Bentley Wood
High School for Girls

Year 11-12 Bridging Work

Physics

Summer 2026

Name: ....

Form: ....

Teacher: ....

Introduction

Congratulations on completing your GCSEs and entering the next stage of your physics learning journey!

Subject Overview

Physics at A Level is for students who are curious about the world around them and eager to understand how it works. From the behaviour of the smallest fundamental particles to the motion of objects on an astronomical scale, physics seeks to lay out the laws that govern nature and our universe.

Course Content

The Year 12 course establishes the essential theoretical knowledge, mathematical techniques and practical skills required to enable students to confidently access the increased complexity and abstraction of the Year 13 topics. The foundational topics covered in Year 12 are *Working as a Physicist*, *Materials*, *Electric Circuits*, *Mechanics*, *Waves and Particle Nature of Light*. Students will also cover the two more advanced topics of *Further Mechanics* and *Space* toward the end of Year 12. The foundations laid in Year 12 are necessary for progression into Year 13, during which students will explore more complex subjects such as *Nuclear and Particle Physics*, *Nuclear Radiation*, *Gravitational Fields*, *Electric and Magnetic Fields*, *Thermodynamics*, and *Oscillations*. By the end of the course, students will have also learned to apply familiar principles to unfamiliar and multi-step problems in a synoptic manner. A strong emphasis is placed throughout both years of study on mathematical modelling, data analysis, uncertainty evaluation and experimental methodology. Given the innovative and rapidly evolving nature of Physics, students are encouraged to engage with wider reading and contemporary research to enhance their appreciation of how Physics drives technological advancement and underpins scientific progress across society.

Methods of Study

Physics at A Level is highly collaborative, with an emphasis on scientific discussion and shared problem-solving. Opportunities for practical work are embedded throughout the curriculum, allowing students to explore physical phenomena directly. Alongside this, students develop and apply theoretical and mathematical models which provide predictive power and context for the experiments conducted. Students also learn how to carry out independent research projects and present their findings through written scientific reports and live presentations.

Examinations

Assessment in the *Edexcel A Level Physics* qualification consists of three written examination papers completed at the end of the two-year course.

In addition to these written exams, students complete a Practical Endorsement throughout the course, based on practical activities undertaken in the laboratory. This practical endorsement is reported separately as a pass/fail and supports students' skills in experimental planning, execution and analysis.

Assessment	Duration	Total Marks	Content Assessed
Paper 1	1 h 45 min	90 (30%)	This assessment draws on content covered in the topics Working as a Physicist, Mechanics, Electric Circuits, Further Mechanics, Electric and Magnetic Fields and Nuclear and Particle Physics
Paper 2	1 h 45 min	90 (30%)	This assessment draws on content covered in the topics Working as a Physicist, Materials, Waves and Particle Nature of Light, Thermodynamics, Space, Nuclear Radiation, Gravitational Fields and Oscillations
Paper 3	2 h 30 min	120 (40%)	This assessment draws on synoptic content from the whole course, with an emphasis on practical principles and applying understanding in different contexts

Career Opportunities

Studying physics at A level cultivates strong numerical, analytical and problem-solving skills. It also provides a solid foundation for a wide range of university courses, including all types of engineering, computer science, mathematics and any of the physical sciences. Beyond academia, the critical thinking and quantitative skills gained through Physics A Level are highly valued by employers across many sectors, including data analysis, finance, scientific research and technology, opening a broad range of career opportunities.

Supporting Resources

The following textbooks are recommended to support independent study and revision:

- ✓ Edexcel AS/A level Physics Student Book 1 (2015), Pearson Education, ISBN: 978-1447991182
- ✓ Edexcel AS/A level Physics Student Book 2 (2015), Pearson Education, ISBN: 978-1447991199
- ✓ A-Level Physics: Edexcel Year 1&2 Complete Revision & Practice (2015), CGP, ISBN: 978-1782943051
- ✓ A-Level Physics: Essential Maths Skills (2015), CGP, ISBN: 978-1782944713

Additionally, the following online resources are recommended to further support independent study and revision:

- ✓ Physics and Maths Tutor: https://www.physicsandmathstutor.com/physics-revision/
- ✓ Save My Exams: https://www.savemyexams.com/subjects/physics/

- ✓ Isaac Physics: https://isaacscience.org/physics/a_level
- ✓ Physics Online: https://www.physicsonline.com
- ✓ Seneca: https://senecalearning.com/en-GB/
- ✓ Educake: https://my.educake.co.uk/login
- ✓ Kerboodle: https://www.kerboodle.com/users/login

Students are also encouraged to visit and explore our science library section, Curie's Corner, to widen their scientific horizons and carry out super curricular reading and research.

Bridging Work

The aim of this bridging work is to help you review and reinforce the key ideas from GCSE Physics, ensuring a smooth transition to the A-Level Physics course. It is also intended to help you gauge whether physics is the right subject choice for you. As you only have four subject choices in sixth form, making the right decision now is important for your future academic success. **Completion of this bridging work is a requirement for enrolment on the A-Level Physics course in September.**

This bridging work booklet is divided into **two** compulsory sections:

PART 1*: Mathematical Skills*

PART 2*: Exam Question Practice*

This is the first piece of work you will be assessed on in Year 12 and will set the tone for the rest of the academic year. It will help us understand your strengths, identify areas for improvement, and gauge your work ethic to ensure it meets the standard expected at A Level Physics. Your physics teachers will check that this bridging work has been completed during your first physics lesson and will follow up if any part is incomplete or has not been completed to a high standard. Use this bridging work as an opportunity to showcase the knowledge, skills, and progress you have made since the beginning of your physics learning journey, and to demonstrate what you are capable of achieving.

We look forward to meeting you at the start of the new academic year and wish you an enjoyable and productive summer!

The Physics Department

PART 1: *Mathematical Skills*

Unit Prefixes

In physics, measurements span an enormous range of magnitudes, from extremely large to extremely small. To express these values conveniently, the International System of Units (SI) uses prefixes that are attached to base units that act as multipliers powers of ten. For example, 1 km is 10^3 m and 1 mm is 10^{-3} m. These prefixes act as multipliers, making measurements easier to write, interpret, and compare. Below is a summary of the prefixes you need to learn:

Symbol	Name	Factor	
P	peta	10^{15}	1000000000000000
T	tera	10^{12}	1000000000000
G	giga	10^{9}	1000000000
M	mega	10^{6}	1000000
k	kilo	10^{3}	1000
BASE UNIT		10^{0}	1
m	milli	10^{-3}	0.001
µ	micro	10^{-6}	0.000001
n	nano	10^{-9}	0.000000001
p	pico	10^{-12}	0.000000000001
f	femto	10^{-15}	0.000000000000001

To convert between SI prefixes, locate the starting prefix and the target prefix in the table. For each row you move **up**, ÷ 1000. For each row you move **down**, × 1000.

Q1 Convert each figure into the units required. Give your answers in standard form where sensible.

a) 54 MN = ……………………………………… N

b) 753 GPa = ……………………………… Pa

c) 0.086 µV = ………………………………… V

d) 23.87 mm/s = ………………………… m/s

Q2 Rewrite each figure using a suitable prefixed unit.

a) 0.5×10^{-6} A = …………………………………

b) 32×10^{5} N = …………………………………

c) 93.09×10^{9} m = ……………………………

d) 0.024×10^{-7} m = ……………………………

Q3 Complete the table by converting each time into the prefixes required. The first cell has been filled in for you.

s	ms	µs	ns	ps
0.000 45	*0.45*			
0.000 000 789				
0.000 000 000 64				

Q4 Complete the table by converting each length into the units required.

mm	m	km	µm	Mm
1 287 360				
295				

Standard Form

Standard form (also called scientific notation) allows us to express any number in the form:

$$\mathbf{A \times 10^{B}} \qquad \textit{where } \mathbf{1 \le A < 10} \textit{ and } \mathbf{B} \textit{ is a whole number}$$

Writing numbers in standard form makes very large and very small values easier to read and compare. It also makes the number of significant figures clear.

In order to convert a number into standard form, you need to:

*1) Move the decimal point until there is exactly one non-zero digit in front of it — this gives you **A**.*

*2) Count how many places the point moved — this gives you **B**.*

3) If the original number was 10 or more, n is positive. If it was less than 1, n is negative.

Q5 Convert these numbers into standard form.

a) 0.003 = ...

b) 5 000 = ...

c) 0.4 = ...

d) 7 000 000 = ...

e) 20 000 = ...

f) 0.0005 = ...

Q6 Write these numbers out in full.

a) 4.6×10^4 = ……………………………………

b) 3×10^5 = ……………………………………

c) 9.1×10^{-3} = ……………………………………

d) 5×10^{-6} = ……………………………………

Significant Figures

Significant figures (s.f.) tell you which digits in a value carry information. Follow the rules below to determine how many significant figures a number contains:

1) *All non-zero digits **are** significant.*
2) *Zeros between two non-zero digits **are** significant.*
3) *Leading zeros **are not** significant.*
4) *Trailing zeros **are** significant when a decimal point is shown.*
5) *Trailing zeros in a whole number with no decimal point **are not** significant.*
6) *In standard form (i.e. $A \times 10^B$) all the digits of A **are** significant.*

To round to *n* significant figures, keep the first n significant digits and look at the next digit. If it is 5 or greater, round the nth digit up. If it is less than 5, leave the nth digit unchanged. Replace any remaining digits with zeros (or write the number in standard form) to preserve the number's magnitude.

Q7 State the number of significant figures each value is given to.

Value	s.f.	Value	s.f.	Value	s.f.	Value	s.f.
2		1066		1800.45		0.070	
2.0		82.42		2.483×10^4		69 324.8	
500		750 000		0.0006		0.0063	

Q8 Round each of the following numbers to the required number of significant figures.

Value	Round To	Answer
1 478 258	5 s.f.	
0.089 56	3 s.f.	
7.001 98	2 s.f.	
4	3 s.f.	
0.01	4 s.f.	

Greek Alphabet

Physics borrows many symbols from the Greek alphabet. The letters we will not use at A Level are zeta, chi, psi, iota, kappa, xi and omicron. You need to learn the rest.

Letter	Name	Use
Α α	alpha	angular acceleration (α); alpha radiation
Β β	beta	beta radiation
Γ γ	gamma	gamma radiation
Δ δ	delta	Δ = change in (e.g. Δt = change in time); δ = small change
Ε ε	epsilon	strain (ε); e.m.f. (ε); permittivity of free space (ε_0)
Ζ ζ	zeta	—
Η η	eta	efficiency (η); viscosity (η)
Θ θ	theta	angles (θ); temperature (θ)
Ι ι	iota	—
Κ κ	kappa	—
Λ λ	lambda	wavelength (λ); decay constant (λ)
Μ μ	mu	micro prefix ($\times10^6$); coefficient of friction (μ); muon
Ν ν	nu	frequency (ν); neutrino
Ξ ξ	xi	—
Ο ο	omicron	—
Π π	pi	pi (π = 3.141…)
Ρ ρ	rho	density (ρ); resistivity (ρ)
Σ σ	sigma	sum of (Σ); stress (σ); conductivity (σ)
Τ τ	tau	torque (τ); time constant (τ)
Υ υ	upsilon	—
Φ ϕ	phi	magnetic flux (Φ); work function (ϕ)
Χ χ	chi	—
Ψ ψ	psi	—
Ω ω	omega	resistance in ohms (Ω); angular velocity (ω)

***PART 2**: Exam Question Practice*

Please complete all the exam questions in this section of the bridging work booklet. These questions have been carefully selected to cover all the physics topics studied at GCSE level. You may watch the Cognito videos in the playlist linked below to help you answer these exam questions.

Recommended Video Playlist: https://youtube.com/playlist?list=PLidqqIGKox7UVC-8WC9djoeBzwxPeXph7&si=UFE978Lrldb-V5i0

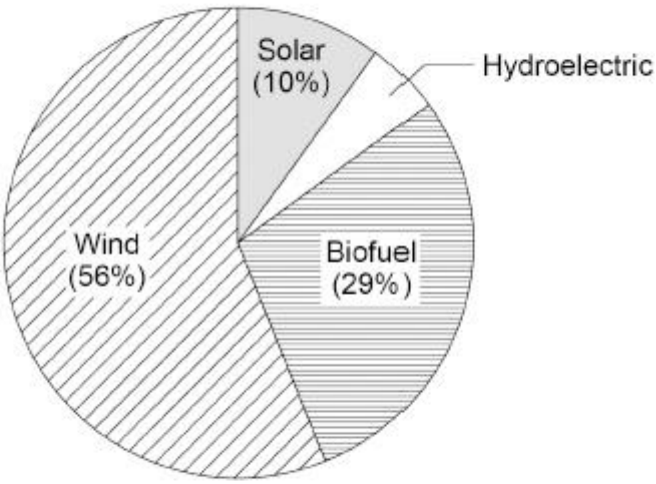
Energy

Q1.

The UK uses renewable energy resources to generate some of its electricity.

Figure 1 shows the proportion of electricity generated by different renewable energy resources in the UK in 2020.

Figure 1



(a) Calculate the percentage of electricity generated using hydroelectric power.

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Percentage = _______________ %

(2)

A remote village in the UK uses a hydroelectric generator to provide electricity.

(b) The mass of water that passes through the hydroelectric generator each day is 2 500 000 kg.

The change in vertical height of the water is 15.0 m.

gravitational field strength = 9.8 N/kg

Calculate the decrease in gravitational potential energy of the water.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

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Decrease in gravitational potential energy = ____________________ J

(2)

Use the Physics Equations Sheet to answer parts (c) and (d).

(c) Write down the equation which links energy (*E*), power (*P*) and time (*t*).

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(1)

(d) The hydroelectric generator transfers electrical power of 3000 W to the village.

Calculate the energy transferred to the village in 60 minutes.

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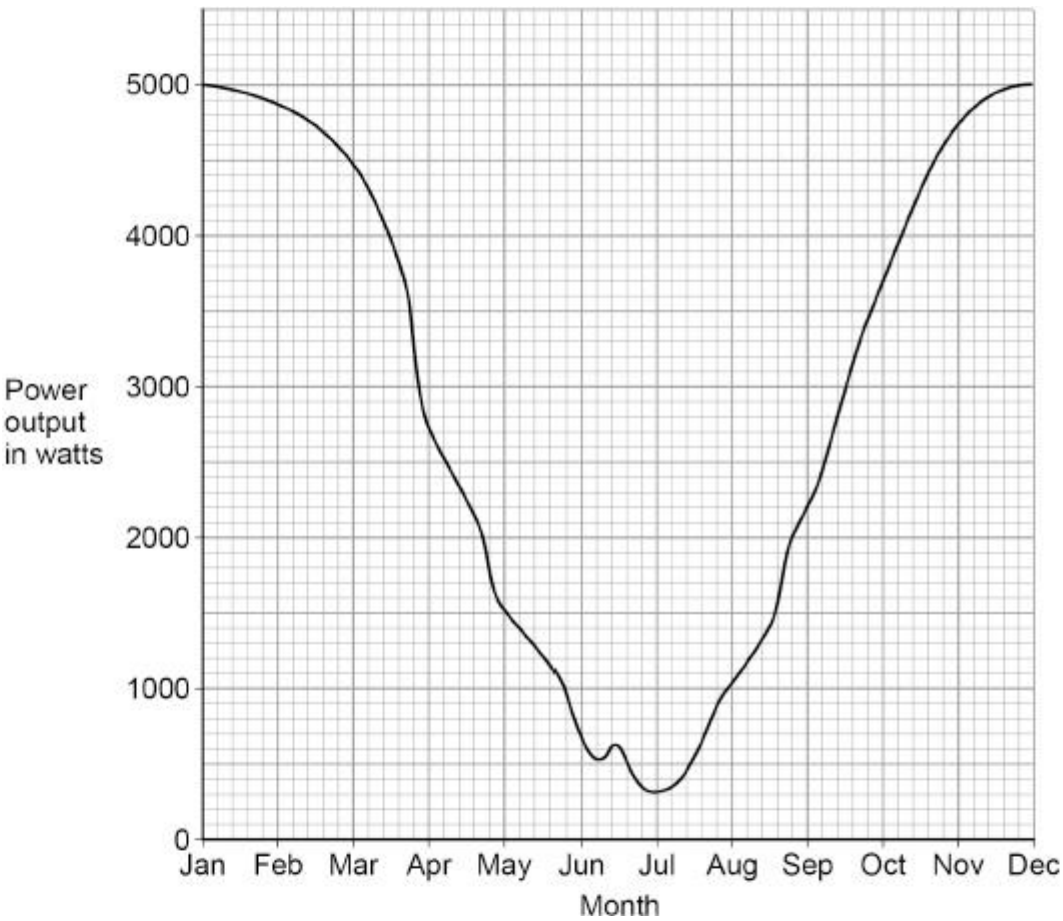
Energy transferred = ____________________ J

(3)

(e) The hydroelectric generator is turned by falling river water.

Figure 2 shows how the power output of the hydroelectric generator varied during one year.

Figure 2



Explain **one** reason why the power output varied.

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(2)

(Total 10 marks)

Q2.

The figure below shows a wind turbine.

Wind turbines may generate electricity when the electricity is not needed.

Two methods that can be used to store the energy from the turbine are:

Method A: Heating water to a high temperature.

Method B: Pumping water uphill into a reservoir.

(a) Which energy store increases when water is heated?

____

(1)

(b) Which energy store increases when water is pumped uphill into a reservoir?

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(1)

(c) The table below shows information about the two methods of storing energy.

Method	**Energy stored per 100 kg of water in kJ**	**Percentage of stored energy wasted**	**Installation**
A: Increasing water temperature by 80 °C	33 600	40%	Anywhere
B: Pumping water uphill to a height of 500 m	490	25%	High mountains

Compare the advantages and disadvantages of the two methods of storing energy.

Include calculations in your answer.

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(4)

(d) Decreasing the amount of carbon dioxide released by different activities will help slow down climate change.

Transport and generating electricity are the two activities that released the largest amounts of carbon dioxide in the UK in 2018.

Explain **one** change that would reduce the amount of carbon dioxide released by **each** activity.

Transport ___

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Generating electricity ___

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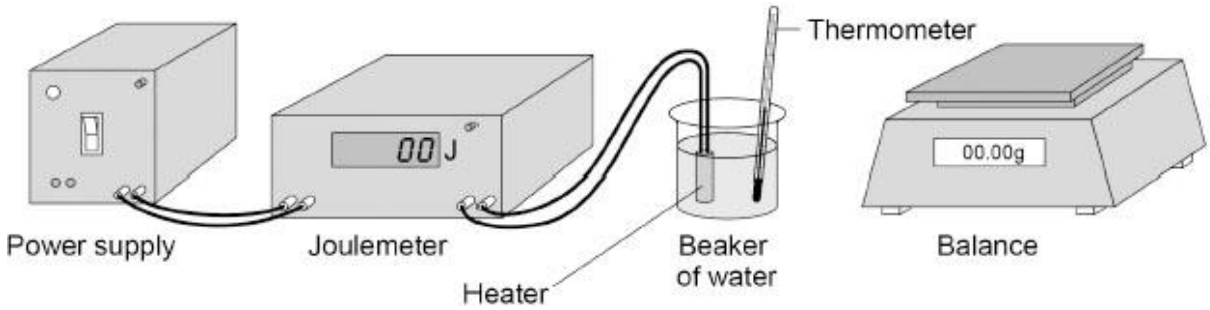
(4)

(Total 10 marks)

Q3.

A student determined the specific heat capacity of water.

The figure below shows the apparatus used.



The joulemeter measures energy transfer.

(a) Give **one** hazard in the investigation.

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(1)

(b) Describe how the student could determine the specific heat capacity of water using the apparatus in the figure above.

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(6)

(c) One source of error in the experiment was energy loss to the surroundings.

Suggest **one** change to the apparatus to reduce energy loss to the surroundings.

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(1)

(d) The student's value for the specific heat capacity of water was 4410 J/kg °C.

The actual value for the specific heat capacity of water is 4200 J/kg °C.

Calculate the percentage difference between the student's value and the actual value.

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Percentage difference = ______________________ %

(2)

(Total 10 marks)

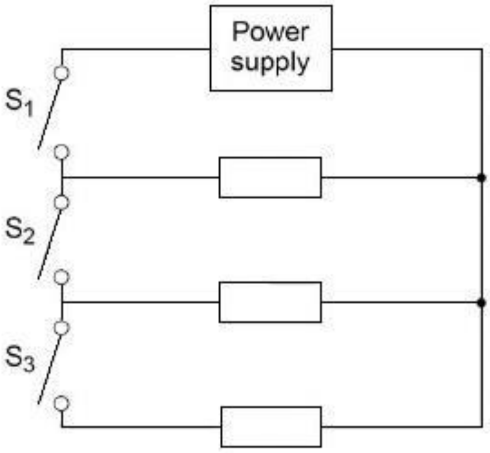
Electricity

Q4.

A hair dryer contains three heating elements.

The figure below shows the circuit diagram for the heating elements in the hair dryer.

In the figure the heating elements are represented by resistor symbols.



(a) Complete the sentence.

The three resistors in above diagram are connected in ________________ with the power supply.

(1)

(b) Which switch must always be closed for the hair dryer to work?

Tick (✓) **one** box.

S_1 ☐

S_2 ☐

S_3 ☐

(1)

(c) Which switches must be closed for the hair dryer to work at maximum power output?

Tick (✓) **one** box.

S_1 and S_2	☐
S_1 and S_3	☐
S_1, S_2 and S_3	☐

(1)

Use the Physics Equations Sheet to answer parts (d) and (e).

(d) Write down the equation which links energy transferred (E), power (P) and time (t).

____

(1)

(e) The heating elements have a maximum power output of 1200 W.

The energy transferred to the heating elements to reach normal operating temperature is 3600 J.

Calculate the time taken for the heating elements to reach normal operating temperature at maximum power output.

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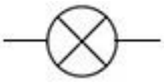
Time = ___________s

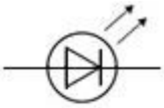
(3)

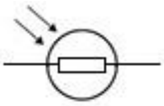
(f) The hair dryer has LEDs to indicate the power setting.

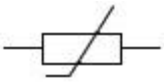
What is the circuit symbol for an LED?

Tick (✓) **one** box.









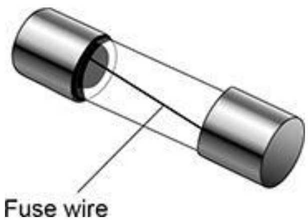
(1)
(Total 8 marks)

Q5.

The live wire in a three-core cable is connected to a fuse inside a plug.

A fuse contains a wire that is designed to melt when the current gets too great.

The figure below shows a fuse.



(a) What colour is the insulation covering the live wire in a three-core cable?

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(1)

(b) Draw the circuit symbol for a fuse in the box below.

(1)

(c) The fuse wire melts when there is a charge flow of 2.0 C for 400 ms.

Calculate the current in the fuse wire.

Use the Physics Equations Sheet.

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Current = ______________________ A

(4)

(d) When the fuse wire is at its melting point, the additional energy needed to melt the wire is 1.02 J.

specific latent heat of fuse wire = 60 kJ/kg

Calculate the mass of the fuse wire.

Use the Physics Equations Sheet.

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Mass = ____________________ kg

(4)

(e) The calculation in part (d) assumes there is no energy transferred to the surroundings.

How would the time taken for the wire to melt be affected if some energy was transferred to the surroundings?

Give a reason for your answer.

Tick (✓) **one** box.

Time taken would decrease	☐
Time taken would stay the same	☐
Time taken would increase	☐

Reason ___

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(2)

(Total 12 marks)

Q6.

A student rubbed a plastic rod with a cloth.

The rod became negatively charged and the cloth became positively charged.

(a) Explain why the cloth became positively charged.

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(3)

Figure 1 shows the negatively charged rod on a balance.

Figure 1

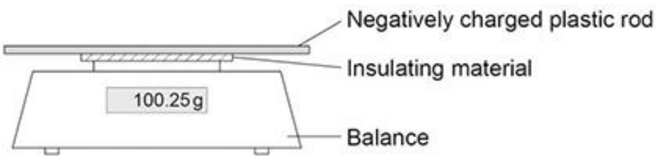
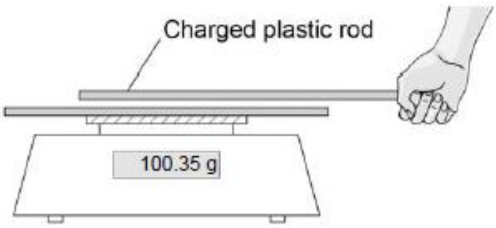


Figure 2 shows another charged rod being held stationary above the rod on the balance.

The rods do not touch each other.

Figure 2



(b) Explain why the reading on the balance increases.

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(3)

(c) The balance had a zero error.

The zero error is not important in this experiment.

Give the reason why.

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(1)

(d) A negatively charged rod is held near an earthed conductor.

Explain why a spark jumps between the negatively charged rod and the earthed conductor.

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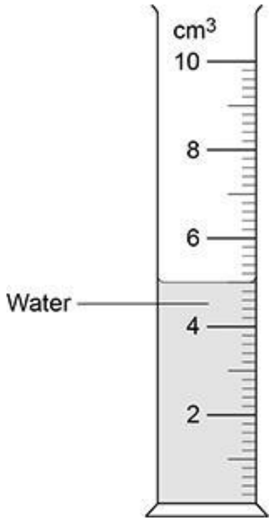
(3)

(Total 10 marks)

Particle Model of Matter

Q7.

The figure below shows a measuring cylinder containing some water, which a student used to measure the volume of a metal ring.



(a) When measuring the volume, the student s eye was in line with the level of the water.

Which type of error would have been caused if the student s eye was **not** in line with the level of the water?

Tick (✓) **one** box.

Random error	☐
Systematic error	☐
Zero error	☐

(1)

(b) The student tied a piece of thick string to the metal ring and lowered the ring into the water.

Suggest **one** reason why the student should have used thin string instead of thick string.

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(1)

The table below shows the results.

Volume of water in cm^3	**Volume of water and ring in cm^3**	**Volume of ring in cm^3**
5.0	5.4	0.4

(c) The true volume of the ring was 0.44 cm^3.

Even without using the string, the measuring cylinder could not give an accurate value for the volume of the ring.

Give **one** reason why.

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(1)

(d) The student used a balance to measure the mass of the ring.

After the ring was removed from the balance, the reading on the balance was 0.02 g.

How could the student use the readings from the balance to determine the correct mass of the ring?

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(1)

(e) The student determined that the density of the ring was 21 500 kg/m^3. The volume of the ring was 0.44 cm^3.

Calculate the mass of the ring. Give your answer in kg.

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Mass = ______________________ kg

(4)

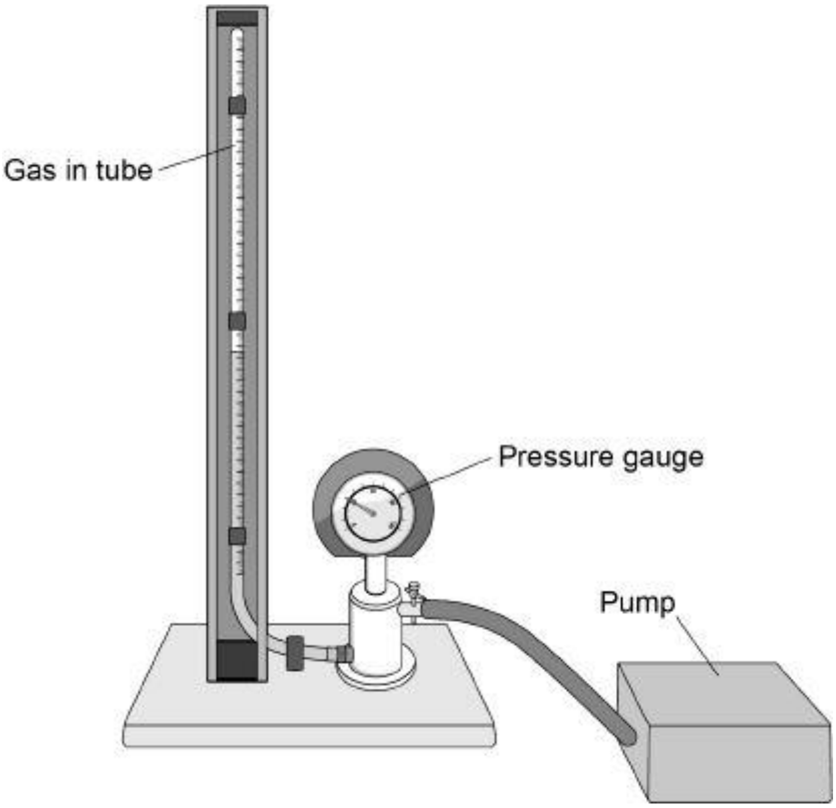
(Total 8 marks)

Q8.

A student investigated how the pressure exerted by a gas varied with the volume of the gas.

Figure 1 shows the equipment the student used.

Figure 1



A pump was used to compress the gas in a tube. As the volume of the gas decreases, the pressure of the gas increases.

(a) The student only recorded one set of results.

Give **two** reasons why taking repeat readings could provide more accurate data.

1. ____

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2. ____

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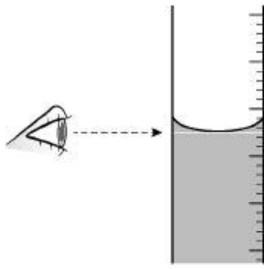
(2)

(b) **Figure 2** shows the position of the student's eye when taking volume measurements.

Figure 2



Explain what type of error would be caused if the student's eye was **not** in line with the level of the liquid in the tube.

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(2)

(c) If the gas is compressed too quickly the temperature of the gas increases.

Explain how the temperature increase would affect the pressure exerted by the gas.

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____

(2)

(d) One of the student's results is given below.

pressure = 1.6×10^5 Pa
volume = 9.0 cm^3

Calculate the volume of the gas when the pressure was 1.8×10^5 Pa. The temperature of the gas was constant.

____

____

____

____

Volume = ______________________ cm^3

(3)

(e) **Figure 3** shows a person using a bicycle pump to inflate a tyre.

Figure 3

The internal energy of the air increases as the tyre is inflated.

Explain why.

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(2)

(Total 11 marks)

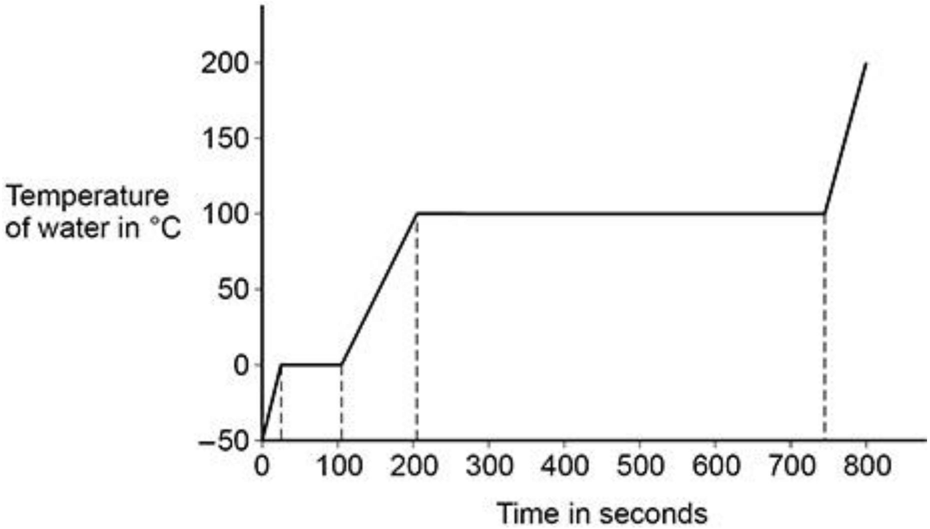
Q9.

A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

The figure below shows the student's results.

The power output of the heater was constant.



(a) The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how the figure above shows this.

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(2)

(b) The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how the figure above shows this.

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____

(2)

(c) A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in the figure above would have been different.

1 ____

____

____

____

2 ____

____

____

____

(2)

(d) When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

____

____

____

____

____

____

____

Specific latent heat of vaporisation = ________________

Unit ___________

(5)

(Total 11 marks)

Atomic Structure

Q10.

Some isotopes emit nuclear radiation.

(a) Carbon-12 and carbon-14 are both isotopes of carbon.

Complete the sentences.

Choose answers from the box.

alpha particles	**electrons**	**neutrons**	**protons**

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have

the **same** number of _________________________.

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have

a **different** number of _________________________.

(2)

(b) Different radioactive isotopes have different half-lives.

What does 'half-life' mean?

Tick (✓) **one** box.

Half the time taken for all of the nuclei in a sample to decay. ☐

The time taken for half the nuclei in a sample to decay. ☐

The time taken for one nucleus to split in half. ☐

(1)

(c) **Table 1** shows the half-life of some different isotopes of carbon.

Table 1

Isotope	**Half-life in seconds**
Carbon-15	2.45
Carbon-16	0.75
Carbon-17	0.19
Carbon-18	0.09

Which isotope is the least stable?

Tick (✓) **one** box.

Carbon-15 ☐

Carbon-16 ☐

Carbon-17 ☐

Carbon-18 ☐

(1)

(d) Workers in nuclear power stations must be aware of nuclear irradiation and radioactive contamination.

Draw **one** line from each term to an example of the term.

Term	**Example**
	Exposure to a beam of gamma rays
Radioactive contamination	
	Exposure to ultraviolet radiation from the Sun
	Accidental transfer of plutonium onto a human body
Nuclear irradiation	
	Using a mobile phone

(2)

(e) Why are workers required to walk across a sticky floor before leaving the nuclear power station?

Tick (✓) **one** box.

To remove alpha particles from their shoes. ☐

To remove gamma radiation from their shoes. ☐

To remove radioactive dust from their shoes. ☐

(1)

(f) The places where people work and live contribute to the nuclear radiation they are exposed to.

Table 2 shows the mean daily dose of radiation caused by two different jobs.

Table 2

Job	**Mean daily dose in mSv**
Aeroplane pilot	0.072
Nuclear power station worker	0.00050

Calculate the number of days a nuclear power station worker must work before receiving the same dose that an aeroplane pilot receives in one day.

____

____

____

Number of days = ____________

(2)

(g) The process of nuclear fission takes place in nuclear power stations.

The process of nuclear fusion takes place in the Sun.

Draw **one** line from each process to its fuel.

Process	**Fuel**
	Hydrogen
Nuclear fission	
	Iron
	Lead
Nuclear fusion	
	Uranium

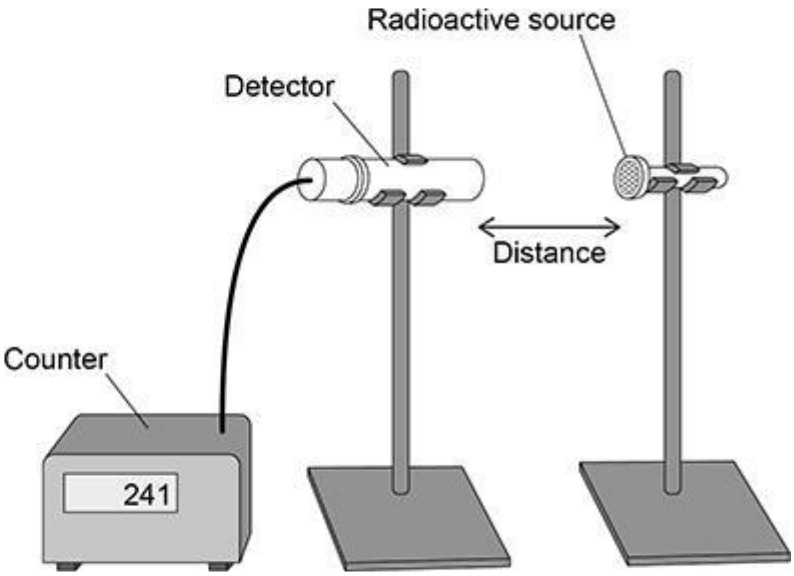
(2)
(Total 11 marks)

Q11.

A teacher investigated the radiation emitted by two different radioactive sources, **A** and **B**.

Figure 1 shows a radiation detector positioned near one of the radioactive sources.

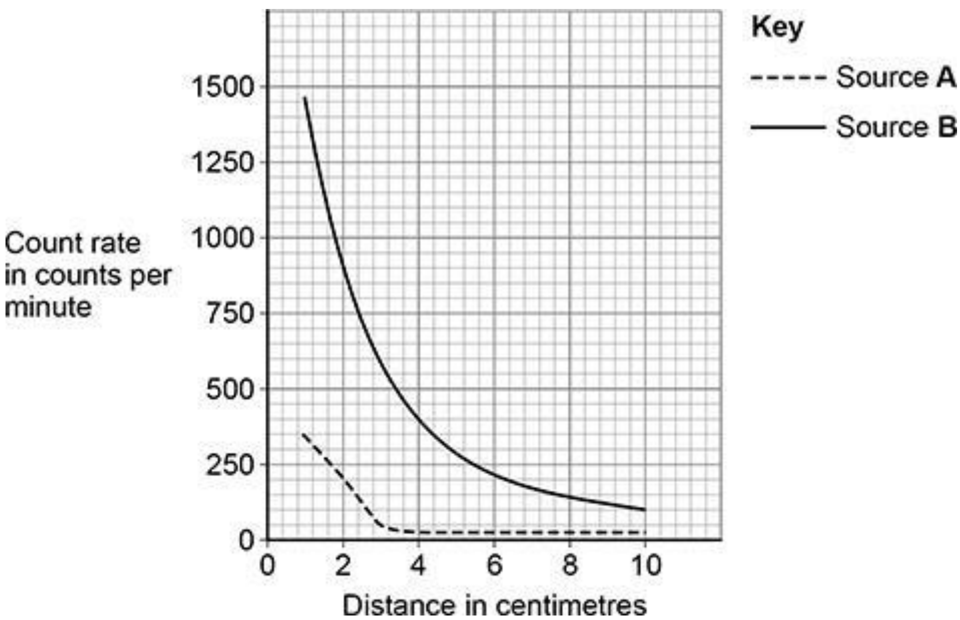
Figure 1



The teacher measured the count rate at different distances for each radioactive source.

Figure 2 shows the results.

Figure 2



(a) Explain how **Figure 2** shows that Source **A** only emits alpha radiation.

(3)

(b) **Figure 2** can **not** be used to determine if Source **B** emits beta radiation or gamma radiation.

Explain how an absorbing material could be used to show which type of radiation is emitted by Source **B**.

(2)

The teacher took safety precautions during the experiment.

(c) Suggest **one** safety precaution the teacher would have taken to reduce the radiation dose the teacher received.

(1)

(d) Suggest **one** safety precaution that the teacher would have taken to avoid becoming contaminated.

____

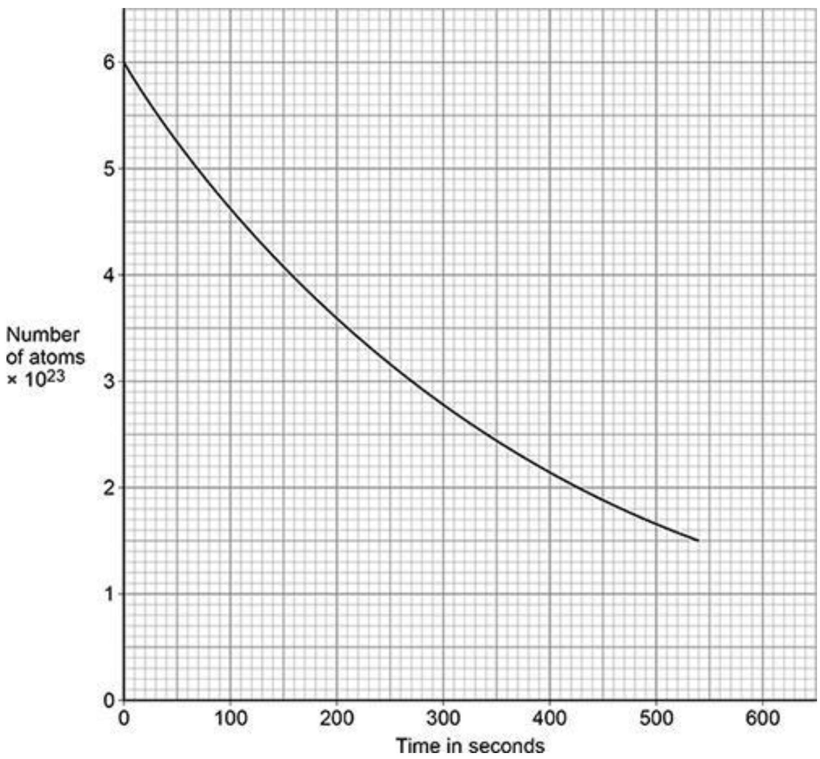
____

____

(1)

(e) **Figure 3** shows how the number of atoms of a radioactive element in a sample varied with time.

Figure 3



Activity is the rate at which a source of unstable nuclei decays.

Determine the activity of the radioactive sample at 300 seconds. Give the unit.

____

____

____

____

Activity = ______________________ Unit ___________

(4)

(Total 11 marks)

Q12.

Scientists have used lasers to start a nuclear **fusion** reaction.

The scientists used the lasers to heat a small amount of an isotope of hydrogen.

(a) Describe what is meant by 'isotopes' of an element.

(2)

(b) Explain how nuclear **fusion** releases energy.

(3)

(c) The fusion reaction releases large amounts of energy.

The fusion reaction takes place in a reactor.

Explain why the walls of the reactor should be made from a material with a very high specific heat capacity.

(2)

(d) Nuclear fusion is safer than nuclear fission.

Nuclear **fission** can lead to an uncontrolled chain reaction.

Give **one** consequence of an uncontrolled chain reaction.

____

____

(1)

(Total 8 marks)

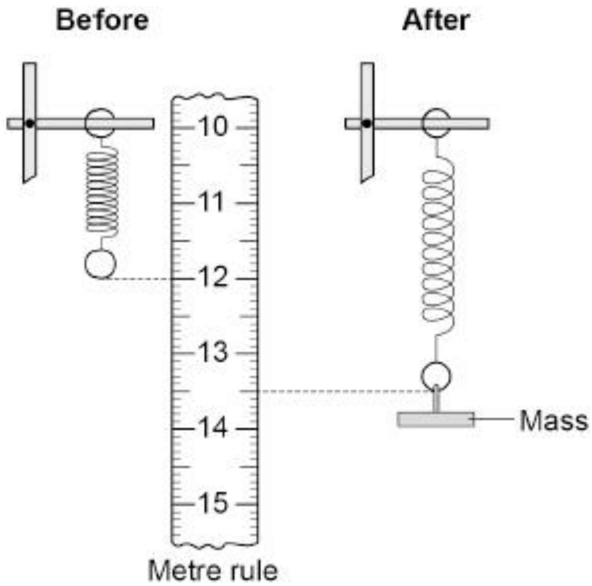
Forces

Q13.

A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.

Figure 1



(a) What is the extension of the spring in **Figure 1**?

Tick (✓) **one** box.

1.5 cm	☐
3.5 cm	☐
13.5 cm	☐

(1)

(b) Give **one** safety precaution the student should have taken during this investigation.

___

___

(1)

(c) The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

____

____

Weight = ____________________ N

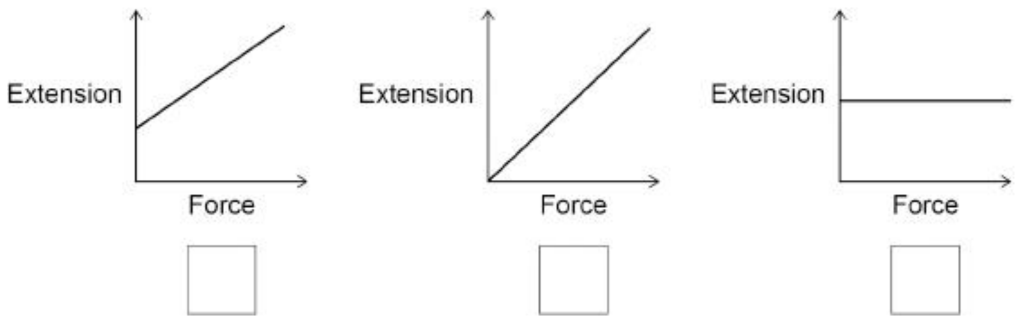
(2)

(d) The weight of the mass applies a force to the spring. The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

Tick (✓) **one** box.

Figure 2



(1)

(e) A force of 2.0 N was applied to a different spring. The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

____

____

____

Spring constant = ____________________ N/m

(2)

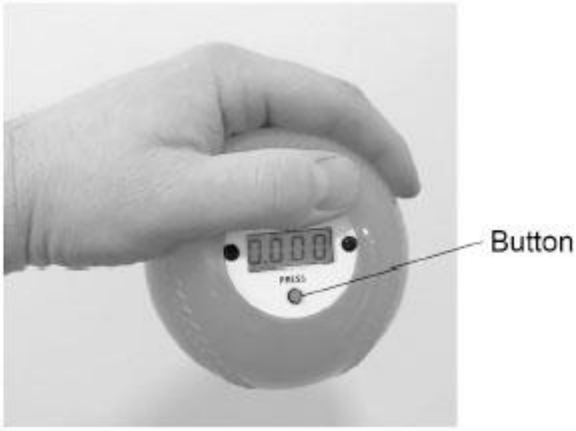
(Total 7 marks)

Q14.

A student investigated the acceleration of a ball dropped from different heights.

Figure 1 shows a 'gravity ball' that the student used.

Figure 1



The button on the gravity ball starts the stopwatch.

When the gravity ball hits the floor, the stopwatch stops.

This is the method used.

1. Measure a vertical height above the floor.
2. Hold the gravity ball at the measured height.
3. Start the stopwatch on the gravity ball and drop the gravity ball.
4. Record the time shown on the stopwatch.
5. Repeat steps 1 to 4 using the same height.
6. Repeat steps 1 to 5 using different heights.

(a) The student dropped the ball from the same height five times and recorded the following results.

0.49 s   0.51 s   0.58 s   0.56 s   0.61 s

Calculate the uncertainty in these measurements of time.

____

____

____

Uncertainty = ± ______________________ s

(2)

(b) What type of error caused the variation in the measurements of time?

Tick (✓) **one** box.

Random error	☐
Systematic error	☐
Zero error	☐

(1)

(c) Suggest **one** reason for the error that caused the variation in the measurements of time.

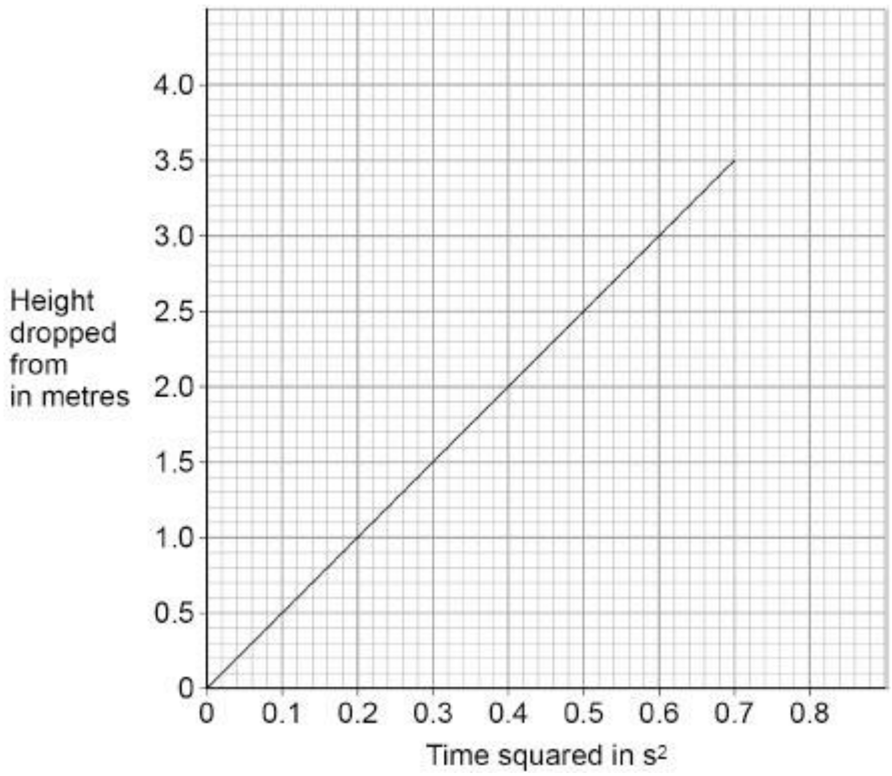
____

____

(1)

(d) **Figure 2** shows a graph of the height the ball was dropped from against the time squared.

Figure 2



The acceleration of the ball can be calculated using the equation:

acceleration = 2 × (gradient of the graph)

Determine the acceleration of the ball.

Acceleration of ball = ____________________ m/s^2

(3)

(Total 7 marks)

Q15.

In a world record attempt, a skydiver jumped from a height of 40 km above the Earth.

(a) The figure below shows an incomplete free-body diagram for the skydiver a few seconds after the start of the jump.

The skydiver has not reached terminal velocity.

Complete the free-body diagram in the figure above.

(2)

(b) During the first 2.5 minutes the mean acceleration of the skydiver was 0.64 m/s^2.

The initial velocity of the skydiver was 0 m/s.

Calculate the velocity of the skydiver 2.5 minutes after the start of the jump.

Use the Physics Equations Sheet.

____

____

____

____

____

____

____

Velocity = ____________________ m/s

(4)

(c) The skydiver accelerated until reaching terminal velocity.

Explain why the skydiver reached terminal velocity.

____

____

____

____

____

____

____

____

(4)

(d) Explain why the atmospheric pressure acting on the skydiver increased as the skydiver fell.

____

____

____

____

(2)

(e) The skydiver opened his parachute.

A few seconds after opening the parachute, the resultant vertical force on the skydiver was 240 N upwards.

The wind caused a resultant horizontal force of 200 N to the left on the skydiver.

Draw a vector diagram overleaf to determine the resultant force on the skydiver.

Magnitude of resultant force = ____________________ N

Angle to vertical of resultant force = ____________________ degrees

(4)

(Total 16 marks)

Waves

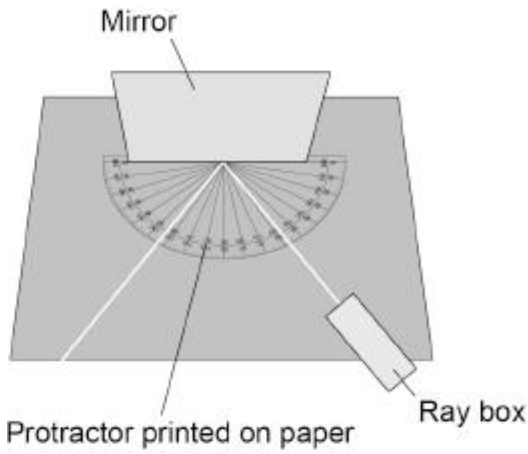
Q16.

A student investigated the behaviour of light.

The student used a mirror with a smooth surface to investigate reflection.

Figure 1 shows the equipment used.

Figure 1



(a) What name is given to reflection from a smooth surface?

____

(1)

The student measured the angle of reflection for different angles of incidence.

The table below shows the results.

Angle of incidence in degrees	**Angle of reflection in degrees**			
	Test 1	Test 2	Test 3	Mean
10	8	10	11	10
20	20	21	20	20
30	28	29	32	30
40	39	41	41	40
50	49	50	52	50

(b) What conclusion can be made from the results in the table above?

____

____

(1)

(c) What type of error caused the variation in the results for the angle of reflection?

Suggest **one** cause of this error.

Type of error ______________________

Cause of error ____

____

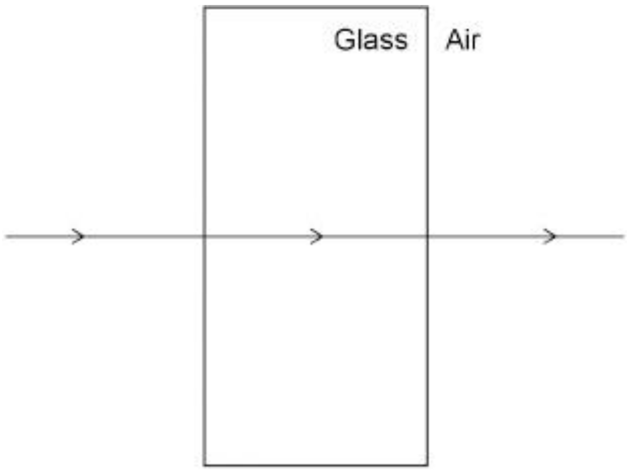
____

(2)

The student also investigated the refraction of light.

(d) **Figure 2** shows the path of a ray of light through a glass block.

Figure 2



Why has refraction **not** occurred?

____

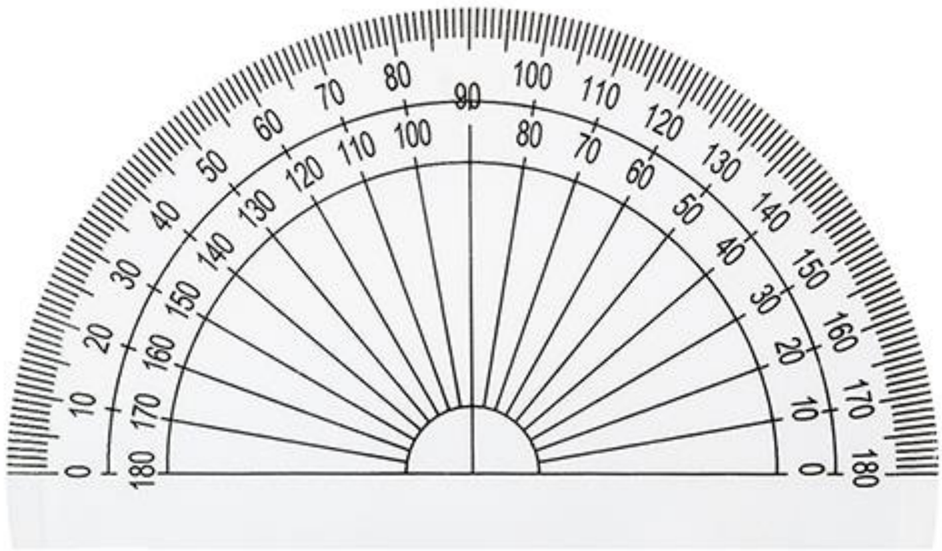
____

(1)

(e) The student measured the angle of refraction for different angles of incidence.

Figure 3 shows the protractor used.

Figure 3



When the angle of incidence was 10° the student measured the angle of refraction four times.

The student recorded the measurements as:

6.0°   6.3°   6.4°   5.8°

Explain why the student should **not** have recorded these results when using the protractor in **Figure 3** to make the measurements.

____

____

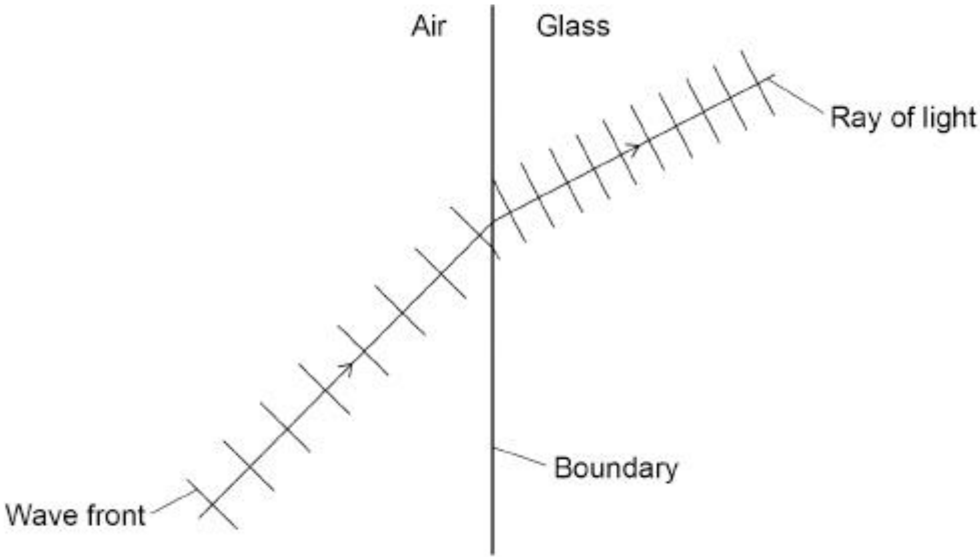
____

____

(2)

(f) **Figure 4** shows what happens to wave fronts as they pass across the boundary between air and glass.

Figure 4



Explain in terms of the wave fronts, why refraction happens at the boundary between air and glass.

____

____

____

____

____

____

____

____

(3)

(Total 10 marks)

Q17.

Radio waves and gamma rays both transfer energy.

(a) Give **three** other similarities between radio waves and gamma rays.

1 ____

____

2 ____

____

3 ____

____

(3)

Both radio waves and gamma rays are used in medicine.

(b) Give **one** medical use of gamma rays.

____

____

(1)

(c) Explain why exposure to gamma rays can be harmful but exposure to radio waves is **not** harmful.

____

____

____

____

(2)

(d) Some medical scanners produce radio waves at a specific frequency.

Explain how radio waves are produced at a specific frequency.

____

____

____

____

(2)

(Total 8 marks)

Q18.

(a) **Figure 1** shows the electromagnetic spectrum.

Figure 1

Radio	Microwave	Infrared	Visible light	Ultraviolet	X-ray	Gamma

Which statement is correct for the direction of the arrow in **Figure 1**?

Tick (✓) **one** box.

The wavelength decreases and the wave speed in air increases.	☐
The frequency increases and the wavelength increases.	☐
The frequency increases and the wave speed in air stays the same.	☐
The wavelength increases and the wave speed in air increases.	☐

(1)

(b) Explain how the properties of X-rays make them suitable for the medical imaging of bones.

____

____

____

____

____

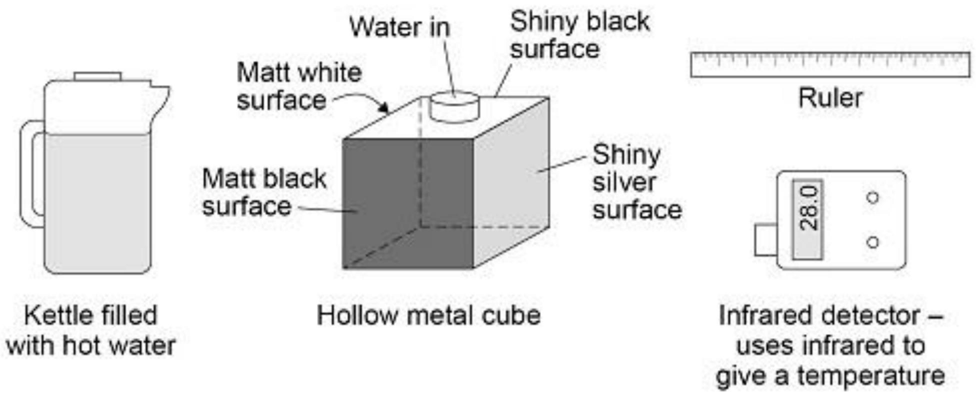
(2)

A student investigated the infrared radiation emitted from the sides of a hollow metal cube.

The sides of the cube are different colours or textures.

Figure 2 shows the equipment used.

Figure 2



Boiling water was poured into the cube. The amount of infrared radiation emitted from each vertical surface was then measured.

(c) Boiling water is a hazard in this investigation.

Suggest how the risk of harm could be reduced in this investigation.

____

____

____

(1)

(d) What is the control variable in this investigation?

____

____

(1)

The following table shows the results.

Type of surface	**Temperature in °C**
Matt black	68.0
Matt white	65.6
Shiny black	66.3
Shiny silver	28.0

(e) The four temperature values in the table cannot be used to show that the infrared detector gives precise readings.

Give the reason why.

____

____

____

(1)

(f) The student looked at the data in the table above and concluded:

'A black surface always emits more infrared radiation than a white surface.'

Explain how using an infrared detector with a resolution of 1 °C would have affected the student's conclusion.

____

____

____

____

____

(2)

Albedo is a measure of the amount of solar radiation reflected by an object compared to the total solar radiation incident on the object.

A perfect reflector has an Albedo value of 1.0
A perfect absorber has an Albedo value of 0.0

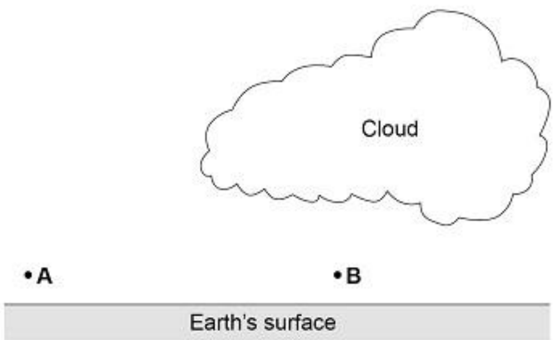
(g) What is the Albedo value of a perfect black body?

____

(1)

(h) **Figure 3** shows two points, **A** and **B**, just above the Earth's surface.

Figure 3



The average Albedo value of the Earth's surface is 0.3
The Albedo value of thick cloud varies between 0.6 and 0.9

At night the air at point **A** cools faster than the air at point **B**.

Explain why.

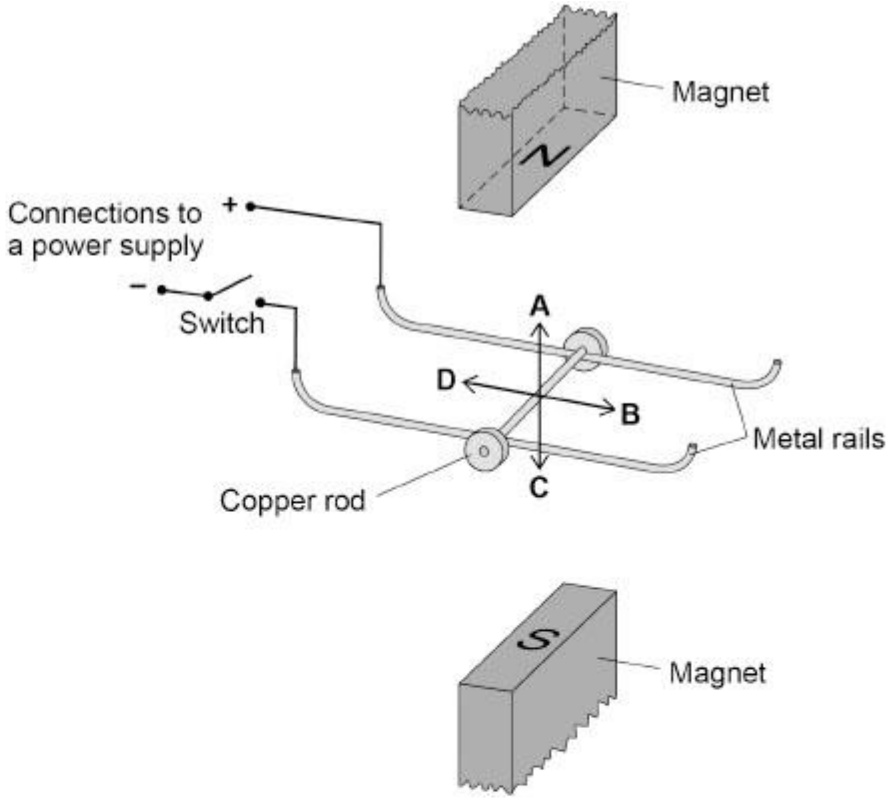
(3)
(Total 12 marks)

Magnetism and Electromagnetism

Q19.

Figure 1 shows some apparatus used to demonstrate the motor effect.

Figure 1



When the switch is closed the copper rod accelerates.

(a) What direction is the acceleration of the copper rod?

Tick (✓) **one** box.

A	☐
B	☐
C	☐
D	☐

(1)

(b) The copper rod has a mass of 5.0 g.

The length of the copper rod in the magnetic field is 0.070 m.

The magnetic flux density is 0.30 T.

Calculate the initial acceleration of the rod when the current in the rod is 2.0 A.

Use the Physics Equations Sheet.

____

____

____

____

____

____

____

____

____

Initial acceleration = ____________________ m/s^2

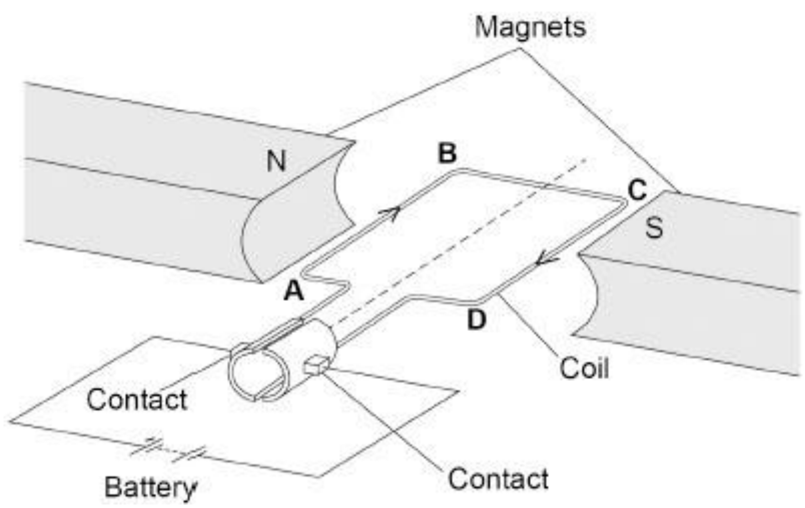
(5)

Figure 2 shows a simple motor.

There is a magnetic field between the two permanent magnets.

When there is a current in the coil, a magnetic field is produced around the coil.

Figure 2



(c) Explain how these magnetic fields cause the coil to continuously rotate.

(4)

(d) In **Figure 2** the coil of the motor is in a horizontal position.

Explain why the resultant moment on the coil is zero when the coil is in a vertical position.

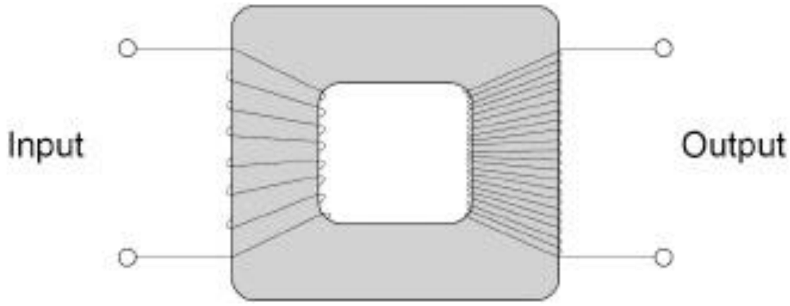
(2)

(Total 12 marks)

Q20.

Transformers are used to change alternating potential differences.

The figure below shows a transformer.



(a) Why is the core of the transformer made from iron?

____

____

(1)

(b) A transformer has 345 turns on the primary coil and 6000 turns on the secondary coil.

The potential difference across the secondary coil is 400 kV.

Calculate the potential difference across the primary coil.

Use the Physics Equations Sheet.

Give your answer in volts.

____

____

____

____

____

____

____

Potential difference = ____________________ V

(4)

(c) There is an alternating current in the primary coil of a transformer.

Explain why there is an alternating potential difference across the ends of the secondary coil of the transformer.

____

____

____

____

____

____

(3)

(Total 8 marks)

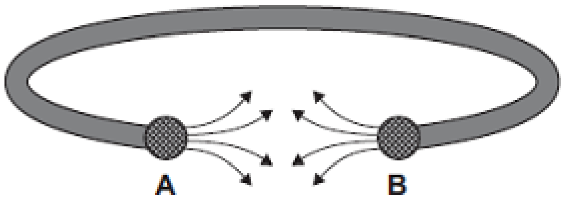
Q21.

(a) Some people wear magnetic bracelets to relieve pain.

Figure 1 shows a magnetic bracelet.

There are magnetic poles at both **A** and **B**.
Part of the magnetic field pattern between **A** and **B** is shown.

Figure 1



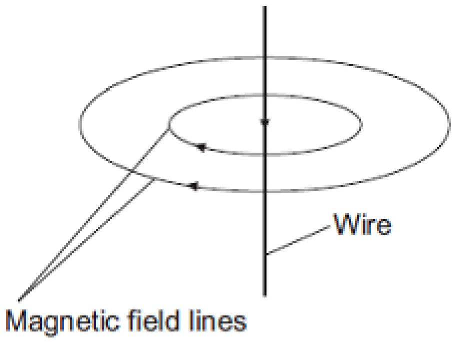
What is the pole at **A**? ______________________

What is the pole at **B**? ______________________

(1)

(b) **Figure 2** shows two of the lines of the magnetic field pattern of a current-carrying wire.

Figure 2



The direction of the current is reversed.

What happens to the direction of the lines in the magnetic field pattern?

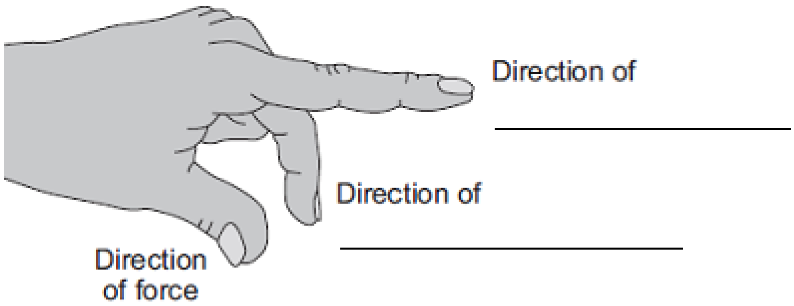
____

(1)

(c) Fleming's left-hand rule can be used to identify the direction of a force acting on a current-carrying wire in a magnetic field.

(i) Complete the labels in **Figure 3**.

Figure 3

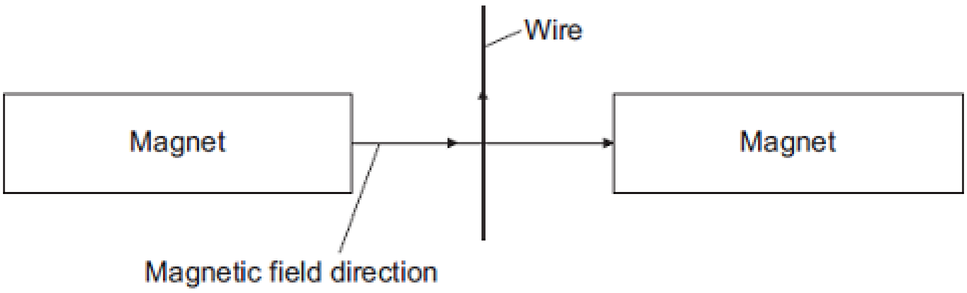


(2)

(ii) **Figure 4** shows:

- the direction of the magnetic field between a pair of magnets
- the direction of the current in a wire in the magnetic field.

Figure 4



In which direction does the force on the wire act?

___

(1)

(iii) Suggest **three** changes that would **decrease** the force acting on the wire.

1. ___

2. ___

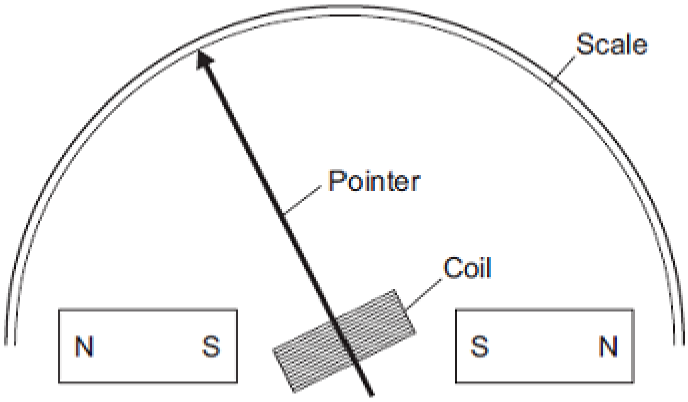
3. ___

(3)

(d) **Figure 5** shows part of a moving-coil ammeter as drawn by a student.

The ammeter consists of a coil placed in a uniform magnetic field.
When there is a current in the coil, the force acting on the coil causes the coil to rotate and the pointer moves across the scale.

Figure 5



(i) The equipment has **not** been set up correctly.

What change would make it work?

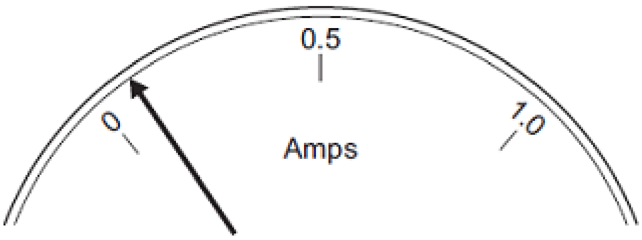
___

___

(1)

(ii) **Figure 6** shows the pointer in an ammeter when there is no current.

Figure 6



What type of error does the ammeter have?

___

(1)
(Total 10 marks)

Space

Q22.

(a) The Sun is the star at the centre of our solar system.

Give **three** other types of object that form our solar system.

1 ____

2 ____

3 ____

(3)

Some main sequence stars will eventually form black holes. The table below gives the mass of four stars.

Star	**Mass in kg**
Arcturus	2.2×10^{30}
Betelgeuse	2.2×10^{31}
Cygni A	1.4×10^{30}
The Sun	2.0×10^{30}

(b) Which star in the table above is most likely to form a black hole?

____

(1)

(c) The distance from Cygni A to the Earth is 1.1×10^8 gigametres.

Which distance is the same as 1.1×10^8 gigametres?

Tick (✓) **one** box.

1.1×10^{11} m ☐

1.1×10^{14} m ☐

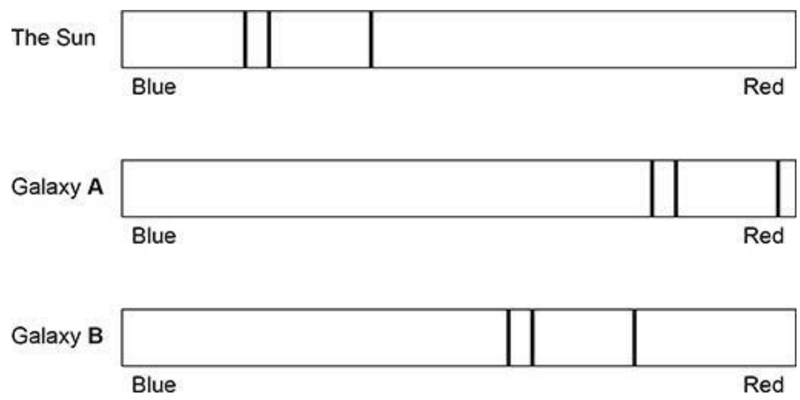
1.1×10^{17} m ☐

1.1×10^{20} m ☐

(1)

(d) The light spectrum from every galaxy includes dark lines. The lines have the same pattern.

The figure below shows the position of dark lines in the visible spectra of light from the Sun and from two distant galaxies.



Explain what these light spectra tell us about the velocities of galaxy **A** and galaxy **B**.

___

___

___

___

___

(3)

(e) The distance between Arcturus and the Earth is 3.6×10^{14} km.

speed of light = 3.0×10^{8} m/s

Calculate the time taken for light from Arcturus to reach the Earth.

___

___

___

___

___

___

Time taken = ______________________ s

(4)

(f) When stars are formed, they contain mostly hydrogen.

Describe how stars produce all other naturally occurring elements.

(4)

(Total 16 marks)

Q23.

(a) Which one of the following types of electromagnetic wave has the highest frequency?

Tick **one** box.

Gamma rays	☐
Infrared	☐
Microwaves	☐
Ultraviolet	☐

(1)

(b) What makes microwaves suitable for sending communications to a satellite in space?

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(1)

(c) Scientists have detected short bursts of radio waves emitted from a distant galaxy.

The scientists think that the radio waves may have been emitted from a neutron star.

What event leads to a neutron star forming?

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(1)

(d) Some of the radio waves from the distant galaxy have a frequency of 1.2 gigahertz (GHz).

Which of the following is the same as 1.2 GHz?

Tick **one** box.

1.2×10^3 Hz	☐
1.2×10^6 Hz	☐
1.2×10^9 Hz	☐
1.2×10^{12} Hz	☐

(1)

(e) Radio waves travel through space at a speed of 3.0×10^8 m/s

Calculate the wavelength of the 1.2 GHz radio waves emitted from the distant galaxy.

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____

Wavelength = ______________________ m

(3)

(f) When radio waves are absorbed by an aerial they may create an alternating current in an electrical circuit.

If an alternating current is created what frequency would it have?

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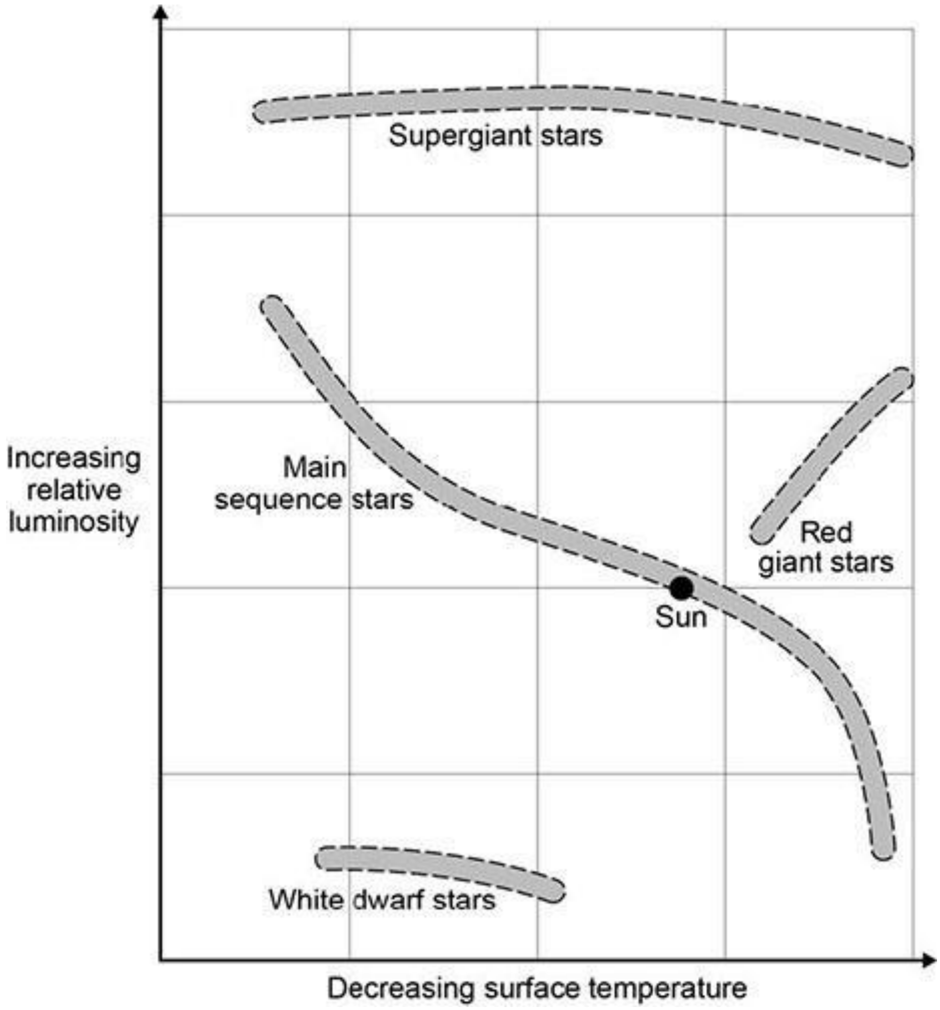
(1)

The diagram shows four groups of stars.

The surface temperature and relative luminosity determine which group a star is in.

A star with a relative luminosity of 1 emits the same amount of energy every second as the Sun.



(g) The Sun is in the group of main sequence stars. These stars are stable.

Explain why a star remains stable.

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(2)

(h) At different points in their lifecycle stars change from one group to another.

Describe what will happen to the Sun between it leaving the main sequence group and becoming a white dwarf.

Use information from the diagram.

(4)

(Total 8 marks)

Good luck!