Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scéimeanna Marcála	Scrúduithe Ardteistiméireachta, 2007
Fisic	**Gnáthleibhéal**

Marking Scheme	Leaving Certificate Examination, 2007
Physics	**Ordinary Level**

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Scéim Mharcála
Fisic

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Marking Scheme
Physics

Leaving Certificate Examination 2007
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Introduction

In considering this marking scheme the following points should be noted.

1. In many instances only key words are given, words that must appear in the correct context in the candidate's answer in order to merit the assigned marks.

2. Marks shown in brackets represent marks awarded for partial answers as indicated in the scheme.

3. Words, expressions or statements separated by a solidus, /, are alternatives which are equally acceptable.

4. Answers that are separated by a double solidus, //, are answers which are mutually exclusive. A partial answer from one side of the // may not be taken in conjunction with a partial answer from the other side.

5. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable.

6. The context and the manner in which the question is asked, and the number of marks assigned to the answer in the examination paper, determine the detail required in any question. Therefore, in any instance, it may vary from year to year.

Section A

Three questions to be answered.

Question 1 40 marks

(i) How did the student know the metre stick was in equilibrium? 4

level / horizontal / no movement / balanced // stated law of equilibrium 4

(ii) Copy the diagram and show all the forces acting on the metre stick 2 × 3

copy diagram 3
1.2 (N) shown at 50 cm 3
partial answer e.g. two forces correctly shown (3)

(iii) 6 + 6 + 3

(a) **Find the total upward force acting on the metre stick**

20.2 (N) 6

(b) **Find the total downward force acting on the metre stick**

20.2 (N) 6
partial answer e.g. 19 (N) (3)

(c) **Explain how these values verify one of the laws of equilibrium**

sum of forces is zero / resultant force is zero // upward forces = downward forces 3

(iv) 6 + 6 + 3

(a) **Find the sum of the anticlockwise moments of the upward forces about the 0 mark**

$(0.3 \times 10 + 0.9 \times 10.2 =)$ 12.18 (N m) 6
partial answer e.g. one moment correct / $F \times d$ / recognises the forces involved (3)

(b) **Find the sum of the clockwise moments of the downward forces about the 0 mark**

$(0.27 \times 4 + 0.5 \times 1.2 + 0.7 \times 15 =)$ 12.18 (N m) 6
partial answer e.g. one moment correct / $F \times d$ / recognises the forces involved (3)
Note: (a) and (b) reversed no penalty
Note: moments taken about a point other than the 0 mark 6 –1 marks in each case

(c) **Explain how these values verify the other law of equilibrium**

sum of moments is zero // (sum of) clockwise moments = anti-clockwise moments 3

Question 2 40 marks

You carried out an experiment to measure the wavelength of a monochromatic light source using a diffraction grating. The diffraction grating had 600 lines per mm.

(i) Draw a labelled diagram of the apparatus that you used **6 + 2 × 3**

diffraction grating / Young's slits 6

(monochromatic) light source / sodium
spectrometer // screen
scale // metre stick any two 2 × 3
any one (3)

NOTE: no labels, deduct 2

(ii) Name a source of monochromatic light **4**

sodium (lamp) / laser 4
any gas that produces a line spectrum (2)

(iii) State the measurements you took during the experiment? **2 × 3**

correct angle // distance from grating to screen 3
another correct angle // distance between fringes 3
partial answer e.g. spectrometer adjustment // laser adjustment (3)

(iv) What is the distance between each line on the diffraction grating? **6 or 3**

$\left(d = \frac{1}{\text{number of lines per metre}} = \right)$ $\frac{1}{600000}$ / 1.6666×10^{-6} (m) 6

partial answer e.g. correct equation (3)

(v) How did you determine the wavelength of the light? **6 or 3**

(nλ =) $d \sin\theta$ // (nλ =) $d\frac{x}{D}$ 6

partial answer (3)

Give one precaution that you took to get an accurate result **6 or 3**

one spectrometer precaution e.g. ensure the fringe not too wide/not too dim,
ensure that the crosshairs are on the centre of the fringe, level the table,
focus the telescope (for infinity), measure the angle between the first order
images on the left and on the right, adjust the collimator,
ensure that the diffraction grating is perpendicular to the (monochromatic) light,
use a grating with a large number of lines, ensure D is large, repeat for
different orders and take the average, etc. any one 6

partial answer e.g. repeat the experiment, mentions no parallax, refers to dark room (3)

Question 3 **40 marks**

(i) Draw a labelled diagram of the apparatus used in the experiment **4 × 3**

beaker of water
mercury thermometer
uncalibrated thermometer
heat source
means of recording thermometric property
detail to improve the accuracy e.g. stirrer

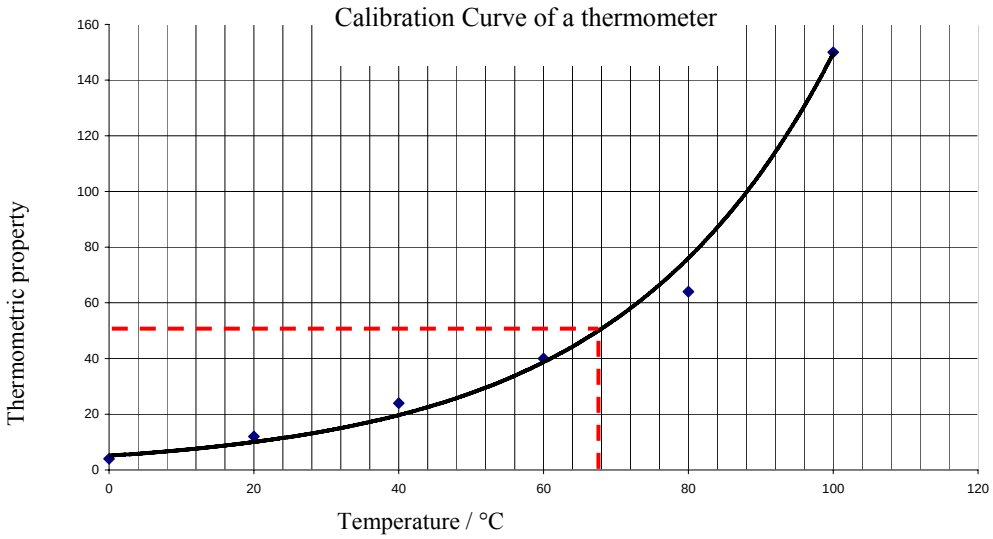
each line merits 3 marks, any four lines 4 × 3

NOTE: no labels, deduct 2

(ii) Using the data in the table, draw a graph on graph paper of the value of the thermometric property against its temperature. **4 × 3**

Put temperature on the horizontal (X-axis)

label axes correctly, (name / symbol / unit acceptable) 3
plot three points correctly 3
plot another three points correctly 3
smooth curve 3
if graph paper is not used, maximum mark 3 × 3
if temperature is on the Y-axis, maximum mark 3 × 3



(iii) Use your graph to estimate the temperature when the value of the Thermometric property is 50 **6 or 3**

68 – 72 (°C) / answer consistent with graph 6
partial e.g. evidence of using the graph (when thermometric property is 50) (3)

(iv) Give an example of a thermometric property **6 or 3**

resistance / emf / voltage / colour / volume / length / pressure, etc. any one 6
partial answer e.g. definition of thermometric property (3)

(v) How was the value of this thermometric property measured? **4**

ohmmeter / multimeter / metre stick, etc. 4

Question 4 40 marks

(i) Draw a labelled diagram of the apparatus used in the experiment **2(2 × 3)**

ammeter/multimeter, heating coil, thermometer, calorimeter, insulation, stop watch — any one (3) — any two — 2 × 3

variable power supply // power supply and variable resistance — 3

detail e.g. closed circuit — 3

NOTE: no labels, deduct 2

(ii) How was the current changed during the experiment? **4**

adjust the (variable) power supply // adjust the (variable) resistor — 4

(iii) Copy the table and complete it in your answerbook. **2 × 3**

I/A	1.0	1.5	2.0	2.5	3.0	3.5	4.0
I^2/A^2	**1.0**	**2.25**	4	**6.25**	**9.0**	**12.25**	**16.0**
$\Delta\theta$/°C	2.2	5.0	8.8	13.8	20.0	26.0	35.2

all correct 2 × 3

any 3 correct (3)

(iv) Using the data in the completed table, draw a graph on graph paper of $\Delta\theta$ against I^2. Put I^2 on the horizontal axis (X-axis) **4 × 3**

label axes correctly, (name / symbol / unit acceptable) — 3

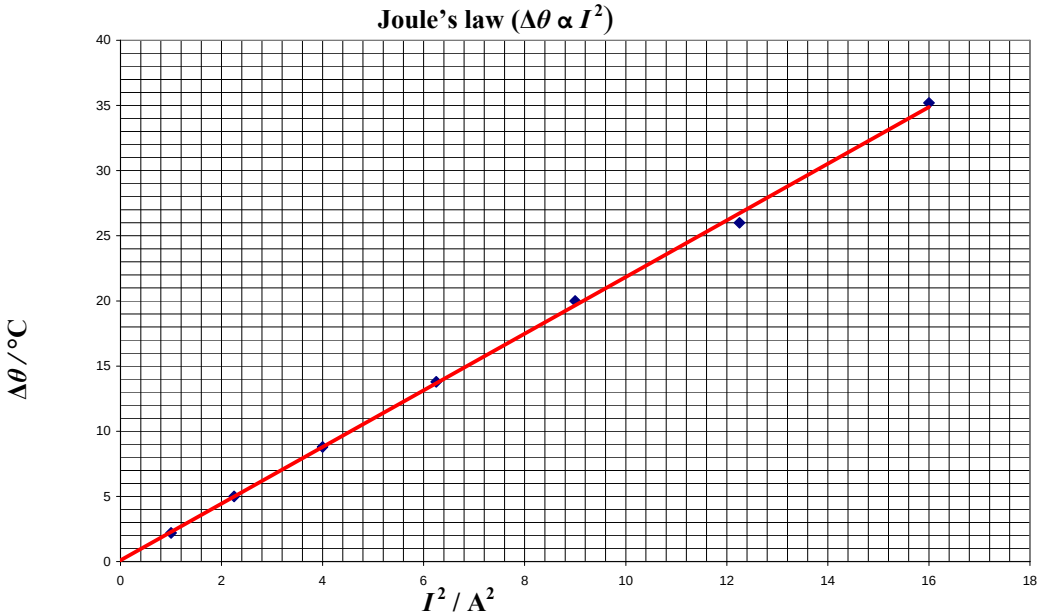
plot three points correctly — 3

plot another three points correctly — 3

straight line — 3

if graph paper is not used, maximum mark 3 × 3

if I^2 is on the Y-axis, maximum mark 3 × 3



(v) Explain how your graph verifies Joule's law ($\Delta\theta \propto I^2$) **2 × 3**

(straight) line — 3

through origin // shows that $\Delta\theta \propto I^2$ — 3

SECTION B (280 Marks)
Five questions to be answered

Question 5 **any *eight* parts** **56 marks**

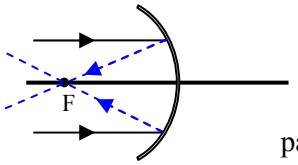
(a) **State Newton's second law of motion** **7 or 4**
rate of change of momentum is directly proportional to the applied force // $F = ma$ 7
partial answer (4)

(b) **Which of the following is not a renewable source of energy?**
wind **nuclear** **solar** **hydroelectric** **7**
nuclear 7

(c) **The temperature of a body is 34 °C. What is its temperature in kelvin?** **7 or 4**
307 (K) 7
partial answer e.g. 273 stated or implied / 239 (4)

(d) **Name two methods by which heat can be transferred** **7 or 4**
conduction, convection, radiation, valid examples any two 7
any one (4)

(e) **The diagram shows parallel rays of light approaching a concave mirror. Copy the diagram and show the paths of the rays after they strike the mirror** **7 or 4**



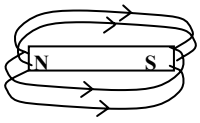
two correct rays 7
partial answer e.g. one ray drawn correct (4)

(f) **Give one application of the Doppler effect** **7 or 4**
red shift of stars / speed detection / specific medical use / valid example, etc. 7
partial answer e.g. used in hospitals (4)

(g) **Name two safety devices that are used in domestic electric circuits** **7 or 4**
fuse, (trip) switch, miniature circuit breaker / MCB, residual current device / RCD, earthing, bonding, etc. any two 7
any one (4)

(h) **Name the electrical component represented in the diagram** **7 or 4**
LDR / light dependant resistor 7
partial answer e.g. mention of resistor / thermistor / light (4)

(i) **Draw a sketch of the magnetic field around a bar magnet** **7 or 4**



Correct diagram to show
magnet, two field lines, correct direction on lines 7
partial answer e.g. incomplete diagram (4)

(j) **The half life of a radioactive element is 3 days. What fraction of a sample of the radioactive element will remain after 9 days?** **7 or 4**
⅛ 7
partial answer e.g. $\frac{1}{4}$ (4)

Question 6 56 marks

Define (i) work, (ii) power, and give the unit of measurement for each one **2(3 × 3)**

(i) work **3 × 3**

(work is done when a) force // formula 3
moves (an object / its point of application) // notation 3
partial answer e.g. energy (3)

Units: joule / N m 3

(ii) power **3 × 3**

work /energy // formula 3
rate of / per second // notation 3
partial answer (3)

Units: watt / J s^{-1} 3

What is the difference between potential energy and kinetic energy? **2 × 3**

potential energy is (energy a body has) due to its position/condition/state / *mgh* /example 3
kinetic energy is (energy a body has) due to its motion / ½ mv^2 / example 3
partial answer (3)

An empty lift has a weight of 7200 N and is powered by an electric motor. The lift takes a person up 25 m in 40 seconds. The person weighs 800 N. Calculate:

(i) the total weight raised by the lift's motor **4 or 2**

7200 + 800 // 8000 (N) 4
partial answer e.g. 7200 (2)

(ii) the work done by the lift's motor **2 x 3**

8000 × 25 // 200×10^3 (J) / 200 (kJ) 2 × 3
partial answer e.g. W = F × s / partial substitution (3)

(iii) the power output of the motor **2 x 3**

$\frac{200 \times 10^3}{40}$ / 5000 (W) / 5 (kW) 2 × 3

partial answer e.g. $P = \frac{w}{t}$ / partial substitution (3)

(iv) the energy gained by the person in taking the lift. **2 x 3**

(800 × 25 =) 20 (kJ) 2 × 3
partial answer e.g. partial substitution (3)

If instead the person climbed the stairs to the same height in 2 minutes, calculate the power generated by the person in climbing the stairs. **5 or 3**

$\frac{800 \times 25}{120}$ / 166.6 (W) 5
partial answer e.g. partial substitution (3)

Note: if the mass is confused with the weight penalise -1 in each case

Give two disadvantages of using a lift. **5 or 3**

needs more energy / uses energy / no exercise so not good for health / cost involved / can be dangerous, etc. any two 5
any one (3)

Question 7 56 marks

Explain <u>resonance</u> and <u>natural frequency</u> **4 × 3**

resonance rapid amplification when forced vibration is // transfer of energy 3
at natural frequency 3
partial e.g. incomplete answer / example (3)
a labelled diagram may merit full marks

natural frequency frequency that a body oscillates at // fundamental frequency 3
(when) placed into motion / vibrates freely 3
partial e.g. incomplete answer / example (3)
a labelled diagram may merit full marks

Describe an experiment to demonstrate resonance **4 × 3**

apparatus: tube of air, tuning fork, means of varying the length any two 2×3
any one (3)
procedure: hold vibrating tuning fork near the opening and vary tube length 3
observation/conclusion: sound amplification 3
accept valid alternatives e.g. sonometer, two tuning forks of the same frequency, etc.
a labelled diagram may merit full marks

What is the name given to (i) the distance A (ii) the height B? **6 + 3**

A = wavelength
B = amplitude / intensity two correct 6 + 3
any one (6)
partial answer e.g. frequency, loudness (3)

Explain what is meant by the frequency of a wave **2 × 3**

number of waves 3
(emitted/produced/passing a point) per second 3
partial answer (3)

State the wave property on which (i) the loudness, (ii) the pitch, of a note depends **2 × 4**

(i) (loudness depends on) amplitude // frequency / wavelength 4
(ii) (pitch depends on) frequency / wavelength 4

A tin-whistle produces a note of 256 Hz. Calculate the wavelength of this note. **3 × 3**

The speed of sound in air is 340 m s^{-1}

$\left(\lambda = \frac{c}{f} = \right) \frac{340}{256}$ / 1.33 (m) 3×3

two quantities substituted correctly into the equation without re-arranging / $\frac{256}{340}$ (2×3)

one quantity substituted correctly into the equation (3)

Question 8 56 marks

(a)

(i) What is meant by the terms *dispersion* and *spectrum*? **3 × 3 + 1**

dispersion – breaking up white light
into its (constituent) colours

spectrum – the range of colours/wavelengths present in
the light source / in white light / rainbow / em radiation

four correct 3 × 3 + 1

three correct (3 × 3), two correct (2 × 3), one correct (1 × 3)

accept spreads out / scatters for breaking up

(ii) What happens to the white light when it enters the prism at Z? **6 or 3**

changes direction / is refracted / slows down / dispersed / broken up 6

partial answer (3)

(iii) Name the invisible radiation formed on the screen at (i) region X, (ii) region Y **6 + 3**

X = infra-red / IR

Y = ultra-violet / UV

two correct 6 + 3

one correct (6)

partial (3)

(iv) Describe how to detect one of these invisible radiations **6 + 2 × 3**

apparatus: blackened thermometer /infra red thermometer // florescent material 6

procedure: beyond red // beyond violet 3

observation/conclusion: rise in temperature // will fluoresce/glow 3

accept valid alternatives

a labelled diagram may merit full marks

(v) Give a use for one of these invisible radiations **6 or 3**

infra-red: source of heat, keep things warm, hatch chickens, heat treatment of muscles etc.

ultra-violet: detect forged currency, disco lights, used in insect removal device, sterilisation, suntan, forensics, etc.

any one 6

partial answer (3)

(b)

The colour on a TV screen is made by mixing the primary colours.

(i) Name the primary colours **6 + 3**

red, green, blue all three correct 6 + 3

any one correct (6)

(ii) How is a secondary colour (e.g. yellow) produced on a TV screen? **4**

mixing **two** (primary) colours/ mixing red and green (colours) 4

accept mixing primary colours

Question 9 **56 marks**

(a)

State Coulomb's law of force between charges **3 × 3**

force proportional / $F \propto$ 3

product of charges / Q_1Q_2 3

inversely proportional to the distance between the charges squared / $\propto \frac{1}{r^2}$ 3

(i) Describe how an electroscope is given a positive charge **3 × 3**

charge a rod (negatively) //charge a rod (positively) 3

bring the (charged) rod close to the cap and earth // touch the cap with (charged) rod 3

remove the earth before removing the rod // metal / conductor (rod) 3

accept valid alternatives e.g. Van De Graaff

labelled diagrams may merit full marks

(ii) What is observed when the cap of an electroscope is earthed?
Why does this happen? **6 + 3**

What? leaves drop / fall 6

Why? (negative) charges move from the earth (to the cap) 3

(iii) How is the cap of the electroscope earthed? **6 or 3**

touch (with finger) 6

partial answer (3)

(b) A capacitor is connected to a switch, a battery and a bulb as shown in the diagram. When the switch is moved from position A to position B, the bulb lights briefly

(i) What happens to the capacitor when the switch is in position A? **6**

it charges / stores charge / stores energy 6

partial answer e.g. gets hot (3)

(ii) Why does the bulb light when the switch is in position B? **6 or 3**

capacitor discharges // current flows 6

partial answer e.g. closed circuit (3)

(iii) When the switch is in position A the capacitor has a charge of 0.6 C, calculate its capacitance **6 or 3**

$\left(C = \frac{Q}{V} = \right) \frac{0.6}{6}$ / 0.1 (F) 6

partial answer e.g. one quantity substituted correctly into the equation / $\frac{6}{0.6}$ (3)

(iv) Give a use for a capacitor **5 or 3**

store charge, (radio) tuning, filtering, smoothing, timing, coupling, store energy, flash camera, phone charger, etc. any one 5

partial answer e.g. storing electric current (3)

Question 10 56 marks

What are X-rays? Give one use for X-rays. **2(6 or 3)**

X-rays: electromagnetic waves // high energy radiation 6
partial answer e.g. stated property such as ionisation / radiation (3)

Use: to photograph bones/ internal organs, to treat cancer, to detect flaws in materials, to determine the thickness of materials, etc. any one 6
partial answer e.g. reference to photograph / medicine / industry, etc (3)

The diagram shows a simple X-ray tube.
Name the parts labelled A, B and C. **6 + 3 + 3**

A = Cathode / (heating) coil / filament
B = Anode / target
C = Lead / shield

all three correct 6 + 3 + 3
two correct (6 + 3)
one correct (6)

A and B mismatched -3 marks

(i) Explain how the electrons are emitted from A. **2 × 6**

thermionic / heating 6
emission / coil 6
partial answer e.g. reference to voltage (6)

(ii) What is the purpose of the high voltage supply? **2 × 3**

to accelerate/ pull / attract /give more energy to // to produce 3
electrons // cathode rays / X -rays 3

(iii) What happens when the electrons hit part B? **4**

X-rays are emitted // energy released (as X-rays) // gets hot 4

(iv) Name a suitable material to use for part B. **6 or 3**

target named metal e.g. tungsten / molybdenum / titanium, etc. 6
anode named metal e.g. copper, etc. (6)
partial answer (3)

(v) Give one safety precaution when using X-rays **4**

use a lead shield, lead apron, lead glass, monitor dosage, reduce dosage, etc. any one 4

Question 11 56 marks

Read this passage and answer the questions below.

Radon is a naturally occurring radioactive gas. It originates from the decay of uranium, which is present in small quantities in rocks and soils. Radon is colourless, odourless and tasteless and can only be detected using special equipment, like a Geiger-Müller tube, that can measure the radiation it releases. Because it is a gas, radon can move freely through the soil and enter the atmosphere. When radon reaches the open air, it is quickly diluted to harmless concentrations, but when it enters an enclosed space, such as a house, it can sometimes accumulate to unacceptably high concentrations. Radon can enter a building from the ground through small cracks in floors and through gaps around pipes and cables. Radon is drawn from the ground into a building because the indoor air pressure is usually lower than outdoors. Being radioactive, radon decays releasing radiation. When radon is inhaled into the lungs the radiation released can cause damage to the lung tissue.

(Adapted from Understanding Radon by the RPII)

(a) **What is radioactivity** **7 or 4**

decay of nuclei with the emission of radiation / energy /α / β / γ		7
partial answer e.g. emission of radiation /α / β / γ // radioactive property		(4)
decay of unstable nuclei		(7)

(b) **What is the source of radon?** **7 or 4**

uranium, radium, rocks, soil	any one	7
partial		(4)

(c) **Name a detector of radiation** **7**

Geiger –Muller tube, ionisation chamber, cloud chamber, GLE, etc.	any one	7

(d) **How does radon enter a building?** **7**

through small cracks, through the floor, through gaps around pipes	any one	7

(e) **How can the build-up of radon in the home be prevented?** **7 or 4**

by installing a radon membrane, installing a depressurising unit, sealing cracks, sealing gaps, having good ventilation, etc.	any one	7
partial		(4)

(f) **Why is radon dangerous?** **7 or 4**

can damage lung tissue // can cause cancer		7
partial		(4)

(g) **Why is radon harmless in the open air?** **7 or 4**

diluted (to harmless concentrations)		7
partial		(4)

(h) **Name a radioactive element other than radon** **7 or 4**

uranium, radium, plutonium, carbon 14, etc.	any one	7
partial		(4)

Question 12 **56 marks**

Part (a)

State the principle of conservation of momentum **7 or 4**

momentum before = momentum after // $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ 7

partial e.g. incomplete equation // in a closed system // law of conservation of energy (4)

A rocket is launched by expelling gas from its engines. Use the principle of conservation of momentum to explain why a rocket rises **6 + 3**

gas moves down (with a momentum)

causing the rocket to move up (in the opposite direction with an equal momentum)

two lines correct 6 + 3

one line correct (6)

partial e.g. same momentum / opposite direction (3)

The diagram shows two shopping trolleys each of mass 12 kg on a smooth level floor. Trolley A moving at 3.5 m s^{-1} strikes trolley B, which is at rest.

After the collision both trolleys move together in the same direction. Calculate: **2(6 or 3)**

(i) the initial momentum of trolley A **6 or 3**

(*mu* =) 12×3.5 / 42 (kg m s^{-1}) 6

partial answer e.g. substitutes one quantity correctly into the equation (3)

(ii) the common velocity of the trolleys after the collision **6 or 3**

(v =) $\frac{42}{24}$ / 1.75 (m s^{-1}) 6

partial answer e.g. $24v$ (3)

Part (b)

(i) Define pressure **2 × 3**

Force / F (over) 3

divided by area / A 3

partial answer e.g. Pa (3)

Describe an experiment to demonstrate that the atmosphere exerts pressure **2 × 3 + 2**

apparatus: glass of water and cardboard // can of water and heat source 3

procedure: place cardboard over glass and invert // boil water and put on lid 3

observation/conclusion: water remains in glass // can collapses 2

accept valid alternatives e.g. sucking out air methods

labelled diagrams may merit full marks

(ii) State Boyle's law **2 × 3**

pressure // PV 3

inversely proportional to volume // = constant 3

partial answer e.g. for fixed mass of gas // if temperature remains same (3)

Find the volume of the balloon when it has risen to a height where the atmospheric pressure is 500 hPa **6 or 3**

($P_1V_1 = P_2V_2$) $\frac{2 \times 1000}{500}$ / 4 (m^3) 6

partial answer e.g. incomplete substitution (3)

What will happen to the balloon as it continues to rise? **2**

(it will continue to) expand // burst // cool 2

Part (c)

State Ohm's law **6 or 3**

$V \propto I$ // $V = IR$ 6

V / I / R / $\propto$ / at a constant temperature (3)

The circuit diagram shows two resistors connected in series with a 6 V battery.
Calculate:

(i) the total resistance of the circuit **6 or 3**

(R =) 3 + 9 / 12 (Ω) 6

partial answer e.g. one quantity substituted correctly into the equation (3)

(ii) the current in the circuit **6 or 3**

$(I = \frac{V}{R} =)\ \frac{6}{12}$ / 0.5 (A) 6

partial answer e.g. one quantity substituted correctly into the equation / $I = \frac{V}{R}$ (3)

(iii) the potential across the 9 Ω resistor **6 or 3**

($V = IR =$) 0.5 × 9 / 4.5 (V) 6

partial answer e.g. one quantity substituted correctly into the equation / $V = IR$ (3)

Name an instrument used to measure the potential difference **4or 2**

voltmeter / multimeter 4

partial answer e.g. ammeter (2)

Part(d)

What is electromagnetic induction? **6 + 4**

emf / voltage / potential difference / current is induced

(due to)changing (magnetic) flux / field // moving magnet

two lines correct 6 + 4

one line correct (6)

a diagram or example may merit full marks

The diagram shows a transformer.

(i) Name the parts labelled A and B **2 × 3**

A = soft iron / core / (laminated) iron / former 3

B = primary / input / coil 3

(ii) The input voltage is 230 V. Part B has 4600 turns and part C has 120 turns.
Calculate the output voltage. **6 or 3**

$(V_0 =)\ \frac{230 \times 120}{4600}$ // 6 (V) 6

partial answer e.g. incomplete substitution (3)

(iii) Name a device that uses a transformer. **6 or 3**

mobile phone charger, television, power supply, washing machine, etc. any one 6

partial answer (3)

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