Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2019

Marking Scheme

Physics

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

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

3. 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.

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

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

6. Each time an arithmetical slip occurs in a calculation, one mark is deducted.

7. A zero should only be recorded when the candidate has attempted the question but does not merit marks. If a candidate does not attempt a question (or part of) examiners should record NR.

8. Examiners are expected to annotate parts of the responses as directed at the marking conference. (See below.)

Symbol	Name	Use
	Cross	Incorrect element
	Tick_n	Correct element (n marks)
	Left Bracket	To identify and separate one of several attempts at an answer
	Horizontal wavy line	To be noticed
	Vertical wavy line	Additional page (at bottom of page)
	−1	−1
P	Partial	Partial answer

9. Bonus marks at the rate of 10% of the marks obtained will be given to a candidate who answers entirely through Irish and who obtains 75% or less of the total mark available in (i.e. 300 marks or less). In calculating the bonus to be applied decimals are always rounded down, not up ¬ e.g., 4.5 becomes 4; 4.9 becomes 4, etc. See below for when a candidate is awarded more than 300 marks.

Marcanna Breise as ucht freagairt trí Ghaeilge

Léiríonn an tábla thíos an méid marcanna breise ba chóir a bhronnadh ar iarrthóirí a ghnóthaíonn níos mó ná 75% d'iomlán na marcanna.

N.B. Ba chóir marcanna de réir an ghnáthráta a bhronnadh ar iarrthóirí nach ngnóthaíonn níos mó ná 75% d'iomlán na marcanna don scrúdú. Ba chóir freisin an marc bónais sin **a shlánú síos**.

Tábla 400 @ 10%

Bain úsáid as an tábla seo i gcás na n-ábhar a bhfuil 400 marc san iomlán ag gabháil leo agus inarb é 10% gnáthráta an bhónais.

Bain úsáid as an ngnáthráta i gcás 300 marc agus faoina bhun sin. Os cionn an mharc sin, féach an tábla thíos.

Bunmharc	Marc Bónais
301 - 303	29
304 - 306	28
307 - 310	27
311 - 313	26
314 - 316	25
317 - 320	24
321 - 323	23
324 - 326	22
327 - 330	21
331 - 333	20
334 - 336	19
337 - 340	18
341 - 343	17
344 - 346	16
347 - 350	15

Bunmharc	Marc Bónais
351 - 353	14
354 - 356	13
357 - 360	12
361 - 363	11
364 - 366	10
367 - 370	9
371 - 373	8
374 - 376	7
377 - 380	6
381 - 383	5
384 - 386	4
387 - 390	3
391 - 393	2
394 - 396	1
397 - 400	0

SECTION A (120 MARKS)

Answer **three** questions from this section. Each question carries 40 marks.

Question 1 **40 marks**

A student performed an experiment to investigate the laws of equilibrium. She suspended a metre stick from two Newton spring balances and hung weights from the metre stick until it was balanced and level, as below.

Before setting up the experiment, the student took two measurements. She measured the weight of the metre stick to be 2 N. She found its centre of gravity at the 50 cm mark.

(i) **How did the student measure the weight of the metre stick?** **6 or 3**

Newton balance // weighed it and multiplied by *g* 6

partial answer e.g. electric balance (3)

(ii) **How did she find the centre of gravity of the metre stick?** **6 or 3**

suspended from string/thread and moved the string until it balanced 6

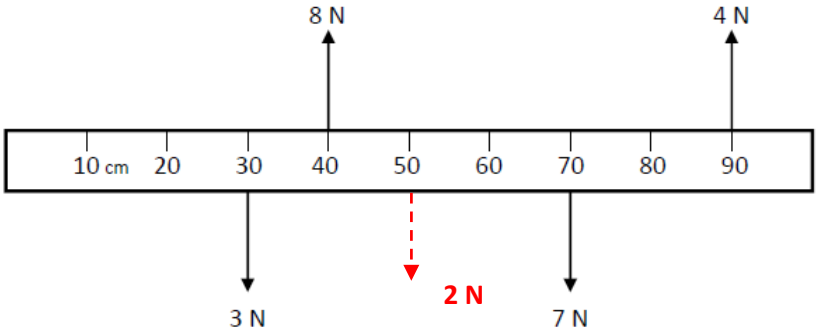
partial answer (3)

(*iii*) How did she make sure that the metre stick was balanced and level? **6 or 3**

balanced: (hung weights until) no movement 3

level: horizontal / used a spirit level / visually level 3

(*iv*) Redraw the above diagram in your answerbook and include the weight of the metre stick. **6 or 3**



copy diagram and show given forces 3

2 N shown downwards at 50 cm mark 3

The first law of equilibrium states that the sum of the upward forces equals the sum of the downward forces.

(*v*) Using appropriate calculations, show that the first law of equilibrium is verified in this experiment. **12 or 6 or 3**

(Force up =) 8 + 4 = 12 6

(Force down =) 3 + 2 + 7 = 12 6

partial answer e.g. any adding of given forces (3)

The second law of equilibrium states that the sum of the clockwise moments equals the sum of the anticlockwise moments.

(*vi*) Using the 0 cm mark on the metre stick as the fulcrum, the calculations for the clockwise moments are given below. In your answerbook, complete the calculations to verify the second law of equilibrium. **4 or 2**

Clockwise moments	(3 × 30) + (2 × 50) + (7 × 70)	680 N cm
Anticlockwise moments	**(8×40) + (4×90)**	680 N cm

(8×40) + (4×90) 4

(8×40) / (4×90) (2)

Question 2 **40 marks**

A student carried out an experiment to measure the specific latent heat of fusion of ice. During the experiment, ice at 0 °C was added to a calorimeter containing warm water.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. **12 or 9 or 6 or 3**

labelled diagram to show:
calorimeter (with water) 3
thermometer 3
ice 3
(electronic) balance 3
incorrect experiment, maximum mark 3 × 3

Note: no labels, deduct 1

(*ii*) The ice was crushed before it was added to the water. Why was the ice crushed? **6**

helps it to melt faster // reference (to increase in) the surface area 6

(*iii*) Mass and temperature were measured in this experiment.
Name (*a*) one mass measured and (*b*) one temperature measured. **12 or 6**

(a) mass of empty calorimeter / mass of calorimeter and water (and ice) / mass of ice 6

(b) temperature of water initially/finally // temperature of (crushed) ice 6

(*iv*) Name an instrument used to measure one of the quantities listed in (*iii*) above. **6**

(electronic) balance // thermometer 6

(*v*) State one precaution used in this experiment, other than crushing the ice. **4**

Insulate the calorimeter, use a sensitive/digital thermometer, stir, dry the crushed ice, use lots of ice, avoid splashing, do quickly etc any one 4

Question 3 **40 marks**

A student carried out an experiment to calculate the refractive index, *n*, of a material.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. **12 or 9 or 6 or 3**

labelled diagram to show:

glass/(perspex) plastic block	// container of liquid	6
raybox / laser / (optical) pins	//(optical) pins	3
detail e.g. protractor, sheet of paper, normal, critical angle	// mirror, ruler	3

other valid methods acceptable

incorrect experiment, maximum mark 6 + 3

Note: no labels, deduct 1

(*ii*) State the formula used in this experiment to calculate the refractive index, *n*. **6**

$\frac{\sin i}{\sin r}$ // $\frac{real\ depth}{apparent\ depth}$ // $\frac{1}{\sin\ C}$ 6

(*iii*) What measurements did the student take during the experiment?
What instrument was used to take these measurements? **12 or 6**

angles *I* and *r* // length of real and apparent depths // critical angle 6

protractor // metre stick // protractor 6

(*iv*) Why should the experiment be repeated? **4**

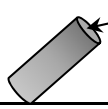
increase accuracy, take an average, to get data for a graph 4

(*v*) Other than repeating the experiment, state one precaution that the student took to improve the accuracy of the experiment. **6**

use large angles of incidence // avoid no parallax 6

Question 4 **40 marks**

A student performed an experiment to measure the resistivity *ρ* of a piece of nichrome wire of length *l*, resistance *R* and diameter *d*.

R (Ω)	22.8	 Circular cross-sectional area	
l (m)	0.98		
d (m)	0.00024	0.00028	0.00023

(*i*) Name the instrument used to measure the length *l* of the wire. **6**

metre stick / ruler 6

(*ii*) Name the instrument used to measure the resistance *R* of the wire. **6**

ohmmeter / (digital) multimeter 6

(*iii*) Name the instrument used to measure the diameter *d* of the wire. **6 or 3**

micrometer (screw gauge) // digital/ Vernier callipers 6

partial answer e.g. callipers (3)

(*iv*) Use the data to calculate the average diameter of the wire. **6 or 3**

d= (0.00024 + 0.00028 + 0.00023) ÷ 3 = 0.00025 m 6

partial answer e.g. one error (3)

(*v*) Calculate the cross-sectional area *A* of the wire. **6 or 3**

$\frac{\pi d^2}{4} = \frac{19.6\times10^{-8}}{4} = 4.9 \times 10^{-8}$ m² // answer consistent with *(iv)* above 6

partial answer e.g. one error (3)

(*vi*) Use the formula $\rho = \frac{RA}{l}$ to calculate the resistivity of the wire. **10 or 7 or 3**

$\rho = \frac{RA}{l} = \frac{(22.8)(4.9\times10^{-8})}{0.98} = 1.14 \times 10^{-6}\ \Omega\, m$ // answer consistent with *(v)* 10

correct substitution of 2 quantities into the equation (7)

partial answer (3)

SECTION B (280 MARKS) Answer **five** questions from this section.

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

Take the best 8 from 10 parts

(a) **State the principle of conservation of momentum.** **7 or 4**

(in a closed system the total) momentum before (interaction) = (the total)momentum after // $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ 7

partial answer (4)

(*b*) A force of 2500 N acts on a car of mass 1000 kg. Calculate the acceleration of the car. **7 or 4**

$a = \frac{F}{m} = \frac{2500}{10^3}$= 2.5 m s^{-2} 7

partial answer (4)

(*c*) Which of the following is the unit of electrical charge? **7**

ampere **coulomb** **farad** **volt**

coulomb 7

(*d*) State Boyle's law. **7 or 4**

(for fixed mass at constant temperature) PV = k // $P \propto \frac{1}{V}$ 7

partial answer (4)

(*e*) A crane moves a load of weight 7000 N to the top of a roof which is 4 m high. The crane takes 20 seconds to do this work. Calculate the power output of the crane. **7 or 4**

$P = \frac{work}{time} = \frac{Fs}{t} = \frac{(7000)(4)}{20}$= 1400 W 7

partial answer (4)

(*f*) The boiling point of water is 100 °C. Convert this temperature to kelvin (K). **7 or 4**

373(.15) K 7

partial answer e.g. reference to 273 (4)

(*g*) Explain why it is possible to hear around corners but not to see around corners. **7 or 4**

sound diffracts more // sound has a bigger wavelength 7

partial answer (4)

(*h*) Name the three primary colours of light. **7 or 5 or 3**

red, green and blue 7

any two (5)

any one (3)

when more than three colours are given cancelling may apply

(i) **What is a semiconductor?** **7 or 4**

material whose resistivity lies between that of an insulator and a conductor 7

partial answer e.g. Si / Ge / diode (4)

(*j*) Name the three forms of nuclear radiation. **7 or 5 or 3**

α, β, γ 7

any two (5)

any one (3)

Question 6 **56 marks**

Armstrong's love of flying started at a young age. After joining the navy he became a fighter pilot.

(i) **A jet starts from rest and accelerates along a runway to a top speed of 28 m s^{-1} in 7 seconds. What is the acceleration of the jet?** **9 or 6 or 3**

$v = u + at \implies 28 = 0 + a(7)$ i.e. $a = 4$ m s^{-2} 9

one error (6)

partial answer (3)

(ii) **Acceleration is a vector quantity, while time is a scalar quantity. Distinguish between a vector quantity and a scalar quantity.** **6 or 3**

vector quantities have a direction (scalar quantities don't) 6

partial answer e.g. gives a valid example for both (3)

(iii) **The moon is constantly in motion, orbiting the Earth. Explain why an astronaut standing on the moon has a constant speed but a changing velocity.** **6 or 3**

when the moon orbits it changes its direction of motion so its velocity changes 6

partial answer (3)

Armstrong applied to become an astronaut and in 1962 he joined NASA.

(iv) **Armstrong had a mass of 90 kg.**
Calculate his weight on Earth. Include units in your answer. **9 or 6 or 3**

weight = m g = (90)(9.8) = 882 N 9

one error e.g. incorrect unit (6)

partial answer e.g. correct unit /N (3)

(*v*) What was Armstrong's mass on the moon? **6**

90 kg / the same 6

(*vi*) Armstrong's weight on the moon was only 17% of his weight on Earth. Explain why. **5 or 3**

smaller mass of moon // less gravitational force 5

partial answer (3)

The footprints he made during that walk are still on the moon to this day. The area of Armstrong's shoe when he took that famous step was 0.03 m^2. He exerted pressure through his foot onto the surface of the moon.

(*vii*) Define pressure. **6 or 3**

$P = \frac{F}{A}$ // pressure is the force per unit area 6

partial answer (3)

(*viii*) Calculate the pressure Armstrong exerted on the surface of the moon. **9 or 6 or 3**

$P = \frac{(882)(0.17)}{0.03}$ = 4998 Pa 9

one error (6)

partial answer (3)

(acceleration due to gravity, g = 9.8 m s^{-2})

Question 7 **56 marks**

When a musician moves his fingers up and down the strings of a guitar, the frequency of the note changes. When the strings are at their longest, the note heard has a low frequency.

The characteristics of a musical note are pitch, loudness and quality.

***(i)* Which of these characteristics can be quantified as a frequency?** **6**

pitch 6

***(ii)* Name the property of a wave that affects its loudness.** **6 or 3**

amplitude 6

partial answer e.g. pitch (3)

(*iii*) When the musician plays the A string on his guitar, the frequency of the note is 110 Hz. The speed of sound in air is 340 m s^{-1}. What is the wavelength of the note? **6 or 3**

$v = f\lambda \implies \lambda = \frac{340}{110} = 3.09 \text{ m}$ 6

partial answer (3)

(iv) Describe an experiment to show that sound cannot travel through a vacuum. **12 or 9 or 6 or 3**

apparatus: (bell) jar, sound source / electric bell any one 3

(vacuum) pump any one 3

procedure: turn on pump / pump out the air 3

observation/conclusion: loudness decreases as air is removed /no sound heard 3

accept valid alternatives

a labelled diagram may merit full marks

The frequency of a sound wave appears to change when it moves past a stationary observer. This phenomenon is called the Doppler effect.

(*v*) Describe how to demonstrate the Doppler effect in a laboratory. **12 or 9 or 6 or 3**

apparatus: buzzer/sound source any one 3

with fixed frequency/pitch, string any one 3

procedure: turn on sound source and rotate using string 3

observation/conclusion: frequency /pitch changes (as sound source moves closer/away) 3

Sound can be described as a longitudinal wave, whereas light is a transverse wave.

(*vi*) Distinguish between a longitudinal wave and a transverse wave. A labelled diagram may help your answer. **9 or 6 or 3**

the disturbance is parallel to the direction of motion for longitudinal waves

the disturbance is perpendicular to the direction of motion for transverse waves

two lines correct 9

one line correct (6)

transverse waves may be polarised (6)

partial answer e.g. longitudinal waves need a medium (3)

a labelled diagram may merit full marks

Waves can undergo reflection, refraction, diffraction, interference and polarisation. While light waves can undergo all five of these wave phenomena, sound waves can only undergo four of them.

(*vii*) Which one of these phenomena do sound waves not undergo? Explain why. **5 or 3**

polarisation as they are not transverse /e.m. waves //

polarisation as they are longitudinal waves 5

partial answer (3)

Question 8 **56 marks**

A student measured the temperature of a large bath full of water and a small cup full of water and said "they are both at the same temperature, so they must contain the same amount of energy".

(i) **Is the student's statement correct? Explain your answer.** **6 or 3**

no, (the bath has) more water/mass 6

partial answer (3)

The thermometric property used by a mercury thermometer is the length of a column of liquid.

(ii) **What is meant by a thermometric property?** **6 or 3**

property which changes (continually) with changing temperature 6

partial answer (3)

(iii) **Name another example of a thermometric property.** **6 or 3**

colour, resistance, pressure, volume, emf, voltage, etc 6

A storage heater consists of an electric heater surrounded by bricks made of a material with a high specific heat capacity.

(iv) **Define specific heat capacity.** **9 or 6 or 3**

energy required to raise the temperature of 1 kg by 1 K / 1 ^{o}C 9

one error (6)

partial answer (3)

(v) **Why does the material in the bricks need to have a high specific heat capacity?** **5 or 3**

so that they can store a lot of heat energy 5

partial answer (3)

A kettle supplies heat to 1.5 kg of water and raises its temperature from 15 °C to 88 °C.

(vi) **Calculate the heat energy gained by the water in the kettle.** **12 or 9 or 6 or 3**

E = m c $d\theta$ = (1.5)(4200)(88-15) = 4.599×10^5 J 12

one error (9)

substitutes at least 2 quantities correctly into the equation (6)

partial answer (3)

If heat energy continues to be supplied, the water will reach its boiling point and change state.

(vii) **Apart from boiling, name one other change of state that can happen to water.** **6 or 3**

freezing, condensing, melting any one 6

partial answer (3)

(viii) **What is meant by latent heat?** **6 or 3**

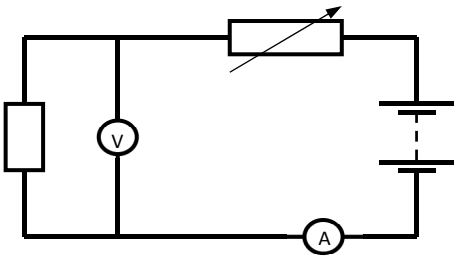
latent heat is the heat required to change the state of a substance without a change in temperature 6

partial answer (3)

(specific heat capacity of water = 4200 J kg^{-1} K^{-1})

Question 9 **56 marks**

(*a*) **The circuit on the right is used to demonstrate Ohm's law.**



(*i*) What is meter A? **6 or 3**

ammeter 6

partial answer e.g. multimeter (3)

(ii) What is meter V? **6 or 3**

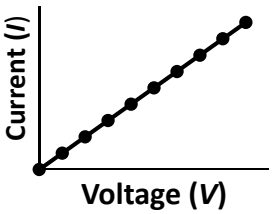
voltmeter 6

partial answer e.g. multimeter (3)

(iii) **Which of the graphs below shows Ohm's law being obeyed? Explain your answer.**

12 or 9 or 6 or 3

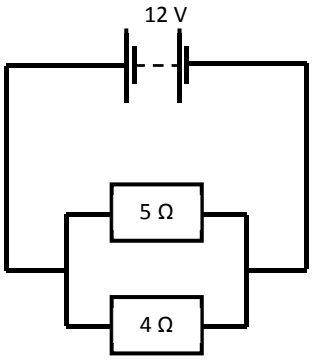
Graph 1 6



the straight line through the origin // $I \propto V$ //

answer consistent with graph 6

partial answer e.g. line (3)



(*b*) In the circuit on the right, the resistors are wired in parallel.

(*i*) Calculate the total resistance in the circuit. **6 or 3**

$\frac{1}{R}=\frac{1}{5}+\frac{1}{4}=\frac{4+5}{20} \quad \Longrightarrow R=\frac{20}{9}=2.2\ \Omega$ 6

partial answer e.g. a correct equation (3)

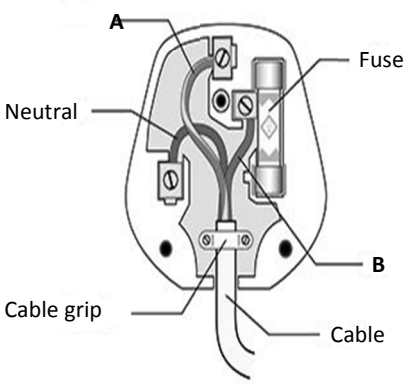
(*ii*) Calculate the current flowing through the circuit. **6 or 3**

$I=\frac{V}{R}=12\div 2.2\ =5.4$ A 6

answer consistent with *(i)* above (6)

partial answer e.g. correct equation (3)

(*c*) The diagram on the right shows the parts of an electrical plug.



(i) **Name the wire labelled A.** **6 or 3**

earth 6

partial e.g. green/yellow, live (3)

(ii) **Name the wire labelled B.** **6 or 3**

live 6

partial e. g. brown, earth (3)

(iii) **State the function of the fuse.** **6 or 3**

break the circuit when current too big // safety device // prevent overheating / fire /damage 6

partial (3)

(iv) **There are two other devices used in the distribution box of a domestic circuit that carry out a similar function to the fuse.**

Name one of these devices. **2**

circuit breaker/ trip switch, RCD , RCB, MCB, ELCB any one 2

Question 10 56 marks

The electron was discovered in 1897 by a British scientist, J.J. Thomson, while he was using a cathode ray tube. In 1906 Thomson won the Nobel Prize in physics for his discovery.

(i) **State two properties of an electron.** **6 or 3**

(negative) charge, small mass, orbits outside nucleus, deflected by electric/magnetic fields

any two 6

partial answer e.g. one correct property (3)

(ii) **How are the electrons produced in a cathode ray tube?** **6 or 3**

thermionic emission 6

partial answer e.g. heating (3)

(iii) **How could the beam of electrons be deflected?** **6 or 3**

by electric / XY plates // magnetic fields 6

partial answer (3)

(iv) **What happens when the beam of electrons strikes the screen?** **6 or 3**

lose energy, fluorescence, KE converted to light energy 6

partial answer (3)

(v) **State one use of a cathode ray tube.** **6 or 3**

CRO, old TV monitors, ECG screens, etc. 6

partial answer (3)

During the course of his work, and completely by accident, Röntgen discovered X-rays. He won the Nobel Prize in physics in 1901.

(vi) **What are X-rays?** **6 or 3**

high energy electromagnetic radiation // electromagnetic radiation of short wavelength 6

partial answer e.g. gives X-ray property such as no mass/ no charge (3)

(vii) **The photograph shows an X-ray tube. When the electrons strike the target, a large amount of their kinetic energy is converted into heat energy. State one way in which an X-ray tube is designed to take account of this large amount of heat energy.** **6 or 3**

its large metal target absorbs most of this heat energy // coolant / heat sink 6

partial answer (3)

(viii) **Why might an X-ray tube be surrounded by lead shielding?** **6 or 3**

for protection from (ionising) radiation 6

partial answer (3)

(ix) **State one use of X-rays.** **6 or 3**

specific use e.g. check for broken bones, locate cracks in metal pipes 6

general use e.g. in medicine /industry (3)

(x) **State one hazard associated with X-rays.** **2**

can cause skin burns /cancer/ionise cells, death, etc. 2

Question 11 **56 marks**

Read the following passage and answer the questions below.

One of the most common sights anywhere in the world are eyeglasses. Since we depend so much on the lenses inside those frames to improve our view of the world, you might wonder just what goes into creating them.

On the back of your eye is a complex layer of cells known as the retina. When you look at an object, an image is formed on the retina. The retina reacts to light and conveys that information to the brain.

To do all that, the eye has a lens between the retina and the pupil and a transparent covering called the cornea. The pupil allows light to enter the eye. The lens, the ciliary muscles and the cornea work together to focus the image onto the retina. The lens has a different power depending on whether the object being viewed is nearby or far away.

Sometimes the eye doesn't focus quite right. Most vision problems occur when the eye cannot focus the image onto the retina. The most common problems associated with the eye are as follows:

- Myopia (short sightedness) occurs when a distant object looks blurred. Short sightedness is corrected with a diverging lens.
- Hyperopia (long sightedness) occurs when a nearby object looks blurred. Long sightedness is corrected with a converging lens.

Placing the correct type and power of lens in front of the eye compensates for the eye's inability to focus the image on the retina.

Adapted from https://science.howstuffworks.com/innovation/everyday-innovations/lens6

(*a*) Name the part of the eye where an image is formed. **7 or 4**

retina 7

partial answer e.g. back of the eye (4)

(*b*) What is the function of the pupil? **7 or 4**

allows light enter the eye 7

partial answer (4)

(c) The eye can focus light from both nearby and distant objects. Describe how the eye changes to allow this to happen. **7 or 4**

the lens has a different power for near and far objects // lens changes shape 7

partial answer, e.g. the lens, the ciliary muscles and the cornea work together to focus the image onto the retina (4)

(*d*) Name the two most common eye defects. **7 or 4**

myopia (short sightedness) and hyperopia (long sightedness) 7

partial answer e.g. myopia // hyperopia (4)

(*e*) What type of lens corrects short sightedness? Draw a sketch of this lens. **7 or 4**

diverging/ concave lens named and sketched  7

partial answer (4)

(*f*) Copy the diagram below into your answerbook and complete the ray diagram to form a real image. **7 or 4**

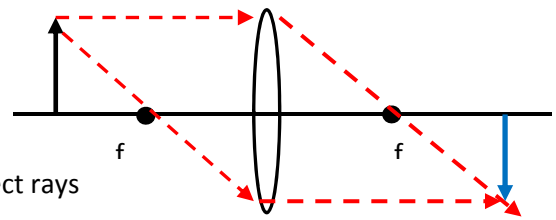


image formed from 2 or more correct rays 7

partial answer (4)

(*g*) The power required to clearly view a nearby object is 38 m^{-1}. A person with an eye defect has a maximum power of 32 m^{-1}. Calculate the power of the lens required to correct this defect? What is the focal length of this lens? **7 or 4**

$P = 38 - 32 = 6\ m^{-1}$ $f = \frac{1}{P} = \frac{1}{6}$ m / 16.7 cm 7

partial answer e.g. $P = 6\ m^{-1}$// correct equation (4)

(*h*) Light undergoes refraction as it passes through a lens. What is meant by refraction? **7 or 4**

the bending of light when it goes from one medium to another 7

partial answer (4)

Question 12 **56 marks**

Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

Part (*a*) A cannonball of mass 7 kg is shot from a cannon straight up into the air, with an initial velocity of 50 m s^{-1}.

(*i*) State the principle of conservation of energy. **6 or 3**

energy cannot be created or destroyed but can be converted from one form to another 6

partial answer (3)

(*ii*) Calculate the cannonball's kinetic energy as it is fired. **6 or 3**

KE = $\frac{1}{2} m v^2 = \frac{1}{2}(7)(50)^2 = 8750$ J 6

partial answer (3)

***(iii*) As the cannonball rises, its kinetic energy is converted into another form of energy. Name this energy.** **4**

potential (energy) 4

(*iv*) Calculate the greatest height reached by the cannonball. **6 or 3**

KE = 8750 = mgh =(7)(9.8) h // $v^2 = u^2 + 2as$ = $(50)^2$+2(-9.8)s $\implies s/h = 127.55\ m$ 6

partial answer (3)

(*v*) The cannonball has a volume of 0.0009 m^3. Calculate the density of the cannonball. **6 or 3**

$\rho = \frac{M}{V} = \frac{7}{0.0009} = 7777.8$ kg m^{-3} 6

partial answer (3)

(acceleration due to gravity, g = 9.8 m s^{-2})

Part (*b*) A capacitor is used in the flash of a camera.

***(i)* Define capacitance.** **6 or 3**

C = $\frac{Q}{V}$ 6

partial answer (3)

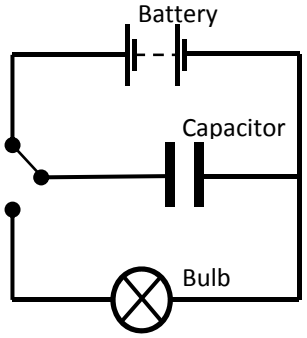
***(ii)* State the unit of capacitance.** **3**

Farad / F 3

***(iii)* The light energy emitted by a flash is supplied by a capacitor. The charge on the capacitor is 0.025 C and the potential difference across it is 250 V. Calculate the capacitance.** **6 or 3**

C = $\frac{Q}{V} = \frac{0.025}{250} = 10^{-4}$ F 6

partial answer (3)



In the flash circuit of a camera, energy is stored up and then suddenly released. A capacitor stores energy when it is charged.

***(iv)* The circuit shown can be used to demonstrate that a capacitor stores energy. Explain how the circuit is used.** **9 or 6 or 3**

throw the switch to close the bottom circuit and observe the bulb lights briefly due to the energy from the capacitor. two lines 9

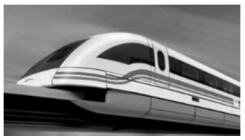
one line (6)

partial e.g. charge the capacitor (3)

***(v)* State another use for a capacitor.** **4 or 2**

specific use: conducts a.c., (radio) tuning/filtering/smoothing ,timing, phone charger, etc. 4

general use: computer, car (2)



Part (*c*) Magnetically levitated trains (known as maglev trains) use magnets under their carriages to float above the magnetic tracks.

(i) **Like poles repel, and this is the property of magnets that is Used in maglev trains. State one other property of magnets.** **6 or 3**

unlike poles attract, magnets attract certain metals, magnets are strongest at the poles, etc. 6

partial answer (3)

(*ii*) What is meant by a magnetic field? **6 or 3**

region/space (around a magnet) within which a magnetic force is experienced 6

partial answer e.g. draws magnetic field (3)

(*iii*) Describe an experiment to plot the magnetic field of a bar magnet. **12 or 9 or 6 or 3**

apparatus: magnet 3

(plotting) compass // iron filings 3

procedure: use the apparatus to locate the field lines e.g. (place the compass on the paper and) mark the dots // sprinkle filings 3

detail: join the dots/ show field lines / lines go from north to south/ field lines are concentrated at the magnet poles // tap filings 3

marks may be obtained from a diagram

(*iv*) State one other use of magnets. **4 or 2**

compass, to keep a fridge door closed, electric bell, electric motor, transformer, electromagnet, electromagnetic induction, moving coil meters, etc. any one 4

partial answer (2)

Part (*d*) Both nuclear fission and nuclear fusion are processes by which the nuclei of atoms are altered to create energy.

(*i*) $^{238}_{92}U$ **is a uranium atom.**
How many protons are in this uranium atom?
How many neutrons are in this uranium atom? **8 or 4**

92 protons 4

146 neutrons 4

partial answer e.g. 92 neutrons and 146 protons (4)

(*ii*) $^{235}_{92}U$ **is another isotope of uranium. What are isotopes?** **6 or 3**

atoms with the same atomic number and with different mass numbers 6

partial answer (3)

(*iii*) Distinguish between nuclear fission and nuclear fusion. **6 or 3**

Fission is the breaking up a nucleus
Fusion is the joining of nuclei into one larger nucleus
(with the emission of energy) two lines correct 6
one line correct (3)

(*iv*) State one advantage and one disadvantage of nuclear energy. **8 or 4**

Advantage: lots of energy, no carbon emissions, no pollution any one 4

Disadvantage: danger of leaked radiation, health risk, etc. any one 4

partial answer e.g. in reverse order (4)