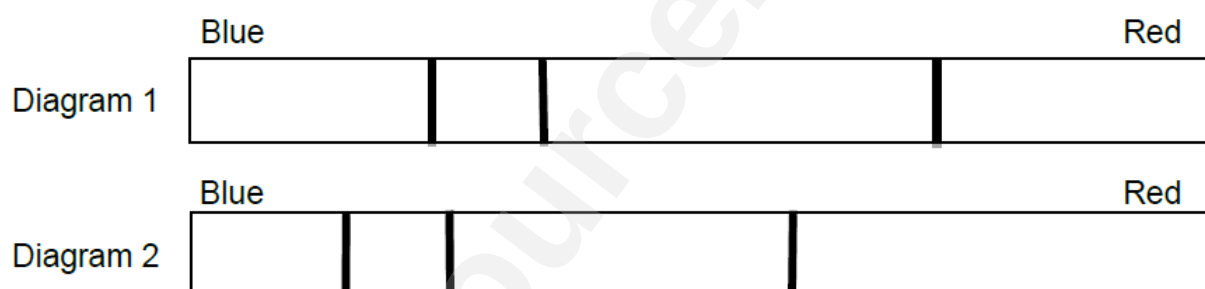
6.1.1 State the Doppler effect in words. (2)

6.1.2 Is the ambulance moving *towards* or *away from* the observer? Give a reason for the answer. (2)

6.1.3 Calculate the speed at which the ambulance is travelling. Take the speed of sound in air as $343 \text{ m}\cdot\text{s}^{-1}$. (5)

- 6.2 A study of spectral lines obtained from various stars can provide valuable information about the movement of the stars.

The two diagrams below represent different spectral lines of an element. Diagram 1 represents the spectrum of the element in a laboratory on Earth. Diagram 2 represents the spectrum of the same element from a distant star.



Is the star moving *towards* or *away from* the Earth? Explain the answer by referring to the shifts in the spectral lines in the two diagrams above.

(2)
[11]

QUESTION 6 (Start on a new page.)

(Feb 2015)

Reflection of sound waves enables bats to hunt for moths. The sound wave produced by a bat has a frequency of 222 kHz and a wavelength of $1,5 \times 10^{-3} \text{ m}$.

- 6.1 Calculate the speed of this sound wave through the air. (3)

- 6.2 A stationary bat sends out a sound signal and receives the same signal reflected from a moving moth at a frequency of 230,3 kHz.

6.2.1 Is the moth moving TOWARDS or AWAY FROM the bat? (1)

6.2.2 Calculate the magnitude of the velocity of the moth, assuming that the velocity is constant. (6)
[10]

Downloaded from eduresourceza.com

QUESTION 6 (Start on a new page.)

(Nov 2015)

Downloaded from eduresourceza.com

- 6.1 The data below was obtained during an investigation into the relationship between the different velocities of a moving sound source and the frequencies detected by a stationary listener for each velocity. The effect of wind was ignored in this investigation.

Experiment number	1	2	3	4
Velocity of the sound source ($\text{m}\cdot\text{s}^{-1}$)	0	10	20	30
Frequency (Hz) of the sound detected by the stationary listener	900	874	850	827

- 6.1.1 Write down the dependent variable for this investigation. (1)
- 6.1.2 State the Doppler effect in words. (2)
- 6.1.3 Was the sound source moving TOWARDS or AWAY FROM the listener? Give a reason for the answer. (2)
- 6.1.4 Use the information in the table to calculate the speed of sound during the investigation. (5)
- 6.2 The spectral lines of a distant star are shifted towards the longer wavelengths of light. Is the star moving TOWARDS or AWAY FROM the Earth? (1)
- [11]**

QUESTION 6 (Start on a new page.)

(Feb 2016)

Reflection of sound waves enables bats to hunt for moths. The sound wave produced by a bat has a frequency of 222 kHz and a wavelength of $1,5 \times 10^{-3}$ m.

- 6.1 Calculate the speed of this sound wave through the air. (3)
- 6.2 A stationary bat sends out a sound signal and receives the same signal reflected from a moving moth at a frequency of 230,3 kHz.
- 6.2.1 Is the moth moving TOWARDS or AWAY FROM the bat? (1)
- 6.2.2 Calculate the magnitude of the velocity of the moth, assuming that the velocity is constant. (6)
- [10]**

QUESTION 6 (Start on a new page.)

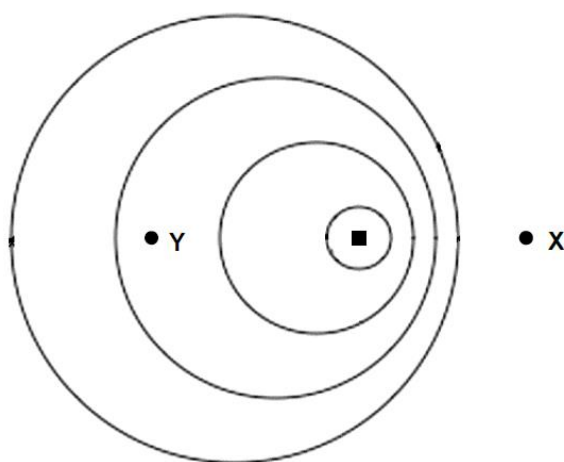
(June 2016)

An ambulance is travelling towards a hospital at a constant velocity of $30 \text{ m}\cdot\text{s}^{-1}$. The siren of the ambulance produces sound of frequency 400 Hz. Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$.

Downloaded from eduresourceza.com

Doppler Effect

The diagram below shows the wave fronts of the sound produced from the siren as a result of this motion. **Downloaded from eduresourceza.com**



- 6.1 At which side of the diagram, **X** or **Y**, is the hospital situated? (1)
- 6.2 Explain the answer to QUESTION 6.1. (3)
- 6.3 Calculate the frequency of the sound of the siren heard by a person standing at the hospital. (5)
- 6.4 A nurse is sitting next to the driver in the passenger seat of the ambulance as it approaches the hospital. Calculate the wavelength of the sound heard by the nurse. (3)
- [12]**

QUESTION 6 (Start on a new page.)

(Nov 2016)

- 6.1 An ambulance is moving towards a stationary listener at a constant speed of $30 \text{ m}\cdot\text{s}^{-1}$. The siren of the ambulance emits sound waves having a wavelength of $0,28 \text{ m}$. Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$.
- 6.1.1 State the Doppler effect in words. (2)
- 6.1.2 Calculate the frequency of the sound waves emitted by the siren as heard by the ambulance driver. (3)
- 6.1.3 Calculate the frequency of the sound waves emitted by the siren as heard by the listener. (5)
- 6.1.4 How would the answer to QUESTION 6.1.3 change if the speed of the ambulance were **LESS THAN** $30 \text{ m}\cdot\text{s}^{-1}$? Write down only **INCREASES**, **DECREASES** or **REMAINS THE SAME**. (1)
- 6.2 An observation of the spectrum of a distant star shows that it is moving away from the Earth.

Explain, in terms of the frequencies of the spectral lines, how it is possible to conclude that the star is moving away from the Earth. (2)

Downloaded from eduresourceza.com

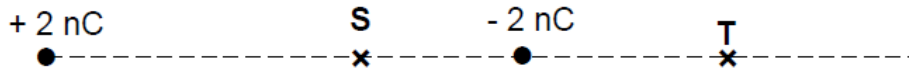
[13]

Electrostatics

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 Two charges of $+2\text{ nC}$ and -2 nC are located on a straight line. **S** and **T** are two points that lie on the same straight line as shown in the diagram below.



Which ONE of the following correctly represents the directions of the RESULTANT electric fields at **S** and at **T**?

	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT S	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT T
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

(Nov 2014)

- 1.2 The magnitude of an electric field, a distance r from a point charge is E . The magnitude of an electric field, a distance $2r$ from the same point charge will be ...

A $\frac{1}{4}E$

B $\frac{1}{2}E$

C $2E$

D $4E$

(Feb 2015) (2)

- 1.3 Two charged spheres of magnitudes $2Q$ and Q respectively are placed a distance r apart on insulating stands.

If the sphere of charge Q experiences a force F to the east, then the sphere of charge $2Q$ will experience a force ...

A F to the west.

B F to the east.

C $2F$ to the west.

D $2F$ to the east.

Downloaded from eduresourceza.com

(Nov 2015) (2)

Electrostatics

- 1.4 P, Q and R are three charged spheres. When P and Q are brought near each other, they experience an attractive force. When Q and R are brought near each other, they experience a repulsive force.

Which ONE of the following is TRUE?

- A P and R have charges with the same sign.
- B P and R have charges with opposite signs.
- C P, Q and R have charges with the same sign.
- D P, Q and R have equal charges.

(Feb 2016) (2)

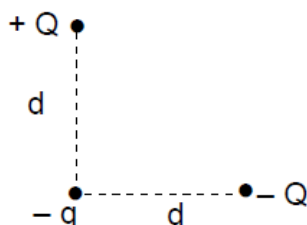
- 1.5 The magnitude of the electric field at a point P from a positive point charge q is $x \text{ N}\cdot\text{C}^{-1}$.

Which ONE of the statements below regarding this electric field is CORRECT?

- A A $+1 \text{ C}$ charge placed at P will experience a force of magnitude $x \text{ N}$ directed away from q .
- B The force on a $+2 \text{ C}$ charge placed at P will have a magnitude $\frac{1}{4}x \text{ N}$ directed away from q .
- C A $+1 \text{ C}$ charge placed at P will experience a force of magnitude $x \text{ N}$ directed towards q .
- D The force on a $+2 \text{ C}$ charge placed at P will have a magnitude $\frac{1}{4}x \text{ N}$ directed towards q .

(June 2016) (2)

- 1.6 Two charges, $+Q$ and $-Q$, are placed a distance d from a negative charge $-q$. The charges, $+Q$ and $-Q$, are located along lines that are perpendicular to each other as shown in the diagram below.



Which ONE of the following arrows CORRECTLY shows the direction of the net force acting on charge $-q$ due to the presence of charges $+Q$ and $-Q$?

A	
B	
C	
D	

Downloaded from eduresourceza.com

(Nov 2016) (2)

Long Questions

QUESTION 7 (Start on a new page.)

(Nov 2014)

The diagram below shows two small identical metal spheres, **R** and **S**, each placed on a wooden stand. Spheres **R** and **S** carry charges of $+8\ \mu\text{C}$ and $-4\ \mu\text{C}$ respectively. Ignore the effects of air.



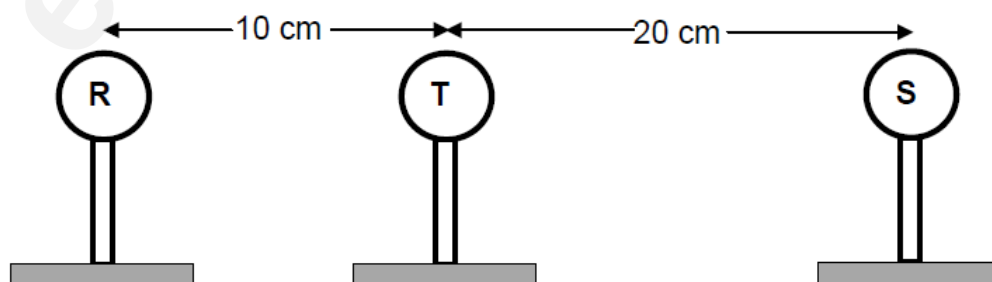
7.1 Explain why the spheres were placed on wooden stands. (1)

Spheres **R** and **S** are brought into contact for a while and then separated by a small distance.

7.2 Calculate the net charge on each of the spheres. (2)

7.3 Draw the electric field pattern due to the two spheres **R** and **S**. (3)

After **R** and **S** have been in contact and separated, a third sphere, **T**, of charge $+1\ \mu\text{C}$ is now placed between them as shown in the diagram below.



Downloaded from eduresourceza.com

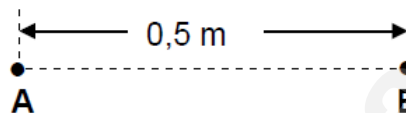
Electrostatics

- 7.4 Draw a free-body diagram showing the electrostatic forces experienced by sphere **T** due to spheres **R** and **S**. (2)
- Downloaded from eduresourceza.com
- 7.5 Calculate the net electrostatic force experienced by **T** due to **R** and **S**. (6)
- 7.6 Define the *electric field at a point*. (2)
- 7.7 Calculate the magnitude of the net electric field at the location of **T** due to **R** and **S**. (Treat the spheres as if they were point charges.) (3)
- [19]**

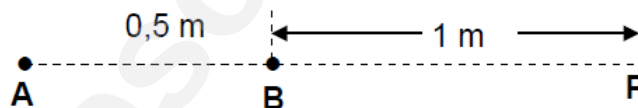
QUESTION 7 (Start on a new page.)

(Feb 2015)

Two identical negatively charged spheres, **A** and **B**, having charges of the **same magnitude**, are placed 0,5 m apart in vacuum. The magnitude of the electrostatic force that one sphere exerts on the other is $1,44 \times 10^{-1} \text{ N}$.



- 7.1 State Coulomb's law in words. (2)
- 7.2 Calculate the:
- 7.2.1 Magnitude of the charge on each sphere (4)
- 7.2.2 Excess number of electrons on sphere **B** (3)
- 7.3 **P** is a point at a distance of 1 m from sphere **B**.



- 7.3.1 What is the direction of the net electric field at point **P**? (1)
- 7.3.2 Calculate the number of electrons that should be removed from sphere **B** so that the net electric field at point **P** is $3 \times 10^4 \text{ N} \cdot \text{C}^{-1}$ to the right. (8)
- [18]**

QUESTION 7 (Start on a new page.)

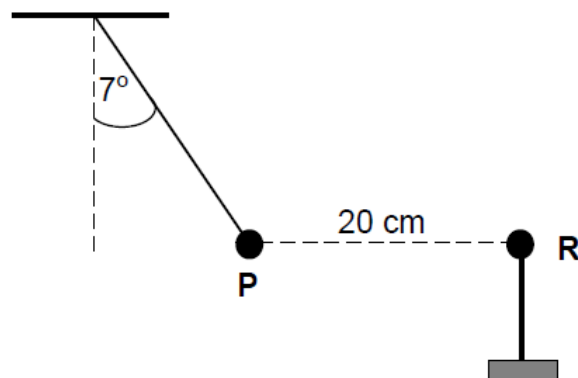
(Nov 2015)

A very small graphite-coated sphere **P** is rubbed with a cloth. It is found that the sphere acquires a charge of $+ 0,5 \mu\text{C}$.

- 7.1 Calculate the number of electrons removed from sphere **P** during the charging process. (3)

Electrostatics

Now the charged sphere **P** is suspended from a light, inextensible string. Another sphere, **R**, with a charge of $-0,9 \mu\text{C}$, on an insulated stand, is brought close to sphere **P**. As a result sphere **P** moves to a position where it is 20 cm from sphere **R**, as shown below. The system is in equilibrium and the angle between the string and the vertical is 7° .

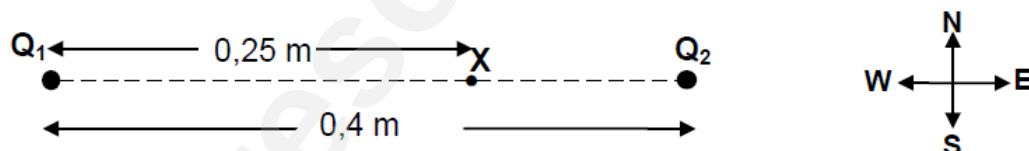


- 7.2 Draw a labelled free-body diagram showing ALL the forces acting on sphere **P**. (3)
 - 7.3 State Coulomb's law in words. (2)
 - 7.4 Calculate the magnitude of the tension in the string. (5)
- [13]**

QUESTION 8 (Start on a new page.)

(Nov 2015)

Two charged particles, Q_1 and Q_2 , are placed $0,4 \text{ m}$ apart along a straight line. The charge on Q_1 is $+2 \times 10^{-5} \text{ C}$, and the charge on Q_2 is $-8 \times 10^{-6} \text{ C}$. Point **X** is $0,25 \text{ m}$ east of Q_1 , as shown in the diagram below.



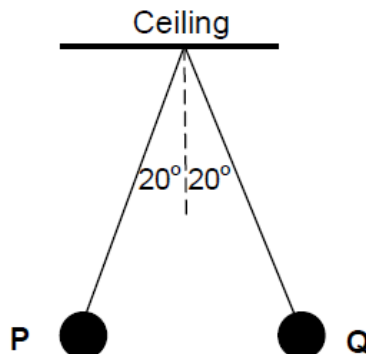
Calculate the:

- 8.1 Net electric field at point **X** due to the two charges (6)
 - 8.2 Electrostatic force that a $-2 \times 10^{-9} \text{ C}$ charge will experience at point **X** (4)
- The $-2 \times 10^{-9} \text{ C}$ charge is replaced with a charge of $-4 \times 10^{-9} \text{ C}$ at point **X**.
- 8.3 **Without any further calculation**, determine the magnitude of the force that the $-4 \times 10^{-9} \text{ C}$ charge will experience at point **X**. (1)
- [11]**

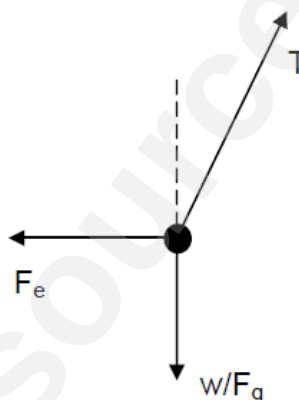
QUESTION 7 (Start on a new page.)

(Feb 2016)

Two identical spherical balls, P and Q, each of mass 100 g, are suspended at the same point from a ceiling by means of identical light, inextensible insulating strings. Each ball carries a charge of +250 nC. The balls come to rest in the positions shown in the diagram below.



- 7.1 In the diagram, the angles between each string and the vertical are the same. Give a reason why the angles are the same. (1)
- 7.2 State Coulomb's law in words. (2)
- 7.3 The free-body diagram, not drawn to scale, of the forces acting on ball P is shown below.



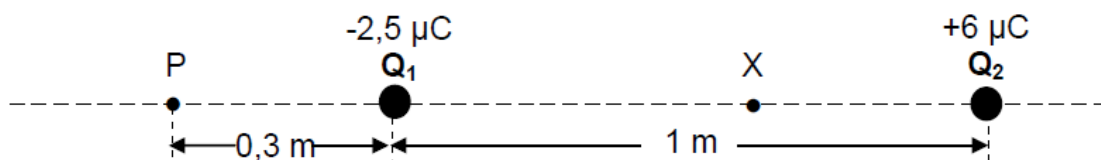
Calculate the:

- 7.3.1 Magnitude of the tension (T) in the string (3)
- 7.3.2 Distance between balls P and Q (5)
- [11]**

QUESTION 8 (Start on a new page.)

(Feb 2016)

A sphere Q_1 , with a charge of $-2,5 \mu\text{C}$, is placed 1 m away from a second sphere Q_2 , with a charge $+6 \mu\text{C}$. The spheres lie along a straight line, as shown in the diagram below. Point P is located a distance of 0,3 m to the left of sphere Q_1 , while point X is located between Q_1 and Q_2 . The diagram is not drawn to scale.



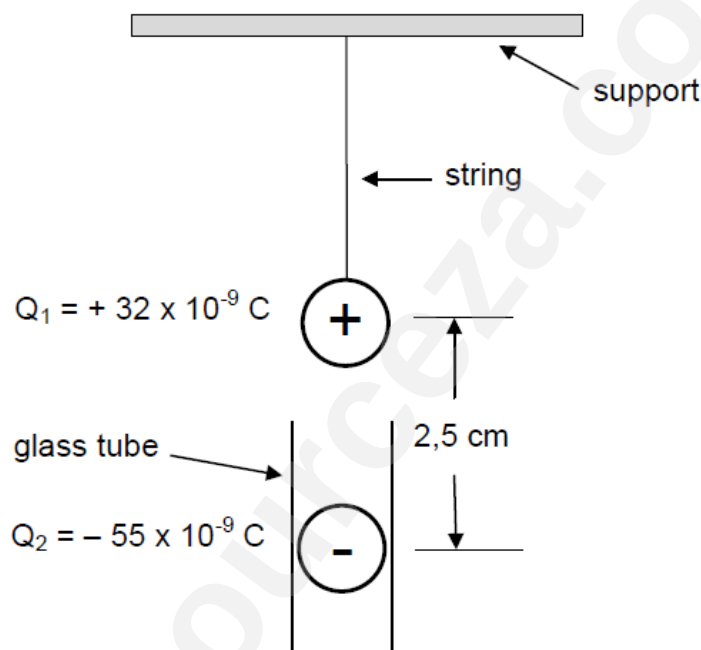
Electrostatics

- 8.1 Show, with the aid of a VECTOR DIAGRAM, why the net electric field at point **X** cannot be zero. (4)
- Downloaded from eduresourceza.com
- 8.2 Calculate the net electric field at point **P**, due to the two charged spheres Q_1 and Q_2 . (6)
- [10]**

QUESTION 7 (Start on a new page.)

(June 2016)

A small sphere, Q_1 , with a charge of $+ 32 \times 10^{-9} \text{ C}$, is suspended from a light string secured to a support. A second, identical sphere, Q_2 , with a charge of $- 55 \times 10^{-9} \text{ C}$, is placed in a narrow, cylindrical glass tube vertically below Q_1 . Each sphere has a mass of 7 g. Both spheres come to equilibrium when Q_2 is 2,5 cm from Q_1 , as shown in the diagram. Ignore the effects of air friction.



- 7.1 Calculate the number of electrons that were removed from Q_1 to give it a charge of $+ 32 \times 10^{-9} \text{ C}$. Assume that the sphere was neutral before being charged. (3)
- 7.2 Draw a labelled free-body diagram showing all the forces acting on sphere Q_1 . (3)
- 7.3 Calculate the magnitude of the tension in the string. (5)
- [11]**

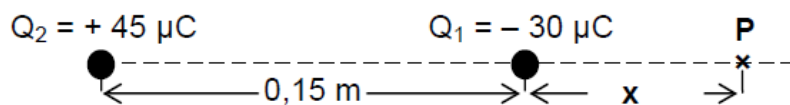
QUESTION 8 (Start on a new page.)

(June 2016)

- 8.1 Define *electric field at a point* in words. (2)
- 8.2 Draw the electric field pattern for two identical positively charged spheres placed close to each other. (3)

Electrostatics

- 8.3 A $-30\ \mu\text{C}$ point charge, Q_1 , is placed at a distance of $0,15\ \text{m}$ from a $+45\ \mu\text{C}$ point charge, Q_2 , in space, as shown in the diagram below. The net electric field at point **P**, which is on the same line as the two charges, is zero.



Calculate x , the distance of point **P** from charge Q_1 .

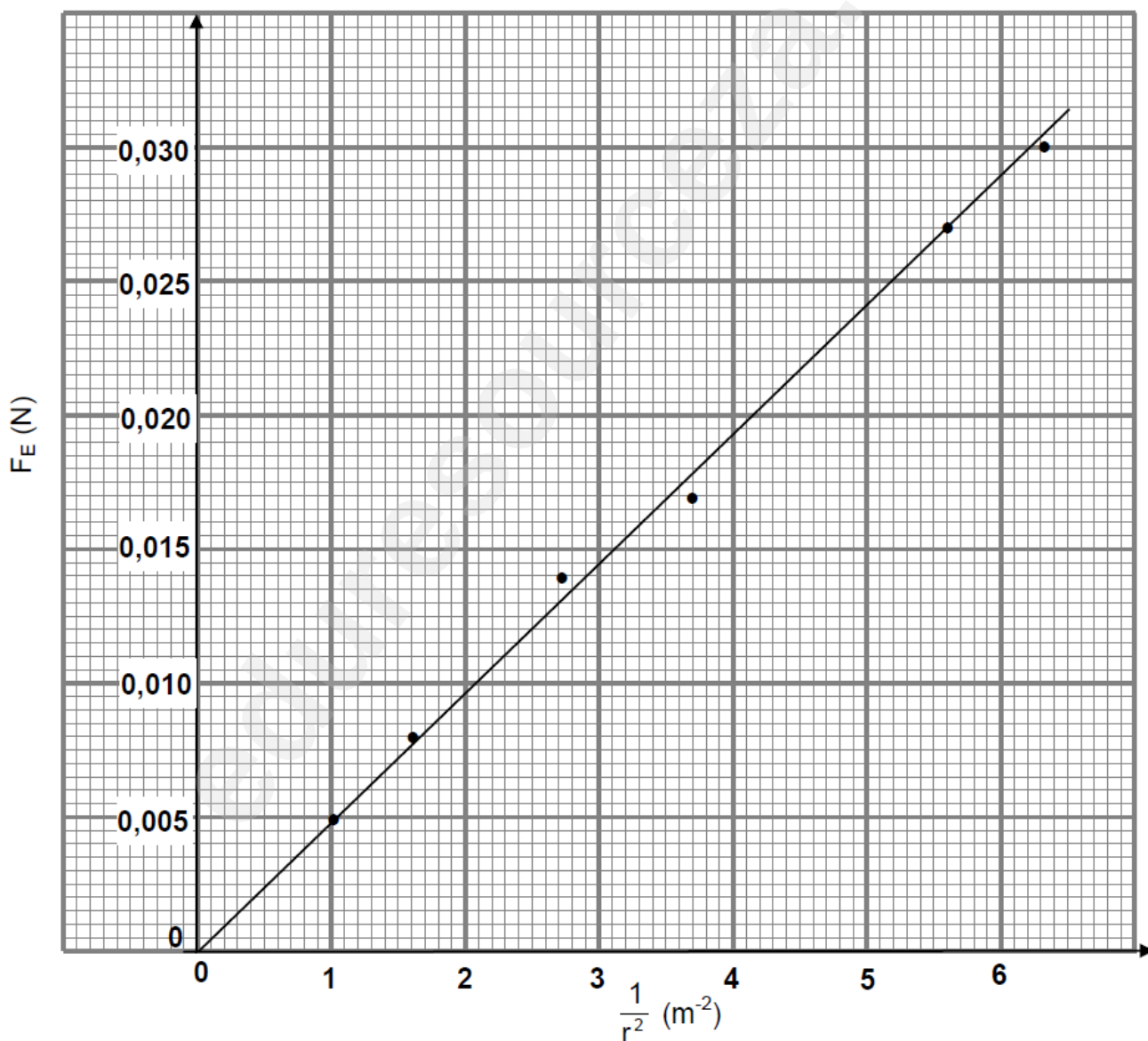
(5)
[10]

QUESTION 7 (Start on a new page.)

(Nov 2016)

- 7.1 In an experiment to verify the relationship between the electrostatic force, F_E , and distance, r , between two **identical**, positively charged spheres, the graph below was obtained.

GRAPH OF F_E VERSUS $\frac{1}{r^2}$



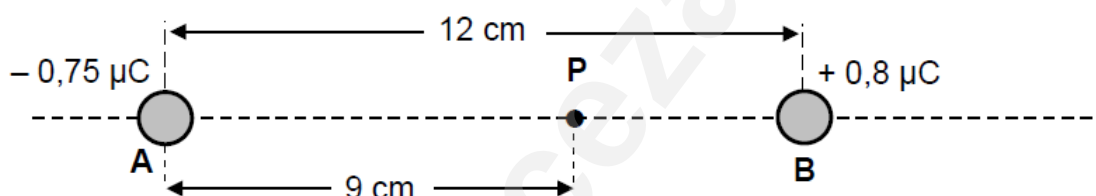
Electrostatics

- 7.1.1 State Coulomb's law in words. (2)
- 7.1.2 Write down the dependent variable of the experiment. (1)
- 7.1.3 What relationship between the electrostatic force F_E and the square of the distance, r^2 , between the charged spheres can be deduced from the graph? (1)
- 7.1.4 Use the information in the graph to calculate the charge on each sphere. (6)

7.2 A charged sphere, **A**, carries a charge of $-0,75 \mu\text{C}$.

- 7.2.1 Draw a diagram showing the electric field lines surrounding sphere **A**. (2)

Sphere **A** is placed 12 cm away from another charged sphere, **B**, along a straight line in a vacuum, as shown below. Sphere **B** carries a charge of $+0,8 \mu\text{C}$. Point **P** is located 9 cm to the right of sphere **A**.



- 7.2.2 Calculate the magnitude of the net electric field at point **P**. (5)
- [17]

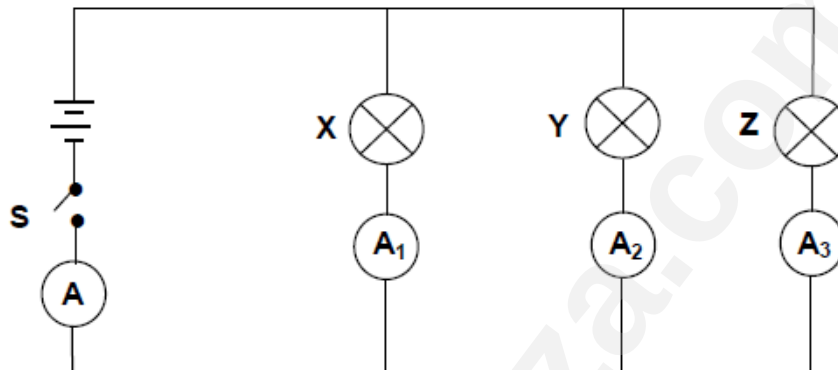
Electric Circuits

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 Three light bulbs, X, Y and Z with resistances R , $2R$ and R respectively, are connected in a circuit as shown below. The battery has negligible internal resistance.

When switch S is closed, all the bulbs light up. The reading on ammeter A is 2,5 A.

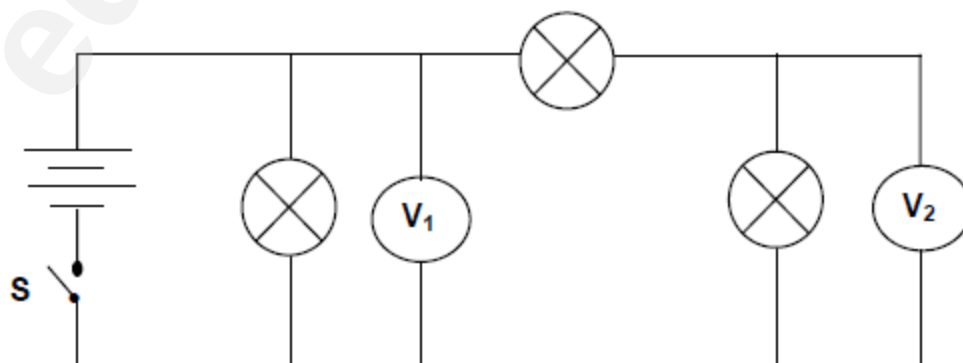


Which ONE of the following correctly describes the readings on the ammeters (in amperes) when bulb Z burns out?

	A_1	A_2	A_3	A
A	1,25	1,25	0	2,5
B	1,6	0,8	0,1	2,5
C	0,75	0,75	0	1,5
D	1	0,5	0	1,5

(Nov 2014) (2)

- 1.2 Three identical light bulbs are connected in a circuit as shown below. The resistances of the battery and connecting wires can be ignored.



Downloaded from eduresourceza.com

Which ONE of the following statements is CORRECT when switch **S** is closed?

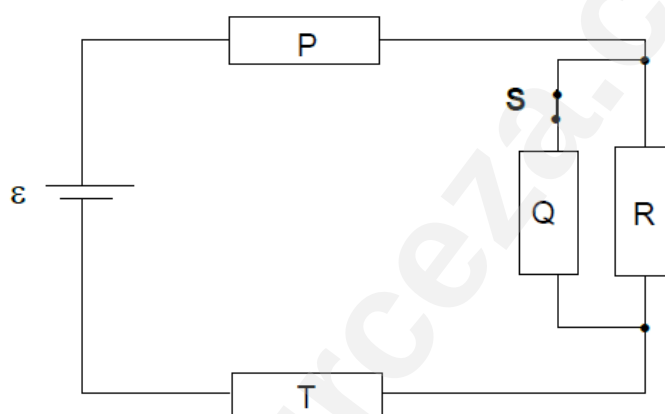
Downloaded from eduresourceza.com

The reading on V_1 is ...

- A half that on V_2 .
- B equal to that on V_2 .
- C twice that on V_2 .
- D three times that on V_2 .

(Feb 2015) (2)

- 1.3 The four resistors **P**, **Q**, **R** and **T** in the circuit below are identical. The cell has an emf ε and negligible internal resistance. The switch is initially CLOSED.



Switch **S** is now OPENED. Which ONE of the following combinations of changes will occur in **P**, **R** and **T**?

	CURRENT IN P	CURRENT IN R	CURRENT IN T
A	Decreases	Remains the same	Decreases
B	Increases	Remains the same	Increases
C	Increases	Increases	Increases
D	Decreases	Increases	Decreases

(Nov 2015) (2)

- 1.4 The minimum value of the resistance that can be obtained by connecting two $4\ \Omega$ resistors is ...

- A $1\ \Omega$.
- B $2\ \Omega$.
- C $3\ \Omega$.
- D $8\ \Omega$.

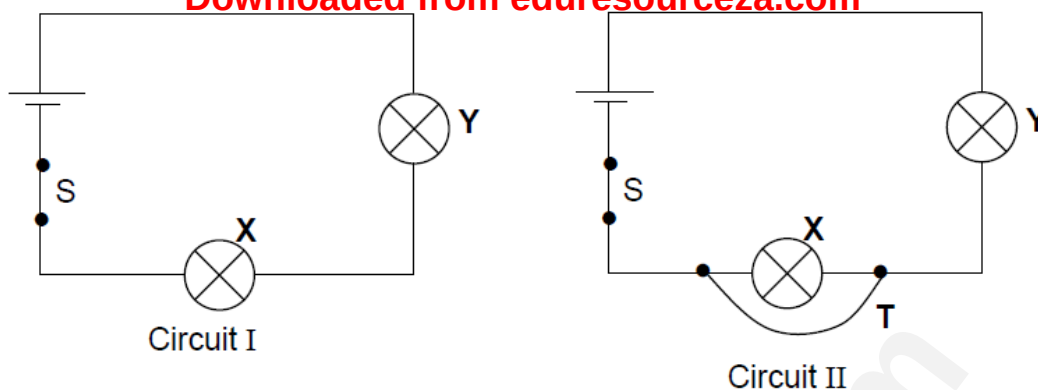
(Feb 2016) (2)

Downloaded from eduresourceza.com

Electric Circuits

- 1.5 Circuit I shows two identical lamps **X** and **Y** connected to a cell of negligible internal resistance. Switch **S** is closed.

Downloaded from eduresourceza.com



A wire **T**, of negligible resistance, is now connected across **X** as shown in Circuit II.

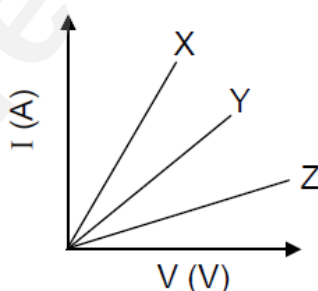
Which ONE of the statements below best describes how the brightness of the lamps have changed after **T** had been connected?

	X	Y
A	Does not light up	Dimmer
B	Brighter	Dimmer
C	Brighter	Brighter
D	Does not light up	Brighter

(June 2016) (2)

- 1.6 Learners investigate the relationship between current (**I**) and potential difference (**V**) at a constant temperature for three different resistors, **X**, **Y** and **Z**.

They obtain the graphs shown below.



The resistances of **X**, **Y** and **Z** are R_X , R_Y and R_Z respectively.

Which ONE of the following conclusions regarding the resistances of the resistors is CORRECT?

- A $R_Z > R_Y > R_X$
- B $R_X = R_Y = R_Z$
- C $R_X > R_Y > R_Z$

Downloaded from eduresourceza.com

Long Questions

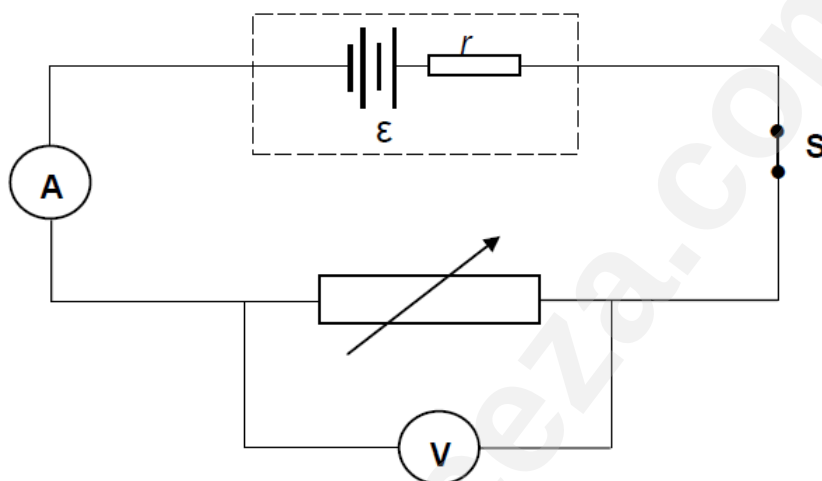
Downloaded from eduresourceza.com

QUESTION 8 (Start on a new page.)

(Nov 2014)

NOTE: The graph for QUESTION 8.1.2 must be drawn on the GRAPH SHEET attached at the end of the QUESTION PAPER.

- 8.1 A group of learners conduct an experiment to determine the emf (ϵ) and internal resistance (r) of a battery. They connect a battery to a rheostat (variable resistor), a low-resistance ammeter and a high-resistance voltmeter as shown in the diagram below.



The data obtained from the experiment is displayed in the table below.

READING ON VOLTMETER (V)	READING ON AMMETER (A)
2	0,58
3	0,46
4	0,36
5	0,24
6	0,14

- 8.1.1 State ONE factor which must be kept constant during the experiment. (1)

- 8.1.2 Using the information in the table above, plot the points and draw the line of best fit on the attached GRAPH SHEET. (3)

Use the graph drawn in QUESTION 8.1.2 to determine the following:

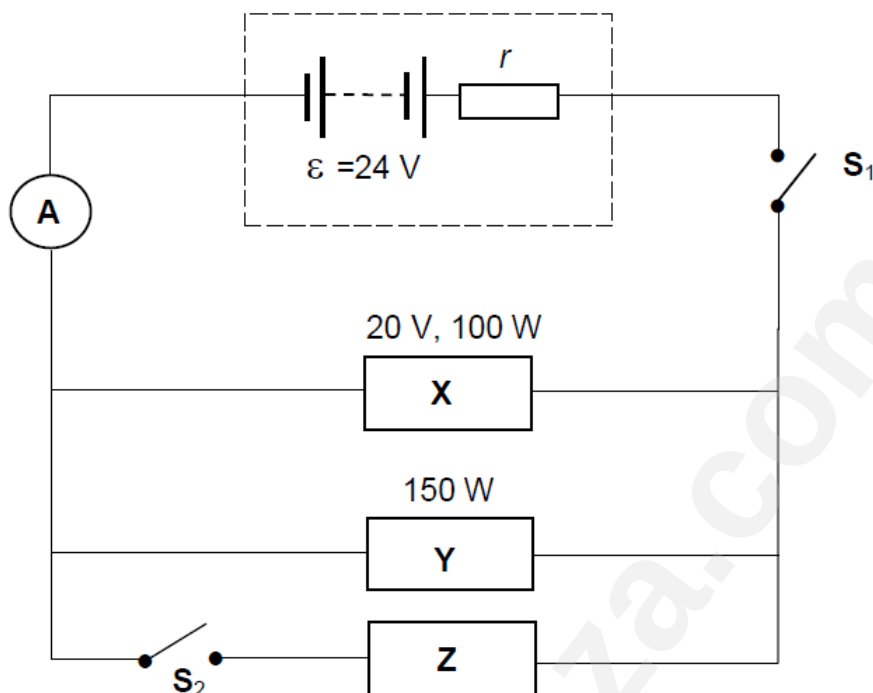
- 8.1.3 Emf (ϵ) of the battery (1)

- 8.1.4 Internal resistance of the battery, WITHOUT USING ANY FORM OF THE EQUATION $\epsilon = I(R + r)$ (3)

Downloaded from eduresourceza.com

Electric Circuits

- 8.2 Three electrical devices, **X**, **Y** and **Z**, are connected to a 24 V battery with internal resistance r as shown in the circuit diagram below. The power rating of each of the devices **X** and **Y** are indicated in the diagram.



With switch S_1 closed and S_2 open, the devices function as rated.

Calculate the:

- 8.2.1 Current in **X** (3)
- 8.2.2 Resistance of **Y** (3)
- 8.2.3 Internal resistance of the battery (5)

Now switch S_2 is also closed.

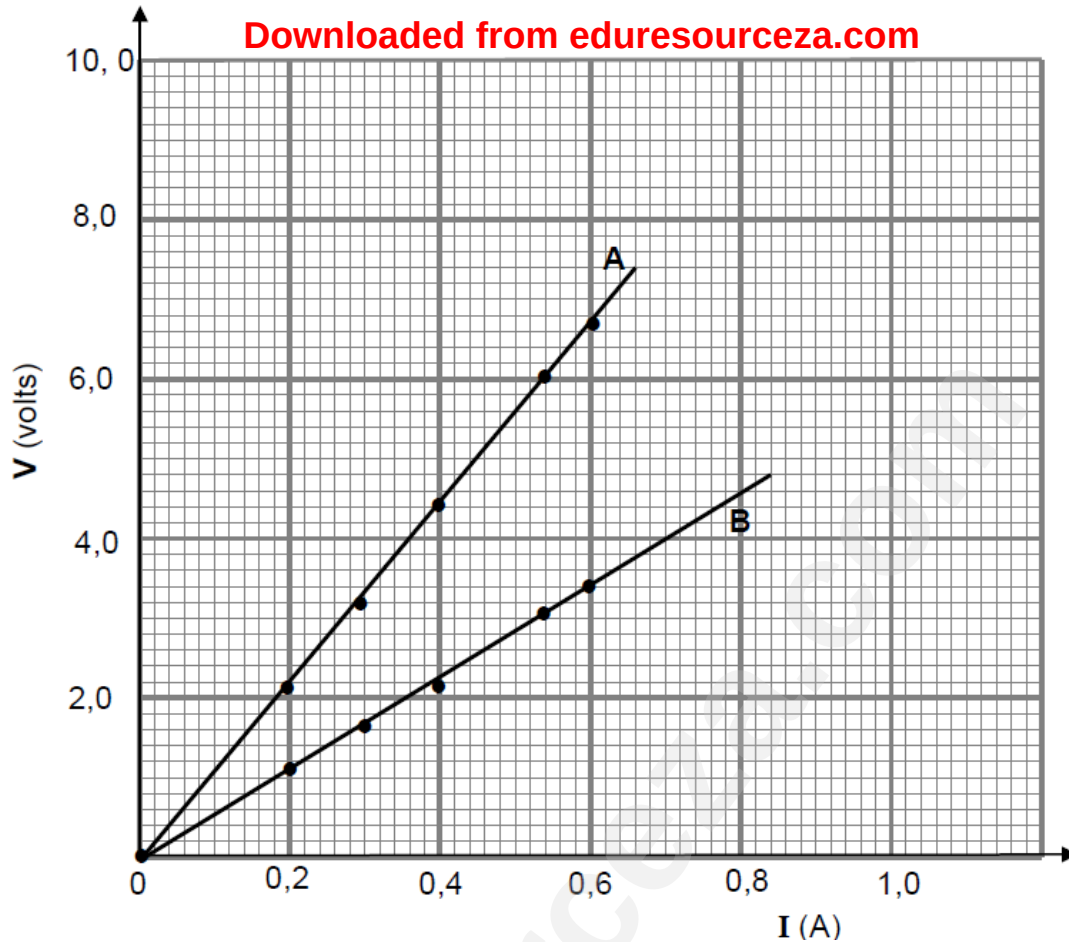
- 8.2.4 Identify device **Z** which, when placed in the position shown, can still enable **X** and **Y** to operate as rated. Assume that the resistances of all the devices remain unchanged. (1)
- 8.2.5 Explain how you arrived at the answer to QUESTION 8.2.4. (2)
- [22]**

QUESTION 8 (Start on a new page.)

(Feb 2015)

- 8.1 Learners want to construct an electric heater using one of two wires, **A** and **B**, of different resistances. They conduct experiments and draw the graphs as shown below.

Graph of V versus I for resistors A and B

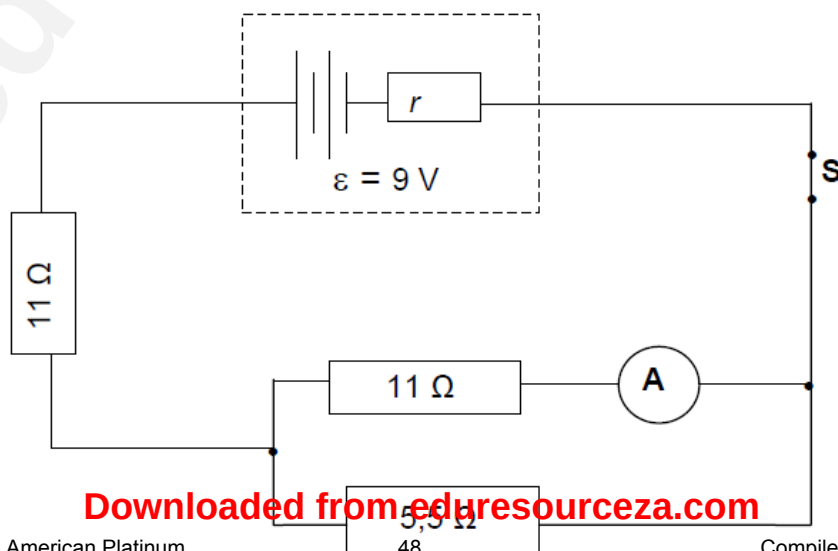


8.1.1 Apart from temperature, write down TWO other factors that the learners should consider to ensure a fair test when choosing which wire to use. (2)

8.1.2 Assuming all other factors are kept constant, state which ONE of the two wires will be the most suitable to use in the heater.

Use suitable calculations to show clearly how you arrive at the answer. (8)

8.2 In the circuit below the reading on ammeter A is 0,2 A. The battery has an emf of 9 V and internal resistance r .



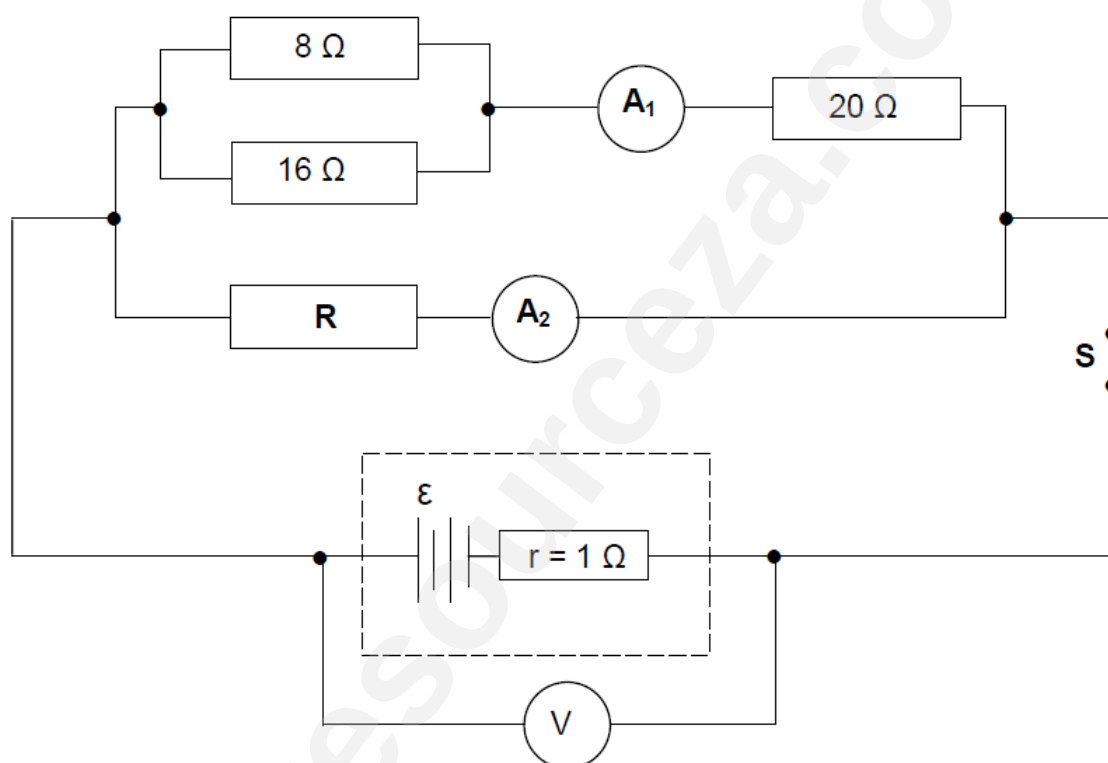
Electric Circuits

- 8.2.1 Calculate the current through the $5,5 \Omega$ resistor. (3)
- 8.2.2 Calculate the internal resistance of the battery. (7)
- 8.2.3 Will the ammeter reading INCREASE, DECREASE or REMAIN THE SAME if the $5,5 \Omega$ resistor is removed from the circuit? Give a reason for the answer. (2)
- [22]**

QUESTION 9 (Start on a new page.)

(Nov 2015)

A battery with an internal resistance of 1Ω and an unknown emf (ϵ) is connected in a circuit, as shown below. A high-resistance voltmeter (V) is connected across the battery. A_1 and A_2 represent ammeters of negligible resistance.



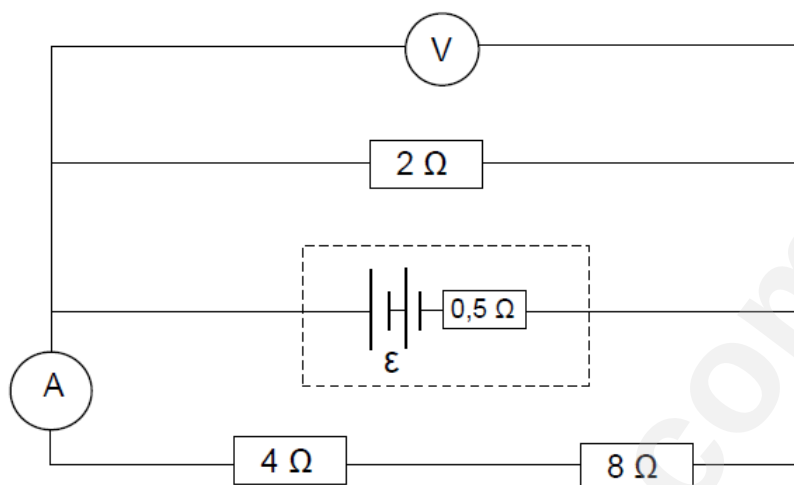
With switch **S** closed, the current passing through the 8Ω resistor is $0,5 \text{ A}$.

- 9.1 State Ohm's law in words. (2)
- 9.2 Calculate the reading on ammeter A_1 . (4)
- 9.3 If device **R** delivers power of 12 W , calculate the reading on ammeter A_2 . (5)
- 9.4 Calculate the reading on the voltmeter when switch **S** is open. (3)
- [14]**

QUESTION 9 (Start on a new page.)

(Feb 2016)

A battery of an unknown emf and internal resistance of $0,5\ \Omega$ is connected to three resistors, a high-resistance voltmeter and an ammeter of negligible resistance, as shown below.



The reading on the ammeter is $0,2\ \text{A}$.

9.1 Calculate the:

9.1.1 Reading on the voltmeter (3)

9.1.2 Total current supplied by the battery (4)

9.1.3 Emf of the battery (5)

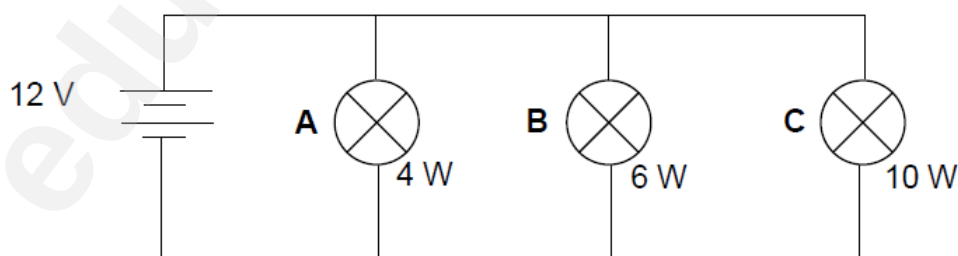
9.2 How would the voltmeter reading change if the $2\ \Omega$ resistor is removed from the circuit? Write down INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (3)

[15]

QUESTION 9 (Start on a new page.)

(June 2016)

9.1 In the diagram below, three light bulbs, **A**, **B** and **C**, are connected in parallel to a $12\ \text{V}$ source of negligible internal resistance. The bulbs are rated at $4\ \text{W}$, $6\ \text{W}$ and $10\ \text{W}$ respectively and are all at their maximum brightness.



9.1.1 Calculate the resistance of the $4\ \text{W}$ bulb. (3)

9.1.2 How will the equivalent resistance of the circuit change if the $6\ \text{W}$ bulb burns out? Write down only INCREASES, DECREASES or NO CHANGE. (1)

9.1.3 How will the power dissipated by the $10\ \text{W}$ bulb change if the $6\ \text{W}$ bulb burns out? Write down only INCREASES, DECREASES or NO CHANGE. Give a reason for the answer. (2)

Electric Circuits

- 9.2 A learner connects a high-resistance voltmeter across a battery. The voltmeter reads 6 V.

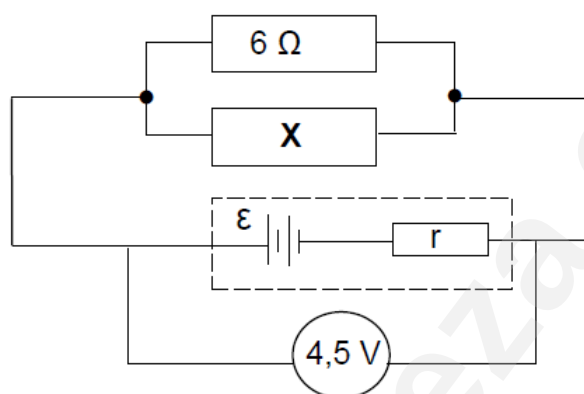
Downloaded from eduresourceza.com

She then connects a $6\ \Omega$ resistor across the battery. The voltmeter now reads 5 V.

- 9.2.1 Calculate the internal resistance of the battery. (4)

The learner now builds the circuit below, using the same 6 V battery and the $6\ \Omega$ resistor. She connects an unknown resistor **X** in parallel with the $6\ \Omega$ resistor. The voltmeter now reads 4,5 V.

- 9.2.2 Define the term *emf* of a cell. (2)

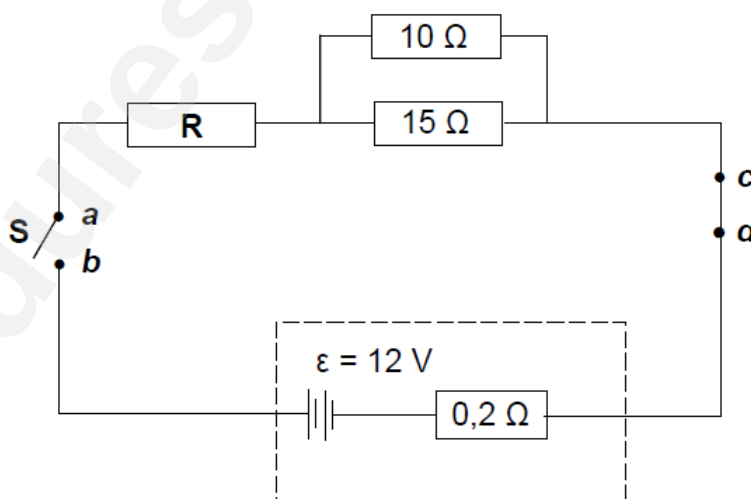


- 9.2.3 Calculate the resistance of **X** when the voltmeter reads 4,5 V. (5)
[17]

QUESTION 8 (Start on a new page.)

(Nov 2016)

- 8.1 In the circuit below the battery has an emf (ϵ) of 12 V and an internal resistance of $0,2\ \Omega$. The resistances of the connecting wires are negligible.



- 8.1.1 Define the term *emf* of a battery. (2)

- 8.1.2 Switch **S** is open. A high-resistance voltmeter is connected across points **a** and **b**.

What will the reading on the voltmeter be?

(1)

Downloaded from eduresourceza.com

- 8.1.3 Switch **S** is now closed. The same voltmeter is now connected across the terminals of the battery. What will the reading on the voltmeter be? (1)

When switch **S** is closed, the potential difference across the terminals of the battery is 11,7 V.

Calculate the:

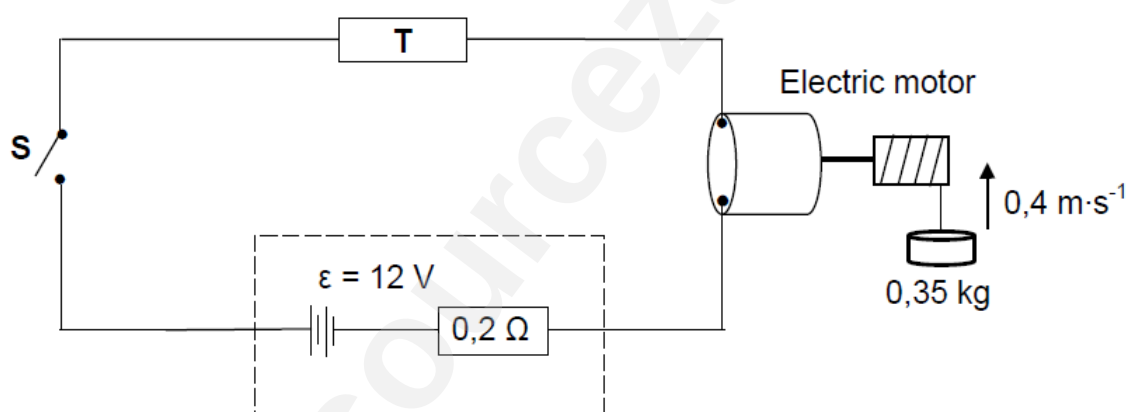
- 8.1.4 Current in the battery (3)

- 8.1.5 Effective resistance of the **parallel** branch (2)

- 8.1.6 Resistance of resistor **R** (4)

- 8.2 A battery with an emf of 12 V and an internal resistance of $0,2 \Omega$ are connected in series to a very small electric motor and a resistor, **T**, of unknown resistance, as shown in the circuit below.

The motor is rated **X** watts, 3 volts, and operates at optimal conditions.



When switch **S** is closed, the motor lifts a $0,35 \text{ kg}$ mass vertically upwards at a constant speed of $0,4 \text{ m} \cdot \text{s}^{-1}$. Assume that there is no energy conversion into heat and sound.

Calculate the value of:

- 8.2.1 **X** (3)

- 8.2.2 The resistance of resistor **T** (5)

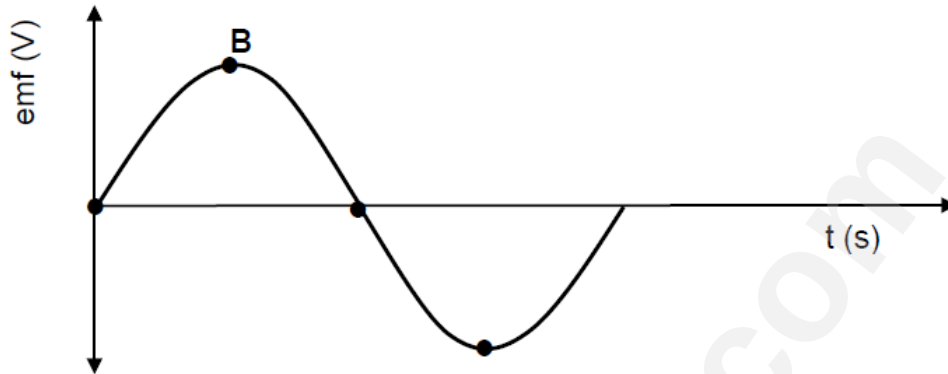
[21]

Electrodynamics

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 The coils of an AC generator make one complete rotation. The resulting graph for the output emf is shown below.

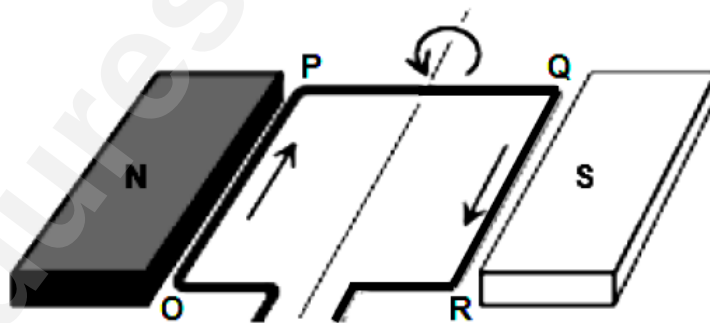


The position **B** on the graph is obtained when the plane of the coil is at an angle of ... to the magnetic field.

- A 0°
- B 60°
- C 90°
- D 120°

(Nov 2014) (2)

- 1.2 A DC current passes through a rectangular wire loop OPQR placed between two pole pieces of a magnet, as shown below.



Which TWO segments of the loop will experience an electromagnetic force when the loop is in the position above?

- A OP and PQ
- B QR and RO
- C OP and QR
- D RO and OP

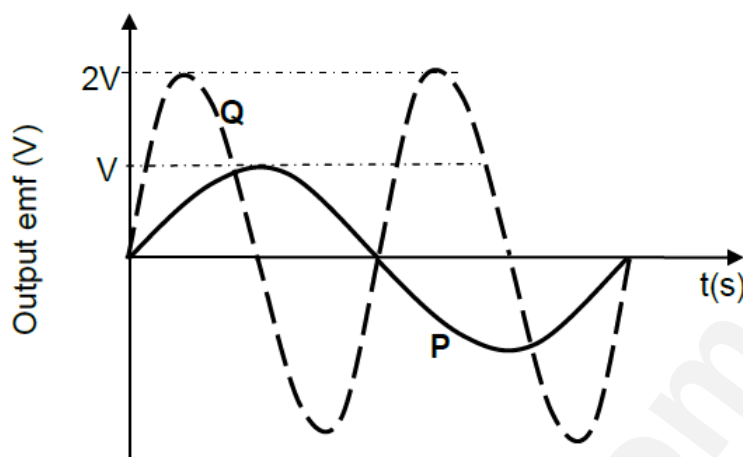
(Nov 2015) (2)

Downloaded from eduresourceza.com

1.3

Graph **P** represents the output emf of an AC generator. Graph **Q** is the output emf after a change has been made using the SAME generator.

Downloaded from eduresourceza.com



Which ONE of the following changes has been made to the generator to produce graph **Q**?

- A The number of turns of the coil has been doubled.
- B The surface area of the coil has been doubled.
- C The speed of rotation has been doubled.
- D The strength of the magnetic field has been doubled.

(Feb 2016) (2)

1.4

Some learners decided to build a small electrical generator in the laboratory. They then used this generator to investigate how the magnitude of the induced emf would change as the magnetic field strength changed.

Which ONE of the following is CORRECT regarding the variables for the investigation?

	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	CONTROL VARIABLE
A	Magnitude of induced emf	Number of turns of coil of generator	Magnetic field strength
B	Number of turns of coil of generator	Magnitude of induced emf	Magnetic field strength
C	Magnitude of induced emf	Magnetic field strength	Number of turns of coil of generator
D	Magnetic field strength	Number of turns of coil of generator	Magnitude of induced emf

(2)

(June 2016)

Downloaded from eduresourceza.com

- 1.5 Which ONE of the following changes may lead to an increase in the emf of an AC generator without changing its frequency?

Downloaded from eduresourceza.com

- 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.

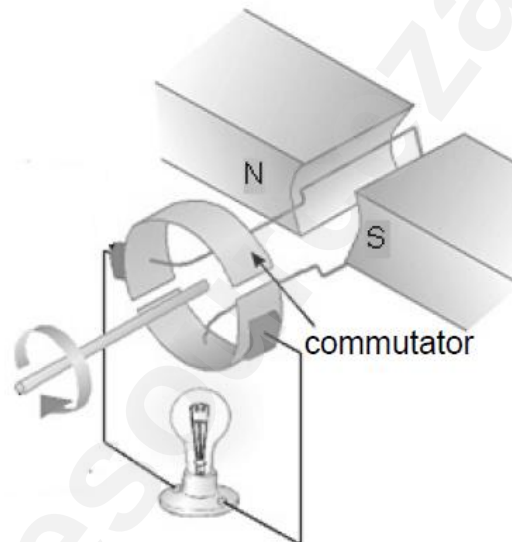
(Nov 2016) (2)

Long Questions

QUESTION 9 (Start on a new page.)

(Nov 2014)

The diagram below represents a simplified version of an electrical machine used to light up a bulb.

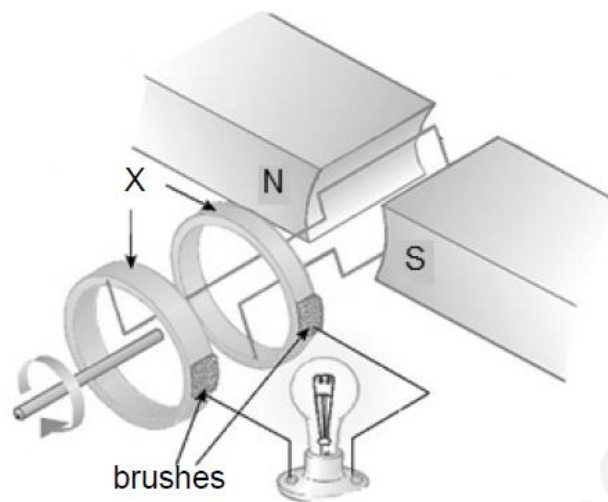


- 9.1 Name the principle on which the machine operates. (1)
- 9.2 State ONE way in which to make this bulb burn brighter. (1)

Downloaded from eduresourceza.com

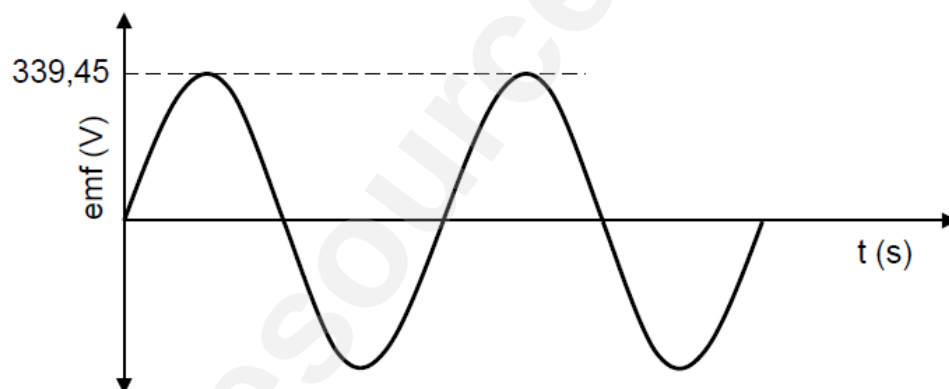
Some changes have been made to the machine and a new device is obtained as shown below.

Downloaded from eduresourceza.com



9.3 Name part **X** in the new device. (1)

9.4 The graph of output emf versus time obtained using the device in QUESTION 9.3 is shown below.



9.4.1 Define the term *root mean square value* of an AC voltage. (2)

9.4.2 Calculate the rms voltage. (3)

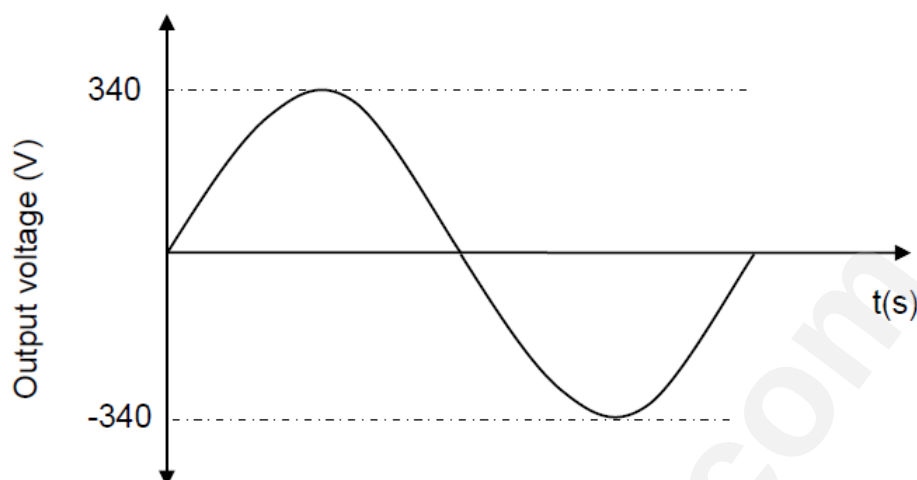
[8]

Downloaded from eduresourceza.com

QUESTION 9 (Start on a new page.)

(Feb 2015)

The graph below shows the output voltage from a household AC generator for one cycle of rotation of the coils.



- 9.1 A 100 W light bulb is connected to this generator and it glows at its maximum brightness. Use the information from the graph to calculate the:

9.1.1 Resistance of the bulb (5)

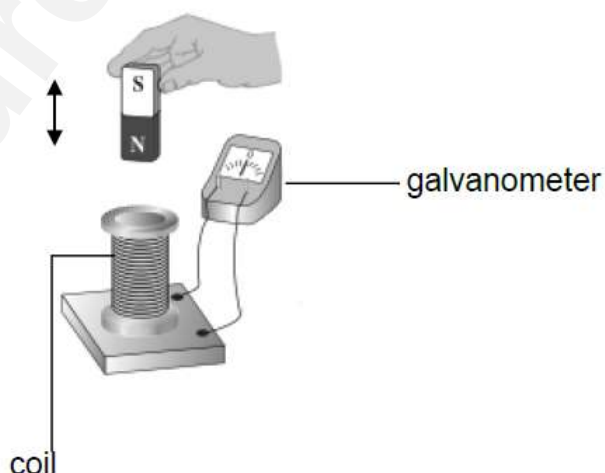
9.1.2 rms current through the bulb (3)

- 9.2 Give ONE reason why AC voltage is preferred to DC voltage for everyday use. (1)

[9]**QUESTION 10 (Start on a new page.)**

(Nov 2015)

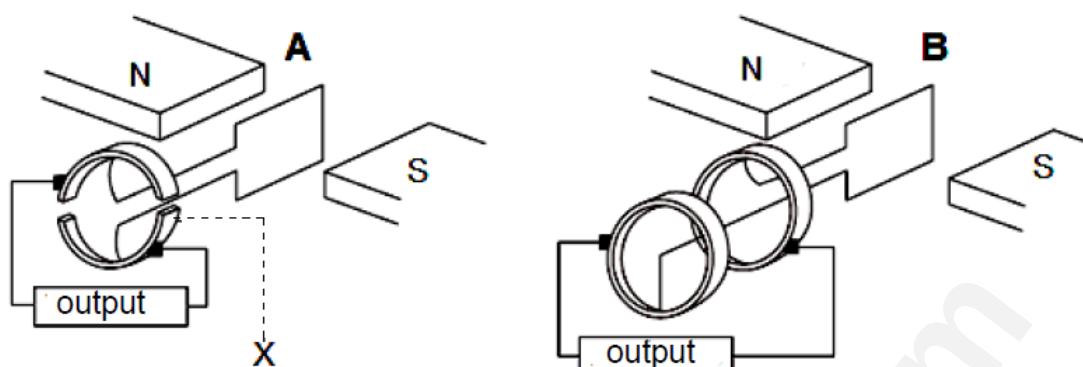
- 10.1 A teacher demonstrates how current can be obtained using a bar magnet, a coil and a galvanometer. The teacher moves the bar magnet up and down, as shown by the arrow in the diagram below.



- 10.1.1 Briefly describe how the magnet must be moved in order to obtain a LARGE deflection on the galvanometer. (2)

The two devices, **A** and **B**, below operate on the principle described in QUESTION 10.1.1 above.

Downloaded from eduresourceza.com



10.1.2 Write down the name of the principle. (1)

10.1.3 Write down the name of part **X** in device **A**. (1)

10.2 A 220 V, AC voltage is supplied from a wall socket to an electric kettle of resistance $40,33 \Omega$. Wall sockets provide rms voltages and currents.

Calculate the:

10.2.1 Electrical energy consumed by the kettle per second (4)

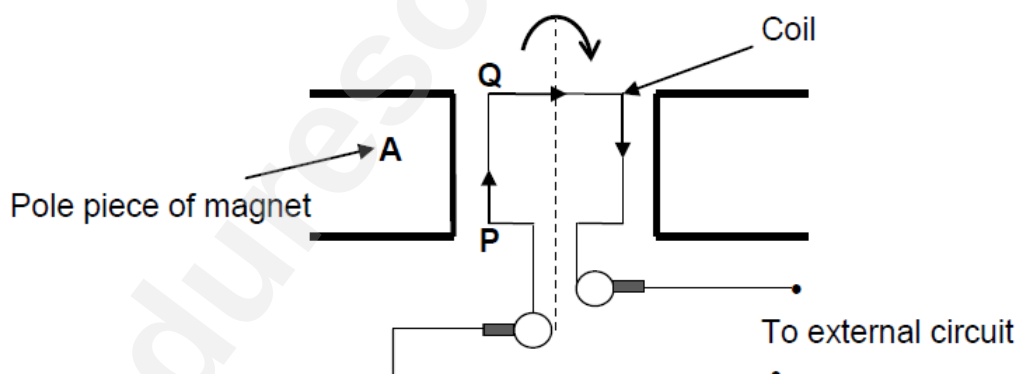
10.2.2 Maximum (peak) current through the kettle (3)

[11]

QUESTION 10 (Start on a new page.)

(Feb 2016)

10.1 A simplified sketch of an AC generator is shown below.



The coil of the generator rotates clockwise between the pole pieces of two magnets. At a particular instant, the current in the segment **PQ** has the direction shown above.

10.1.1 Identify the magnetic pole **A**.
Only write NORTH POLE or SOUTH POLE. (1)

10.1.2 The coil is rotated through 180° .

Will the direction of the current in segment **PQ** be from **P** to **Q** or **Q** to **P**? (1)

Downloaded from eduresourceza.com

- 10.2 An electrical device is connected to a generator which produces an rms potential difference of 220 V. The maximum current passing through the device is 8 A.

Downloaded from eduresourceza.com

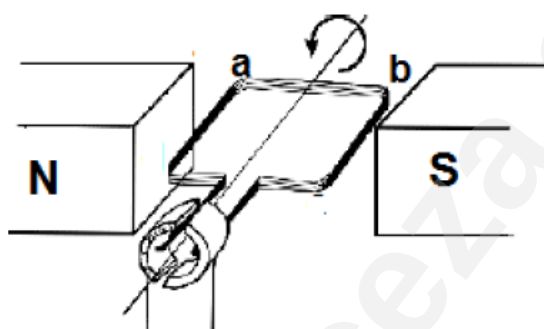
Calculate the:

- 10.2.1 Resistance of the device (5)
- 10.2.2 Energy the device consumes in two hours (5)
- [12]**

QUESTION 10 (Start on a new page.)

(June 2016)

- 10.1 A part of a simplified DC motor is shown in the sketch below.



- 10.1.1 In which direction (a to b, OR b to a) is the current flowing through the coil if the coil rotates anticlockwise as indicated in the diagram? (1)
- 10.1.2 Name the rule you used to answer QUESTION 10.1.1. (1)
- 10.1.3 Which component in the diagram must be replaced in order for the device to operate as an AC generator? (1)
- 10.2 An electrical device of resistance $400\ \Omega$ is connected across an AC generator that produces a maximum emf of 430 V. The resistance of the coils of the generator can be ignored.
- 10.2.1 State the energy conversion that takes place when the AC generator is in operation. (2)
- 10.2.2 Calculate the root mean square value of the current passing through the resistor. (5)

[10]

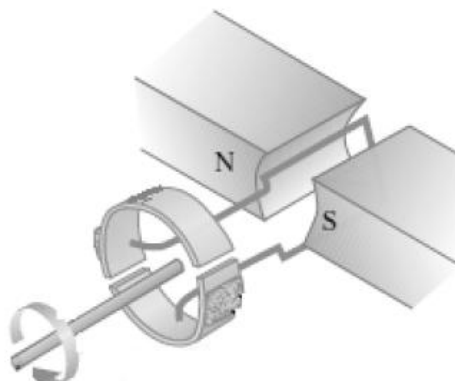
Downloaded from eduresourceza.com

QUESTION 9 (Start on a new page.)

(Nov 2016)

Downloaded from eduresourceza.com

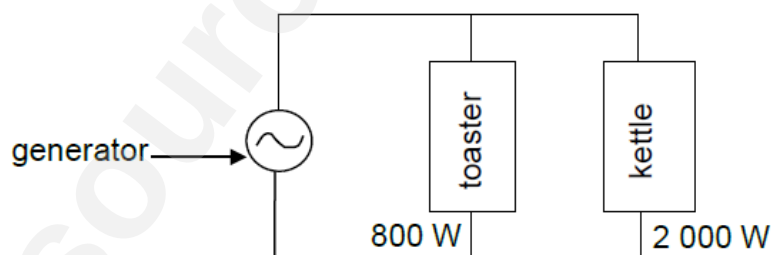
- 9.1 A generator is shown below. Assume that the coil is in a vertical position.



- 9.1.1 Is the generator above AC or DC? Give a reason for the answer. (2)

- 9.1.2 Sketch an induced emf versus time graph for ONE complete rotation of the coil. (The coil starts turning from the vertical position.) (2)

- 9.2 An AC generator is operating at a maximum emf of 340 V. It is connected across a toaster and a kettle, as shown in the diagram below.



The toaster is rated at 800 W, while the kettle is rated at 2 000 W. Both are working under optimal conditions.

Calculate the:

- 9.2.1 rms current passing through the toaster (3)
- 9.2.2 Total rms current delivered by the generator (4)
- [11]**

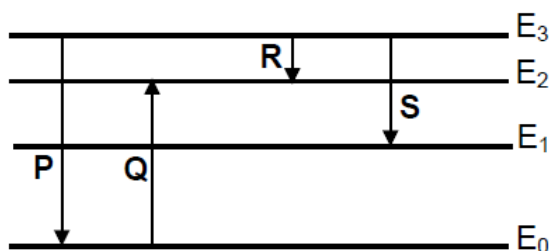
Downloaded from eduresourceza.com

Optical Phenomena

Downloaded from eduresourceza.com

Multiple Choice Questions

- 1.1 The diagram below shows the electron transitions **P**, **Q**, **R** and **S** between different energy levels in an atom.



Which ONE of the transitions will result in an emission of a radiation with the longest wavelength?

- A **P**
- B **Q**
- C **R**
- D **S**

(Nov 2014) (2)

- 1.2 The spectrum of an element from a star shows some absorption lines. These lines are produced because ...

- A atoms absorb energy when moving from an excited state to a lower energy state.
- B a cold gas absorbs certain frequencies of light passing through it.
- C a hot gas absorbs certain frequencies of light passing through it.
- D atoms release energy when moving from an excited state to a lower energy state.

(Feb 2015) (2)

- 1.3 When light of a certain wavelength is incident on a metal surface, no electrons are ejected. Which ONE of the following changes may result in electrons being ejected from the metal surface?

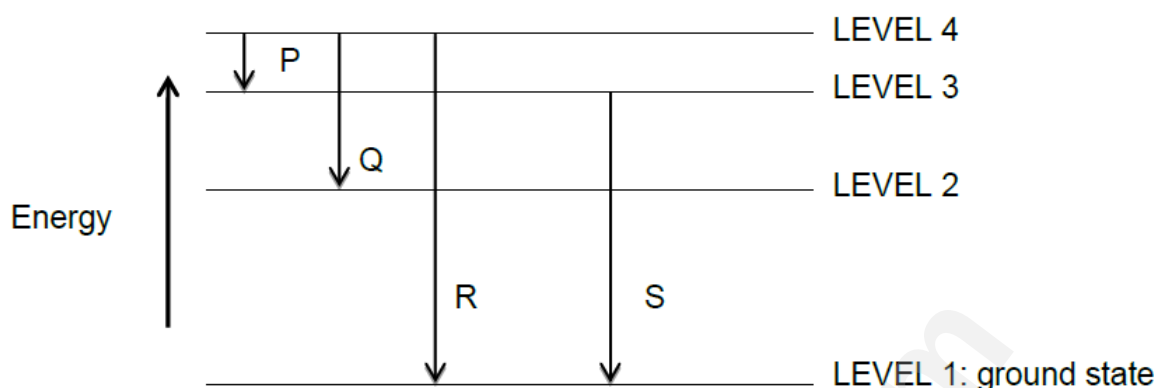
- A Increase the intensity of the light.
- B Use light with a much shorter wavelength.
- C Use metal with a larger work function.
- D Increase the surface area of the metal.

(Nov 2015) (2)

Downloaded from eduresourceza.com

- 1.4 The possible atomic transitions in an excited atom of an element are shown below.

Downloaded from eduresourceza.com



Which transition will produce the spectral line with the longest wavelength?

- A P
- B Q
- C R
- D S

(Feb 2016) (2)

- 1.5 In an experiment on the photoelectric effect, a scientist shines red light on a metal surface and observes that electrons are ejected from the metal surface. Later the scientist shines blue light, with the same intensity as the red light, on the same metal surface.

Which ONE of the statements below will be the CORRECT observation as a result of this change?

- A The number of ejected electrons per second will increase.
- B The number of ejected electrons per second will decrease.
- C The speed of the ejected electrons will decrease.
- D The maximum kinetic energy of the ejected electrons will increase.

(June 2016)

- 1.6 The wavelength of a monochromatic light source **P** is twice that of a monochromatic light source **Q**. The energy of a photon from source **P** will be ... of a photon from source **Q**.

- A a quarter of the energy
- B half the energy
- C equal to the energy
- D twice the energy

(Nov 2016) (2)

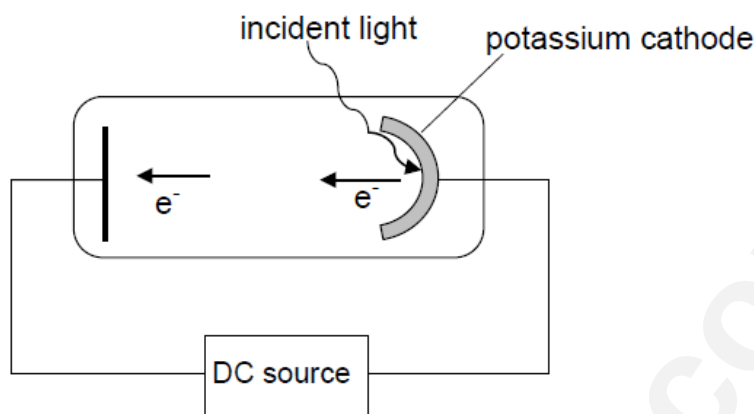
Downloaded from eduresourceza.com

Long Questions

QUESTION 10 (Start on a new page.) Downloaded from eduresourceza.com

(Nov 2014)

Ultraviolet light is incident onto a photocell with a potassium cathode as shown below. The threshold frequency of potassium is $5,548 \times 10^{14}$ Hz.



10.1 Define the term *threshold frequency* (cut-off frequency). (2)

The maximum speed of an ejected photoelectron is $5,33 \times 10^5 \text{ m}\cdot\text{s}^{-1}$.

10.2 Calculate the wavelength of the ultraviolet light used. (5)

The photocell is now replaced by another photocell with a rubidium cathode. The maximum speed of the ejected photoelectron is $6,10 \times 10^5 \text{ m}\cdot\text{s}^{-1}$ when the same ultraviolet light source is used.

10.3 How does the work function of rubidium compare to that of potassium? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)

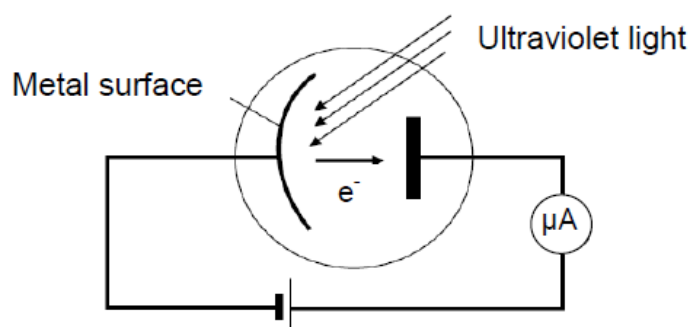
10.4 Explain the answer to QUESTION 10.3. (3)

[11]

QUESTION 10 (Start on a new page.)

(Feb 2015)

A learner uses photocells to determine the maximum kinetic energy of ejected photoelectrons. One photocell has a caesium cathode and the other has a sodium cathode. Each photocell is radiated by ultraviolet light from the same source as shown below.



Downloaded from eduresourceza.com

The incomplete results obtained are shown in the table below.

Downloaded from eduresourceza.com

NAME OF THE METAL	WORK FUNCTION OF THE METAL (J)	MAXIMUM KINETIC ENERGY OF PHOTOELECTRONS (J)
Caesium	$3,36 \times 10^{-19}$	$2,32 \times 10^{-19}$
Sodium	$3,65 \times 10^{-19}$	E_K

- 10.1 Define the term *work function of a metal*. (2)
- 10.2 Use the information in the table to calculate the wavelength of the ultraviolet light used in the experiment. (4)
- 10.3 Calculate the maximum kinetic energy, E_K , of an electron ejected from the sodium metal. (4)
- 10.4 The intensity of the incident ultraviolet light was then increased.
- 10.4.1 Give a reason why this change does NOT affect the maximum kinetic energy of the ejected photoelectrons. (1)
- 10.4.2 How does the increased intensity affect the reading on the ammeter? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)
- 10.4.3 Explain the answer to QUESTION 10.4.2. (2)
- [14]**

QUESTION 11 (Start on a new page.)

(Nov 2015)

In an experiment to demonstrate the photoelectric effect, light of different wavelengths was shone onto a metal surface of a photoelectric cell. The maximum kinetic energy of the emitted electrons was determined for the various wavelengths and recorded in the table below.

INVERSE OF WAVELENGTH $\frac{1}{\lambda} (\times 10^6 \text{ m}^{-1})$	MAXIMUM KINETIC ENERGY $E_{k(\text{max})} (\times 10^{-19} \text{ J})$
5,00	6,60
3,30	3,30
2,50	1,70
2,00	0,70

- 11.1 What is meant by the term *photoelectric effect*? (2)
- 11.2 Draw a graph of $E_{k(\text{max})}$ (y-axis) versus $\frac{1}{\lambda}$ (x-axis) ON THE ATTACHED ANSWER SHEET. (3)

11.3 USE THE GRAPH to determine:

Downloaded from eduresourceza.com

11.3.1 The threshold frequency of the metal in the photoelectric cell (4)

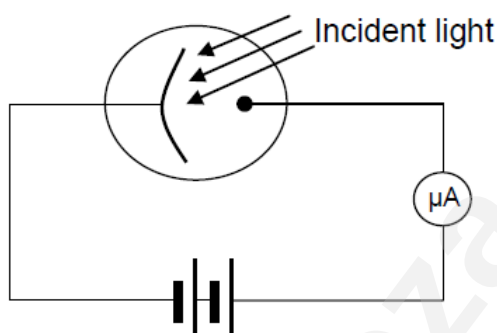
11.3.2 Planck's constant (4)
[13]

QUESTION 11 (Start on a new page.)

(Feb 2016)

An investigation was conducted to determine the effects of changes in frequency AND intensity on the current generated in a photoelectric cell when light is incident on it.

The apparatus used in the investigation is shown in the simplified diagram below.



The results of the experiment are shown in the table below.

EXPERIMENT	FREQUENCY (Hz)	INTENSITY (Cd)	CURRENT (μA)
A	$4,00 \times 10^{14}$	10	0
B	$4,50 \times 10^{14}$	10	0
C	$5,00 \times 10^{14}$	10	0
D	$5,01 \times 10^{14}$	10	20
E	$5,01 \times 10^{14}$	20	40
F	$6,50 \times 10^{14}$	10	30

11.1 Define the term *work function*. (2)

11.2 Identify an independent variable. (1)

The threshold frequency for the metal used in the photocell is $5,001 \times 10^{14}$ Hz.

11.3 Define the term *threshold frequency*. (2)

11.4 Calculate the maximum speed of an emitted electron in experiment F. (5)

In experiments D and E, the current doubled when the intensity was doubled at the same frequency.

11.5 What conclusion can be made from this observation? (2)
[12]

Downloaded from eduresourceza.com

QUESTION 11 (Start on a new page.)

(June 2016)

- 11.1 In an experiment on the photoelectric effect, light is incident on the surface of a metal and electrons are ejected.

11.1.1 What does the photoelectric effect indicate about the nature of light? (1)

11.1.2 The intensity of the light is increased. Will the maximum speed of the ejected electrons INCREASE, DECREASE or REMAIN THE SAME? Give a reason for the answer. (2)

The wavelength corresponding with the threshold frequency is referred to as *threshold wavelength*.

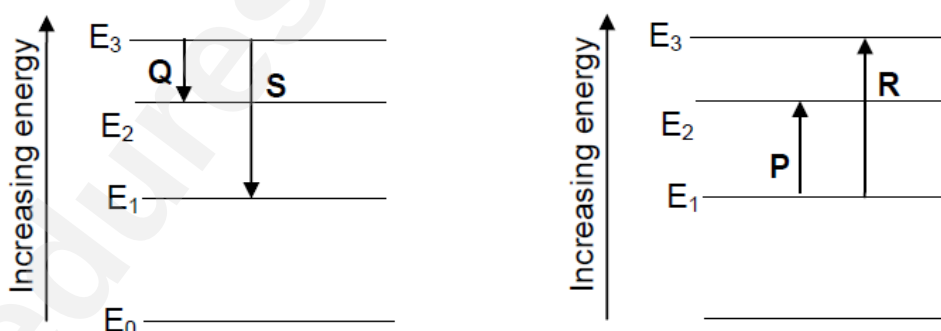
The table below gives the values of threshold wavelengths for three different metals.

METAL	THRESHOLD WAVELENGTH (λ_0) IN METRES
Silver	$2,88 \times 10^{-7}$
Calcium	$4,32 \times 10^{-7}$
Sodium	$5,37 \times 10^{-7}$

In the experiment using one of the metals above, the maximum speed of the ejected electrons was recorded as $4,76 \times 10^5 \text{ m}\cdot\text{s}^{-1}$ for light of wavelength 420 nm.

11.1.3 Identify the metal used in the experiment by means of suitable calculations. (5)

- 11.2 The simplified energy diagrams showing the possible electron transitions in an atom are shown below.



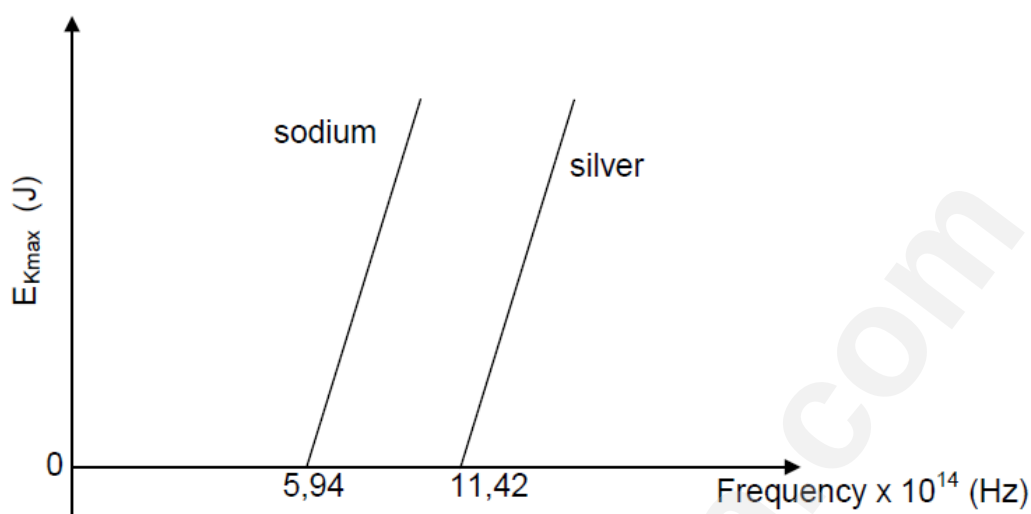
Using the letters **P**, **Q**, **R** and **S**, identify the lines that CORRECTLY show transitions that will result in the atom giving off an EMISSION SPECTRUM. Give a reason for the answer.

(4)
[12]

QUESTION 10 (Start on a new page.)

(Nov 2016)

- 10.1 A learner is investigating the photoelectric effect for two different metals, silver and sodium, using light of different frequencies. The maximum kinetic energy of the emitted photoelectrons is plotted against the frequency of the light for each of the metals, as shown in the graphs below.



- 10.1.1 Define the term *threshold frequency*. (2)
- 10.1.2 Which metal, sodium or silver, has the larger work function? Explain the answer. (3)
- 10.1.3 Name the physical constant represented by the slopes of the graphs. (1)
- 10.1.4 If light of the same frequency is shone on each of the metals, in which metal will the ejected photoelectrons have a larger maximum kinetic energy? (1)
- 10.2 In a different photoelectric experiment blue light obtained from a light bulb is shone onto a metal plate and electrons are released.
- The wavelength of the blue light is 470×10^{-9} m and the bulb is rated at 60 mW. The bulb is only 5% efficient.
- 10.2.1 Calculate the number of photons that will be incident on the metal plate per second, assuming all the light from the bulb is incident on the metal plate. (5)
- 10.2.2 **Without any further calculation**, write down the number of electrons emitted per second from the metal. (1)

[13]