VCE Physics Unit 2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of Booklet

Section	Number of questions	Number of questions to be answered	Number of marks
A Core – Areas of study			
1. Motion	18	18	37
2. Wave-like properties of light	14	14	29
B Detailed studies			
Astronomy **OR**			
Astrophysics	12	12	24
3. Energy from the nucleus	12	12	24
4. Investigations: Flight	12	12	24
5. Investigations: Sustainable energy sources	12	12	24
6. Medical physics	12	12	24
			Total 90

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, up to two pages (one A4 sheet) of pre-written notes (typed or handwritten) and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied
Question and answer booklet of 40 pages.
Answer sheet for multiple-choice questions.
Data sheet.

Instructions
Detach the formula sheet from the centre of this booklet during reading time.
Please ensure that you write your **name** and your **teacher's name** in the space provided on this booklet and on the answer sheet for multiple-choice questions.
Unless otherwise indicated, the diagrams in the booklet are **not** drawn to scale.
All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

SECTION A – CORE

Instructions for Section A

Answer **all** questions **for both** Areas of study in this section in the spaces provided.

Where an answer box has a unit printed in it, give your answer in that unit.

You should take the value of g to be 10 m s^{-2}.

In questions where more than one mark is available, appropriate working should be shown.

Areas of study | **Page**

TEVPHYU2_QA_2011.FM

Area of study 1 – Motion

The following information relates to Questions 1 to 6.

A 23 000 kg boat is moving through the ocean at a constant speed of 7.00 m s^{-1} as shown in Figure 1.

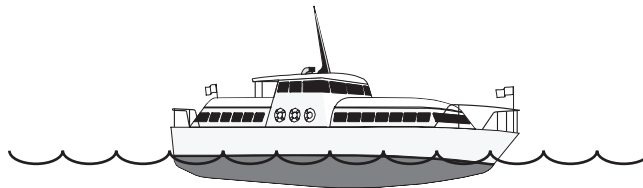**Question 1**

How fast is the boat travelling in km h^{-1}?

km h^{-1}

1 mark

Question 2

On the diagram provided, show the forces acting on the boat.
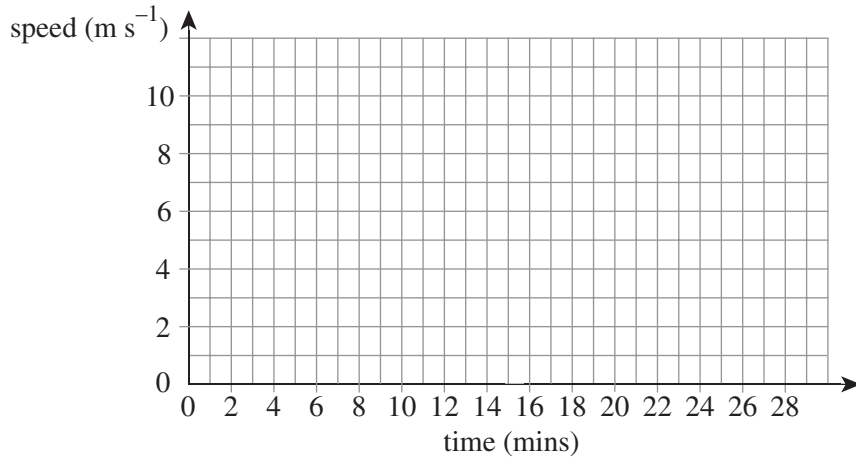

Figure 1

2 marks

Question 3

What is the net force acting on the boat? Explain how you obtained this result.

N

2 marks

The boat now accelerates to 10 m s^{-1} in 8 minutes. It then holds this speed for 15 minutes before decelerating (in 5 minutes) to a standstill as it reaches the port.

Question 4

On the axes provided, draw the speed–time graph of the boat from the point at which it starts to accelerate.

Figure 2

3 marks

Question 5

What is the distance travelled by the boat? Give your answer to the nearest kilometre.
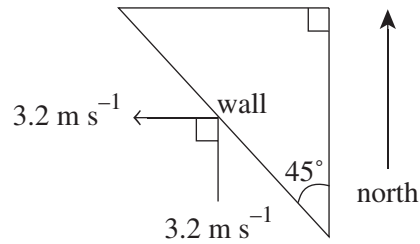
km

2 marks

Question 6

What is the magnitude of the force decelerating the boat?

N

2 marks

The following information relates to Questions 7 to 10.

Elena is waiting for her mum at school and, while waiting, decides to conduct a physics experiment. She bounces one of her 'superballs' (mass 45 g) off the wall as shown in Figure 3.

Figure 3

Question 7

What is the kinetic energy of the ball?

J

2 marks

Question 8

What is the magnitude of the change in **velocity** from its starting position?

m s^{-1}

2 marks

Question 9

What is the change in momentum of the ball? You do not have to specify a direction.

N s

2 marks

Question 10

Is this an example of an elastic or inelastic collision (please circle)? Explain.
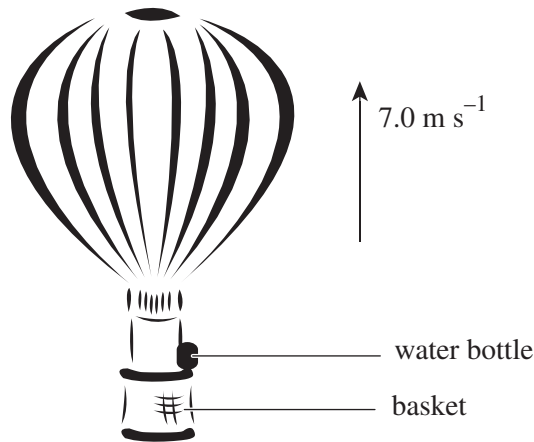
elastic	inelastic

_____

_____

2 marks

The following information relates to Questions 11 to 15.

Joan and Janie have taken an early morning balloon ride. The balloon is going upwards at a constant velocity of 7.0 m s^{-1}. When the balloon reaches a height of 85 metres, Janie accidentally knocks over a water bottle that had been resting on the ledge.

Question 11

What is the initial velocity of the water bottle just as it has been knocked over?

magnitude	m s^{-1}
direction	

2 marks

Question 12

Explain what forces (if any) are acting on the bottle. Assume that the air around the balloon is stationary.

_____

_____

_____

2 marks

Question 13

What is the maximum height reached by the water bottle above the ground? (Ignore air resistance for this question only.)

m

2 marks

Question 14

What is the velocity of the bottle just before it hits the ground?

magnitude	m s^{-1}
direction	

2 marks

Question 15

How far apart are the balloon and the water bottle 2 seconds after the bottle falls out of the balloon?

m

3 marks

The following information relates to Questions 16 to 18.

Ronald and Dominic are investigating a car spring. They use one spring and place weights on it to see the level of compression. They get the following results:

Mass (kg)	Compression (cm)
0	0
45	1.5
90	3.0
135	4.5
180	6.0

Table 1

Question 16

Using the axes provided below, draw the force–compression graph. Note the units on the axes.
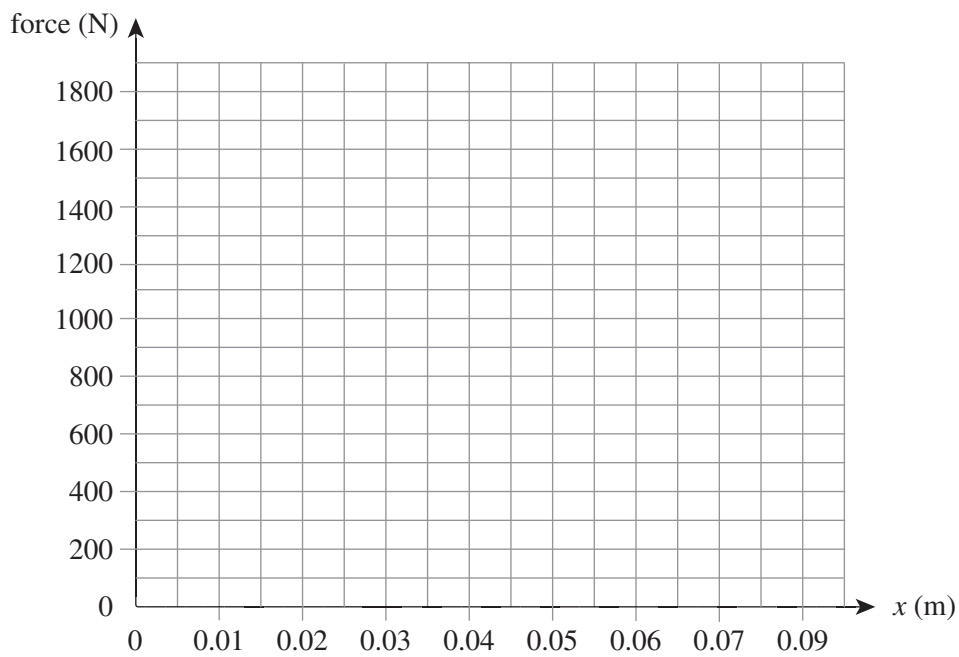
Figure 4

2 marks

Question 17

What is the spring constant for this spring?

N m^{-1}

2 marks

Question 18

How much energy is stored when the spring is compressed by 4 cm?

J

2 marks

END OF AREA OF STUDY 1

Area of study 2 – Wave-like properties of light

Dan, a physics teacher, uses a laser for a refraction experiment. The laser gives out light of wavelength 535 nm when travelling through air. The speed of light in air is 3.0×10^8 ms^{-1}.

Question 1

The laser produces light in the

A.   microwave part of the electro-magnetic (EM) spectrum.

B.   visible part of the EM spectrum.

C.   ultraviolet part of the EM spectrum.

D.   infrared part of the EM spectrum.
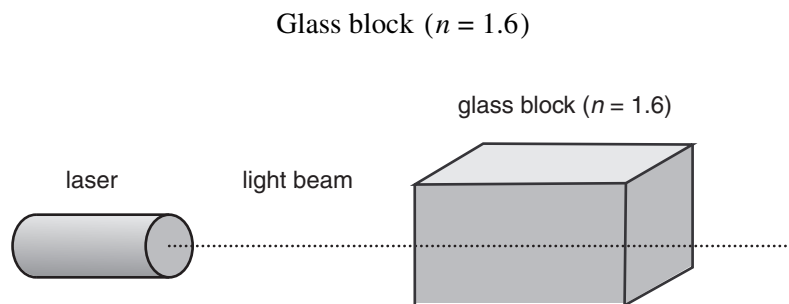
1 mark

Question 2

The laser light can also be described in terms of its frequency.
Calculate the frequency of the laser light.

H$_2$ 2 marks

Dan now shines the laser light through a block of glass as shown in Figure 1. The glass has a refractive index of 1.6 for light of wavelength 535 nm.

Glass block ($n = 1.6$)

Figure 1

Question 3

Complete the table to indicate which properties of the laser light (wavelength, frequency, period and speed) will increase, decrease or remain constant as the light enters the glass.

	Wavelength	**Frequency**	**Period**	**Speed**
Increase/Decrease/Constant				

2 marks

Dan now changes the position of the laser so that it hits the glass at a different angle as shown in Figure 2 when viewed from above. The angle of incidence is 55°.
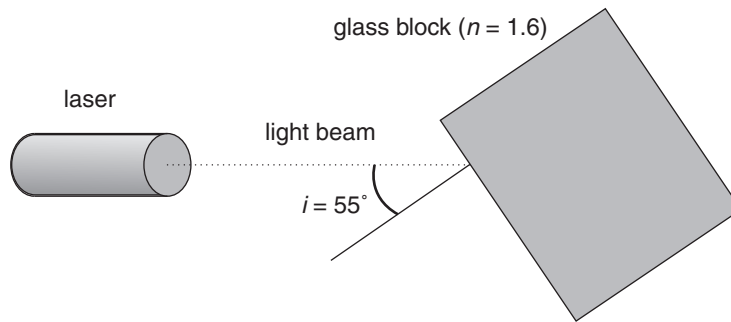
Figure 2

Question 4

Show, using suitable calculations, that the angle of deviation of the light beam after it emerges from the rectangular block is 0°.

3 marks

Dan now changes the laser for another one that produces light of wavelength 425 nm. All other aspects of the experiment remain unchanged.

Question 5

How does changing lasers affect the path of the light ray and the incident angle before it comes out of the block? There is no need to provide any calculations.

_____

_____

_____

_____

2 marks

Question 6

What will now be the angle of deviation between the light entering and the light emerging from the glass? Explain your answer.

_____

_____

_____

_____

2 marks

Newton's particle theory of light was also able to explain the refraction of light. However, it led to a hypothesis about the speed of light in water which was later falsified (shown to be wrong) by experiment.

Question 7

State the hypothesis that was later shown to be wrong.

_____

_____

1 mark

As a consequence of the hypothesis being falsified, a competing theory about the nature of light became much more widely accepted.

Question 8

Describe this competing theory about the nature of light and explain how it better predicts the properties of light as it travels through water.

_____

_____

_____

_____
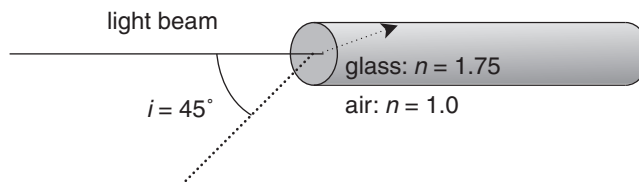
2 marks

Optical fibres work thanks to the phenomenon of total internal reflection. The fibre shown in Figure 3 is made of glass with a refraction index of 1.75. A light ray is incident on the fibre with an incident angle of 45°.

light beam

glass: $n = 1.75$

air: $n = 1.0$

$i = 45°$

Figure 3

Question 9

Calculate the critical angle for this type of glass.

°

2 marks

Question 10

If the light ray in Figure 3 continues onward into the fibre, will it emerge from the fibre or will it be totally internally reflected? Support your answer with calculations.
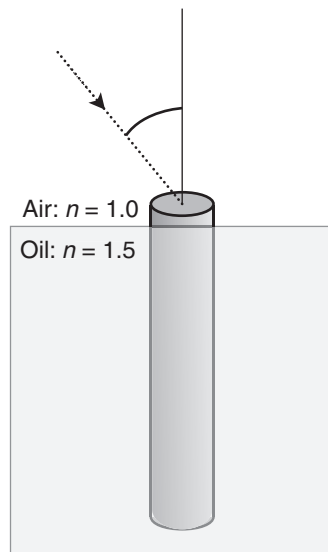
_____

_____

_____

_____

_____

_____

3 marks

The fibre is now submerged in oil with a refractive index of 1.5, as shown in Figure 4. The incident light is still entering the fibre in the air.

Air: $n = 1.0$

Oil: $n = 1.5$

Figure 4

Question 11

Calculate the relative refractive index between glass and oil.

2 marks

Question 12

Explain whether the light is now more or less likely to undergo total internal reflection within the fibre.
Use at least one calculation to support your answer.

_____

_____

_____

_____

_____

3 marks

Light that is reflected off the surface of water has been horizontally polarised. This reflected light is the source
of glare coming off the water. Manufacturers of sunglasses reduce glare by making polarising sunglasses.

Question 13

In what direction should the polarising lens in the sunglasses be oriented? Show this by drawing the
direction in the glasses in Figure 5.

Figure 5

1 mark

Question 14

Explain your answer to Question 13 and include a diagram to support your explanation.

_____

_____

_____

_____

_____

3 marks

END OF AREA OF STUDY 2

SECTION B – DETAILED STUDIES

Instructions for Section B

Select **one** Detailed study.

Answer **all** questions from the Detailed study, in pencil, on the answer sheet provided for multiple-choice questions.

Write the name of your chosen Detailed study on the multiple-choice answer sheet **and** shade the matching box.

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 2, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

You should take the value of g to be 10 m s^{-2}.

Detailed study 1 – Astronomy

The following information relates to Questions 1 and 2.

The Voyager 1 spacecraft was launched in 1977 and is now heading out beyond our solar system. It is the furthest man-made object to do so. It sends signals to Earth via radio waves which travel at the speed of light $(3 \times 10^8 \text{ m s}^{-1})$.
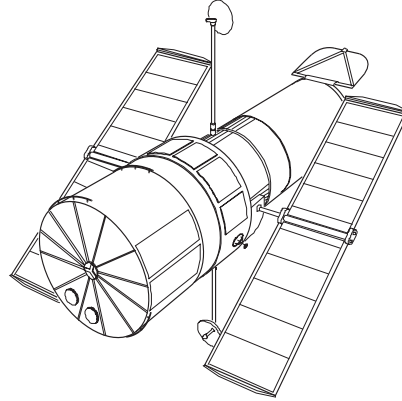
Figure 1

Question 1

Voyager 1 is approximately some 17.4 billion (1.74×10^{10}) kilometres from the Earth.

How long does it roughly take to send a radio signal from Earth to Voyager 1?

A. 58 000 hours

B. 16 hours

C. 58 hours

D. 0.016 hours

Question 2

A parsec is a unit of measurement used in astronomy to measure the distance to stars.

$$1 \text{ Parsec} = 3.1 \times 10^{16} \text{ metres}$$

How far has Voyager travelled in parsecs?

A. 0.56

B. 1.8

C. 5.6×10^{-4}

D. 1800

Question 3

Some communication satellites use a geosynchronous orbit around the equator – in this case the satellite appears stationary to observers on the ground and always at the same point in the sky.

If a person was standing directly underneath the satellite on the equator, the term that best describes its position would be

A. zenith.

B. altitude.

C. azimuth.

D. nadir.

Question 4

Melbourne's position is 38° south of the equator.

This means that the south celestial pole is located at what altitude in the sky?

A.   0°

B.   52°

C.   90°

D.   38°

Question 5

For a person standing in Melbourne, which statement is correct?

A.   The person sees both the northern and southern sky equally.

B.   The person sees the northern sky more than the southern sky.

C.   The person sees the southern sky more than the northern sky.

D.   The person cannot see the northern sky at all.

Question 6

For a person standing on the equator, which statement is correct?

A.   The person sees both the northern and southern sky equally.

B.   The person sees the northern sky more than the southern sky.

C.   The person sees the southern sky more than the northern sky.

D.   The person cannot see the northern sky at all.

Question 7

A star has a right ascension (RA) of 02:00 hours. Another star has a RA of 12:30 hours.

How long will it take the second star to cross the same point in the sky as the first star?

A.   01:30 hours

B.   10:30 hours

C.   12:30 hours

D.   14:30 hours

Question 8

In the 16th Century, the Catholic Church opposed the findings of Copernicus – that the Earth orbited the sun.

Which model did the church prefer?

A.   Tychonic

B.   Lunar-centric
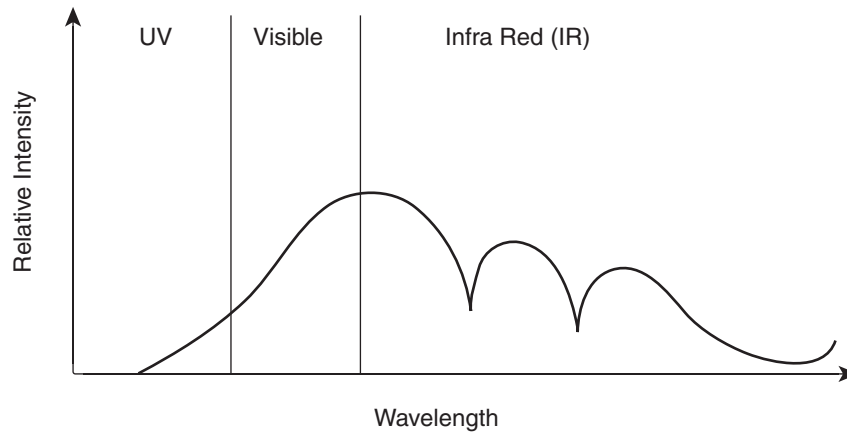
C.   Heliocentric

D.   Ptolemaic

Question 9

There is a region between Mars and Jupiter where there is a high concentration of celestial objects.

These objects are known as

A.   asteroids.

B.   nebulae.

C.   comets.

D.   planets.

The following information relates to Question 10.

The graph below shows the amount of electromagnetic radiation (light) that reaches the Earth's surface.

Figure 2

Question 10

The WISE (Wide-field Infrared Survey Explorer) telescope had to be launched into orbit around the Earth.

The main reason why it could not be Earth-based was because

A.   it was too expensive to have on Earth.

B.   not enough IR light reaches the Earth's surface.

C.   too much IR light reaches the Earth's surface.

D.   not enough UV light reaches the Earth's surface.

Question 11

The Hubble telescope had a manufacturing fault with the main mirror when it was first put into orbit.
This led to the images being fuzzy and of a lower resolution.

This is most likely an example of

A.   spherical aberration.

B.   chromatic aberration.

C.   design fault.

D.   software fault.

Question 12

Galileo used a telescope to make many astronomical observations. One such observation was regarding stars and planets.

He observed that, when compared to viewing the sky with the naked eye,

A.   stars and planets looked no different.

B.   planets looked no different while stars appeared as discs.

C.   stars looked no different while planets appeared as discs.

D.   stars and planets appeared as discs.

END OF DETAILED STUDY 1 – ASTRONOMY

Detailed study 2 – Astrophysics

Question 1

The Sun is an example of a

A. white dwarf.

B. main sequence star.

C. red giant star.

D. gas giant.

Question 2

The Sun generates heat from fusion reactions inside its core.

The evidence for this is that the sun

A. is composed of mostly Hydrogen and Helium.

B. has been 'burning' for about 5 billion years already.

C. emits a continuous flux of neutrinos, a particle associated with certain fusion reactions.

D. All of the above provide evidence for nuclear fusion in the Sun's core.

Question 3

The Sun's surface temperature is about

A. 5500 °C.

B. 550 °C.

C. 5.5 million °C.

D. We cannot measure the Sun's surface temperature.

Question 4

Planets, stars and galaxies are thought to have been formed by the action of

A. electromagnetic forces.

B. strong nuclear forces.

C. gravitational forces.

D. inter-atomic forces.

The following information relates to Questions 5 to 7.

Measuring the distances to stars requires special techniques. Only for the stars that are relatively near to us can we measure the distance directly, using the parallax method. For stars that are further away we need to resort to indirect measurement such as the inverse square law of light.

Question 5

In the context of the text above, 'relatively near to us' means
A.   about 100 million kilometres away.
B.   up to 4 light-years away.
C.   up to 1600 light-years away.
D.   within our own Galaxy.

Question 6

Using parallax to measure the distance to stars requires a very large base line. The diagram below shows how such a measurement could be made.
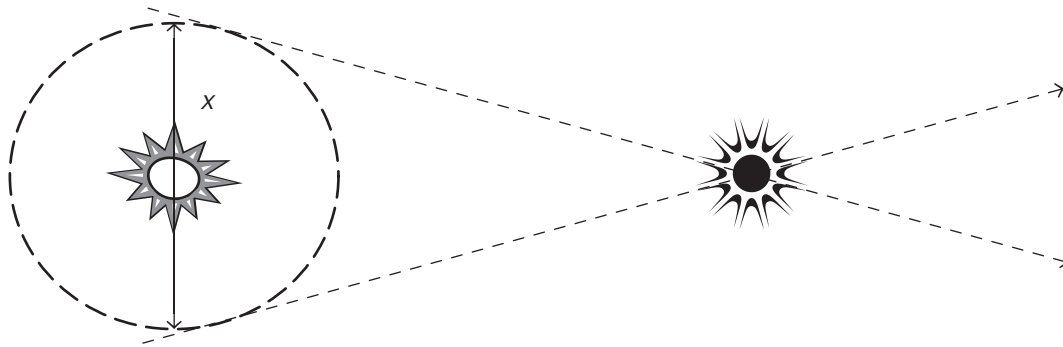

Figure 1

The baseline is marked *X* on the diagram and is equal to
A.   the diameter of the sun.
B.   the radius of the Earth's orbit around the sun.
C.   the Astronomical Unit (AU) times two.
D.   the diameter of the Earth.

Question 7

Using the inverse square law to measure the distance to the stars is considered an indirect method because it
A.   is less accurate.
B.   is unsafe to look directly at stars.
C.   is a highly complex distance measurement.
D.   requires the known distance of another star for comparison.

Question 8

Stars undergo various changes during their lifetimes.

Of the following options, which one combines a plausible beginning and end stage of a star's lifetime?

	Beginning stage	**End stage**
A.	Red giant	White dwarf
B.	Main sequence star	Brown dwarf
C.	White dwarf	Black hole
D.	Neutron star	Main sequence star

Question 9

The big bang theory is now considered to be a more complete cosmological model than the steady state theory.

This has come about mainly because

- **A.** the big bang theory was the only one that could explain Hubble's observation of the expanding universe.
- **B.** the big bang theory was the only one that could explain the large scale structure of the universe.
- **C.** the steady state theory was unable to explain the presence of the Cosmic Background Radiation.
- **D.** the steady state theory was unable to explain the red shift of distant galaxies.

Question 10

Edwin Hubble used Doppler Shift for light to show that most galaxies are

- **A.** extremely large like our Milky Way Galaxy.
- **B.** moving relative from our Milky Way Galaxy.
- **C.** all of a similar size like our Milky Way Galaxy.
- **D.** spiral galaxies like our Milky Way Galaxy.

The following information relates to Questions 11 and 12.

Hubble measured key characteristics for a large number of galaxies and represented this data in a graph like the one below.
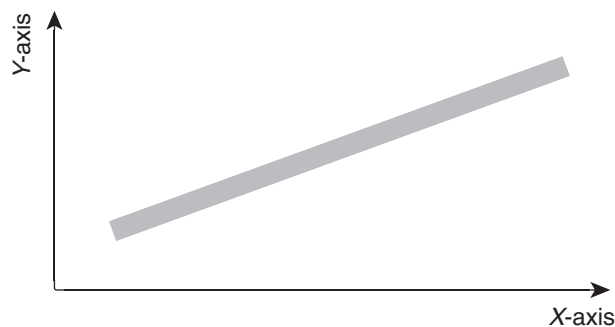
Figure 2

Question 11

From the table below, pick the most suitable labels for the *X* and *Y*-axes on this graph.

	X-axis	*Y*-axis
A.	Luminosity	Surface temperature
B.	Distance	Luminosity
C.	Distance	Speed of recession
D.	Luminosity	Speed of recession

Question 12

The most important conclusion that can be drawn from Hubble's data is that
A. the universe is expanding.
B. the universe is static and unchanging.
C. the universe is much larger than previously thought.
D. the universe is red shifted.

END OF DETAILED STUDY 2 – ASTROPHYSICS

### Detailed study 3 – Energy from the nucleus

Question 1

The Sun is capable of providing humankind with vast amounts of energy.

In this context we can think of the sun as a giant

A.   nuclear fusion reactor.
B.   coal fired power plant.
C.   nuclear fission reactor.
D.   solar power plant.

The following information relates to Questions 2 to 4.

The graph below shows the binding energy per nucleon for various nuclei as a function of their mass number. The curve is divided into two sections: I and II.
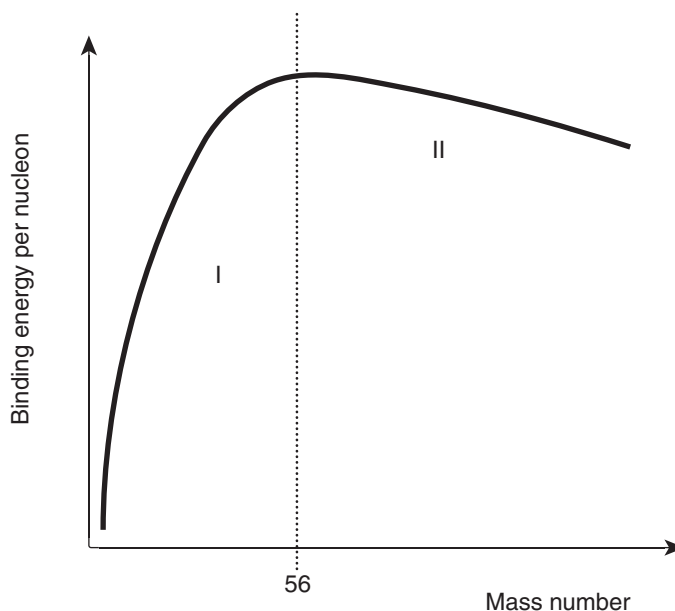
Figure 1

Question 2

Which of the following options is correct?

A.   Section I shows the nuclei that can release energy by nuclear fission.
B.   Section II shows the nuclei that can release energy by nuclear fission.
C.   Section I shows the nuclei that can release energy by both nuclear fission and fusion.
D.   Section II shows the nuclei that can release energy by nuclear fission and fusion.

Question 3

The nucleus with mass number 56 can be considered the nucleus with

A.   the most massive nucleons.
B.   the least massive nucleons.
C.   the most total binding energy.
D.   the least total binding energy.

Question 4

Nuclear binding energy can be defined as the energy needed to

A. join the nucleons together to make a nucleus.

B. join the nucleus of an atom to its electrons to make an atom.

C. separate all of the electrons from the nucleus of an atom.

D. separate all of the constituent nucleons from a nucleus.

Question 5

People opposed to nuclear fission power often use the argument that nuclear fission leads to the production of highly radioactive waste products.

The isotopes produced in fission reactions are highly radioactive because these isotopes contain

A. too few neutrons to keep them stable.

B. too many neutrons to keep them stable.

C. too much binding energy to keep them stable.

D. too few nucleons to keep them stable.

Question 6

Plutonium-239 (Pu-239) is a potential source of nuclear energy because Pu-239

A. is a very heavy isotope of Plutonium.

B. is highly unstable.

C. is able to undergo neutron capture.

D. is a fissionable nucleus.

Question 7

Nuclear fission of U-235 relies on the capture of thermal neutrons.

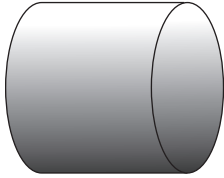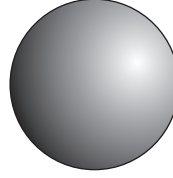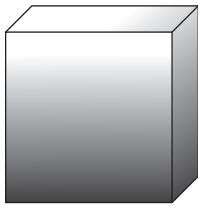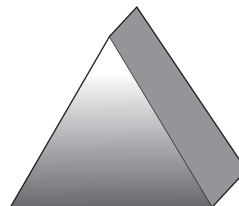This means that the neutrons used to cause fission in U-235 must be

A. extremely hot.

B. fast moving.

C. slow moving.

D. not moving at all.

Question 8

To optimise the capture of thermal neutrons in a working fission reactor it is important to minimise the surface area of the fuel cell.

Which of the following fuel configurations would provide optimum neutron capture?

A.

B.

C.

D.

Question 9

For a sustained nuclear fission reaction it is necessary to initiate a chain reaction.

One of the requirements for achieving a chain reaction is

A.   the production of multiple free neutrons during each fission reaction.

B.   sufficient density of the nuclear fuel to maximise the probability of neutron capture.

C.   optimum configuration of nuclear fuel to reduce the loss of free neutrons.

D.   all of the above are requirements for a nuclear chain reaction

Question 10

In a typical Uranium-235 fission reaction 193 MeV of energy is produced.

This means that the mass defect in such a nuclear reaction must be

A. 3.43×10^{-28} kg.

B. 1.03×10^{-19} kg.

C. 2.00×10^{-9} kg.

D. 2.15×10^{-15} kg.

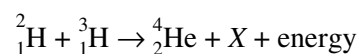**Question 11**

Nuclear reactions are much more energetic than chemical reactions because

A.   the strong nuclear force is much weaker than the electro-magnetic force.

B.   the strong nuclear force is stronger than the weak nuclear force.

C.   the electro-magnetic force is weaker than the strong nuclear force.

D.   the electro-magnetic force is weaker than the weak nuclear force.

Question 12

The following reaction represents an example of a nuclear fusion reaction"

$$^2_1H + ^3_1H \rightarrow ^4_2He + X + \text{energy}$$

In this reaction the symbol X represents

A. a neutron.
B. a positron.
C. a proton.
D. an electron.

END OF DETAILED STUDY 3 – ENERGY FROM THE NUCLEUS

**Detailed study 4 – Investigations: Flight**

Question 1

The original manned flight was not done on a plane but with a balloon. Air is heated in a confined space.

They way lift is achieved in a balloon is by

A.   decreasing the Bernoulli effect over the balloon.
B.   increasing the Bernoulli effect over the balloon.
C.   increasing the density of the hot air which creates buoyancy.
D.   decreasing the density of the hot air which creates buoyancy.

The following information relates to Questions 2 to 4.

In Figure 1 an aeroplane is stationary on a runway.

Runway

Vertical
stabiliser
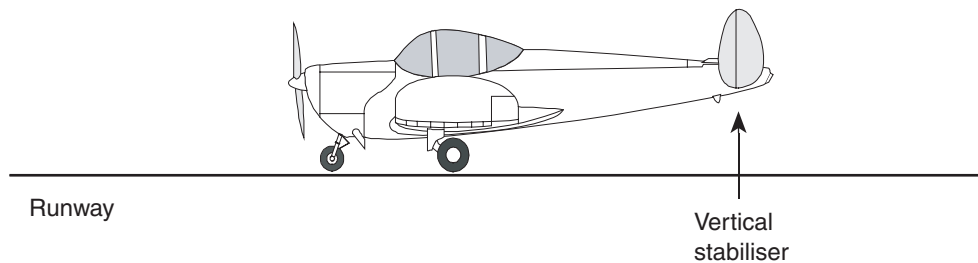
Figure 1

In Figure 2 the same aeroplane is now seen travelling above the runway at a constant speed and height.

Runway
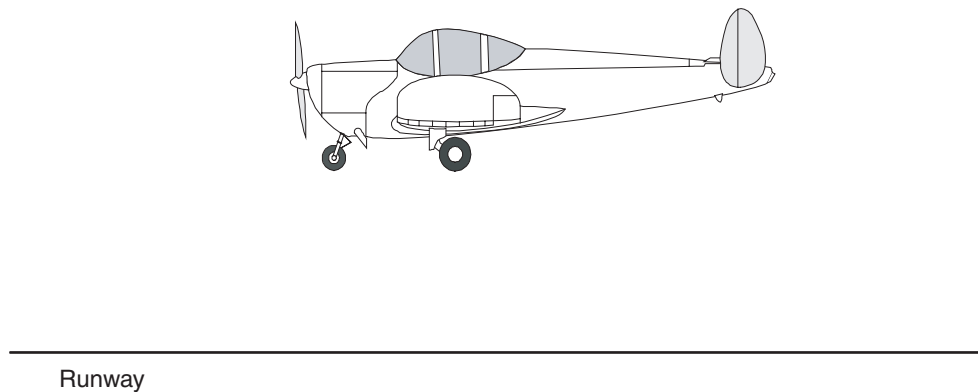
Figure 2

Question 2

Which of the option below best describes the opposite and equal forces acting on the plane?

	Figure 1	**Figure 2**
A.	weight = lift	lift = normal reaction
B.	weight = lift	weight = normal reaction
C.	weight = normal reaction	lift = normal reaction
D.	weight = normal reaction	weight = lift

Question 3

The air deflected over the aerofoil (wing) helps generate lift on the wing.

In terms of Newton's action-reaction pairs,
A.   the aerofoil pushes down (action) and the air pushes upward (reaction).
B.   the aerofoil pushes upward (action) and the air pushes downward (reaction).
C.   both aerofoil and air push downward.
D.   both aerofoil and air push upward.

Question 4

If the vertical stabiliser (where the rudder is located) shown in Figure 1 was damaged, the plane would tend to
A.   roll.
B.   nose dive.
C.   yaw.
D.   pitch upwards.

The following information relates to Questions 5 to 7.

Bernoulli developed an equation that relates velocity, pressure and density. One version of the formula is:

$$P_1 + \frac{1}{2}pv_1^2 + pgh_1 = \text{constant}$$

Where P_1 = fluid pressure in N m^{-2}

p_1 = fluid density (air in this case) in kg m^{-3}

v_1 = fluid velocity in m s^{-1}

h_1 = height above ground in m

g = acceleration due to gravity (10 m s^{-2})

Question 5

If the height of the fluid does not change, what term decreases if the fluid velocity increases?
A.   height
B.   pressure
C.   density
D.   force due to gravity

Question 6

The Bernoulli equation is based on
A.   conservation of gravity.
B.   conservation of energy.
C.   conservation of forces.
D.   none of the above

Another version of the Bernoulli equation is:

$$P_1 + \frac{1}{2}pv_1^2 = P_2 + \frac{1}{2}pv_2^2$$

(given constant height and density)

Question 7

The left-hand side of the equation is for air moving under the wing and the right-hand side is for air moving above.

If the density (p) is taken as 1.29 kg m^{-3} and an air velocity (v_2) above the wing is 125 m s^{-1} and below the wing (v_1) is 95 m s^{-1}, the difference in pressure ($P_1 - P_2$) would be nearest to

A.   19.4 N m^{-2}

B.   10 N m^{-2}

C. 4.3×10^3 N m^{-2}

D. 8.5×10^3 N m^{-2}

Question 8

Aerobatic planes have a modified wing design, one that allows them to have the same lift if they are upside down as the right way up.

Which aerofoil design is most likely to be the best for an aerobatic plane?

Direction

A.

B.

C.

D.
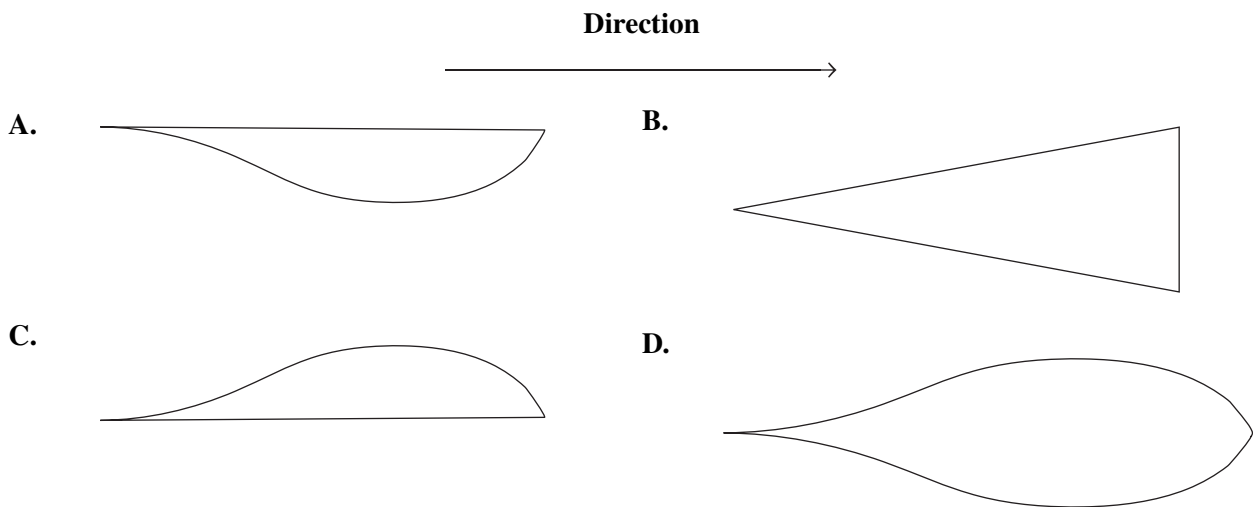
The following information relates to Questions 9 to 11.

The Boeing 747-400 was the first in the jumbo fleet to introduce 'winglets' at the end of the wings. These are upturned wings placed at the end of the main wing. Figure 3 shows the air flow before and after the winglets were installed. As a consequence the fuel efficiency of the 747 improved by around 3.0%. When the plane is flying at a constant cruising speed of 900 km h^{-1}, the thrust produced by each engine (there are four engines) is around 250 kN. The drag at this speed on the plane is approximately 24 kN.
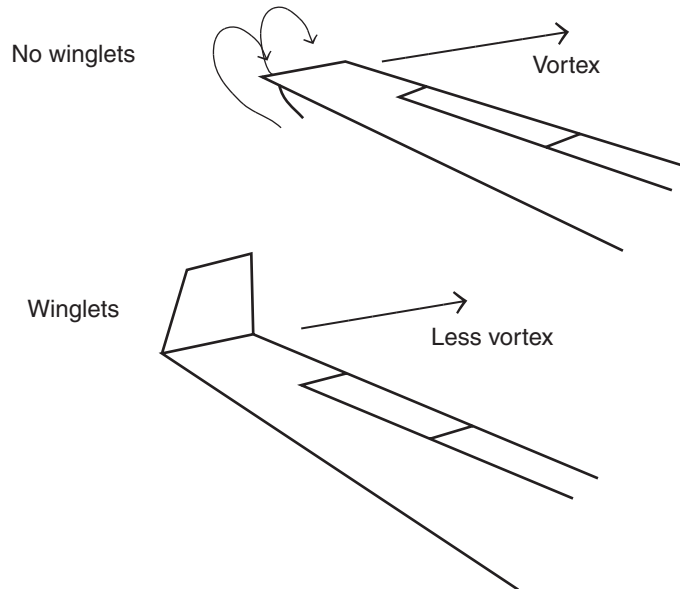
Figure 3

Question 9

The reason why the winglets increase fuel efficiency is that they

A.   increase drag.

B.   decrease drag.

C.   increase thrust.

D.   decrease thrust.

Question 10

If the original range of the 747 is approximately 13 000 km, how far extra has the range been extended by the use of winglets?

A.   390 km

B.   13 390 km

C.   39 000 km

D.   4333 km

Question 11

When the 747 is at cruising speed, what is the available power output?

A.   225 000 MW

B.   250 MW

C.   1000 MW

D.   244 MW

Question 12

The 'Mach Number' relates the speed of an object to the speed of sound in the material. It is given by the ratio:

$$\text{mach number} = \frac{\text{speed of object in medium}}{\text{speed of sound in medium}}$$

In air, sound travels at 330 m s^{-1}.

If a jet fighter is travelling at 1300 km h^{-1}, which selection best describes its Mach Number?

A. 1.09
B. 1.00
C. 4.03
D. 0.91

END OF DETAILED STUDY 4 – INVESTIGATIONS: FLIGHT

Detailed study 5 – Investigations: Sustainable energy sources

The following information relates to Questions 1 to 4.

Consider the following energy sources:

1.	Coal	2.	Wind
3.	Oil	4.	Solar
5.	Nuclear	6.	Hydroelectric

Question 1

Which of the options are non-renewable energy sources?

A.   1 and 3

B.   2, 4 and 5

C.   1, 3 and 5

D.   2, 4 and 6

Question 2

Which of the options are fossil fuels?

A.   1 and 3

B.   2, 4 and 5

C.   1, 3 and 5

D.   2, 4 and 6

Question 3

Of the renewable sources of energy, which is most effective during the day?

A.   1

B.   4

C.   5

D.   6

Question 4

Of the renewable sources of energy, which is currently used the most in Australia?

A.   1

B.   4

C.   5

D.   6

The following information relates to Questions 5 and 6.

Consider the following energy conversions:

Option 1:	Chemical $\rightarrow$ Electrical
Option 2:	Light $\rightarrow$ Electrical
Option 3:	Mechanical $\rightarrow$ Electrical
Option 4:	Nuclear $\rightarrow$ Electrical
Option 5:	Gravitational $\rightarrow$ Electrical

Question 5

Which of the following choices would most likely be a battery as used in a torch?

A. Option 1
B. Option 2
C. Option 4
D. Option 5

Question 6

Which of the following choices would most likely use a radioactive material such as Uranium?

A. Option 1
B. Option 2
C. Option 4
D. Option 5

The following information relates to Questions 7 and 8.

Below is a graph showing the power consumption versus the luminosity of a compact fluorescent globe and an incandescent globe. The luminous flux is a measure of the strength of the light source as perceived by the human eye.
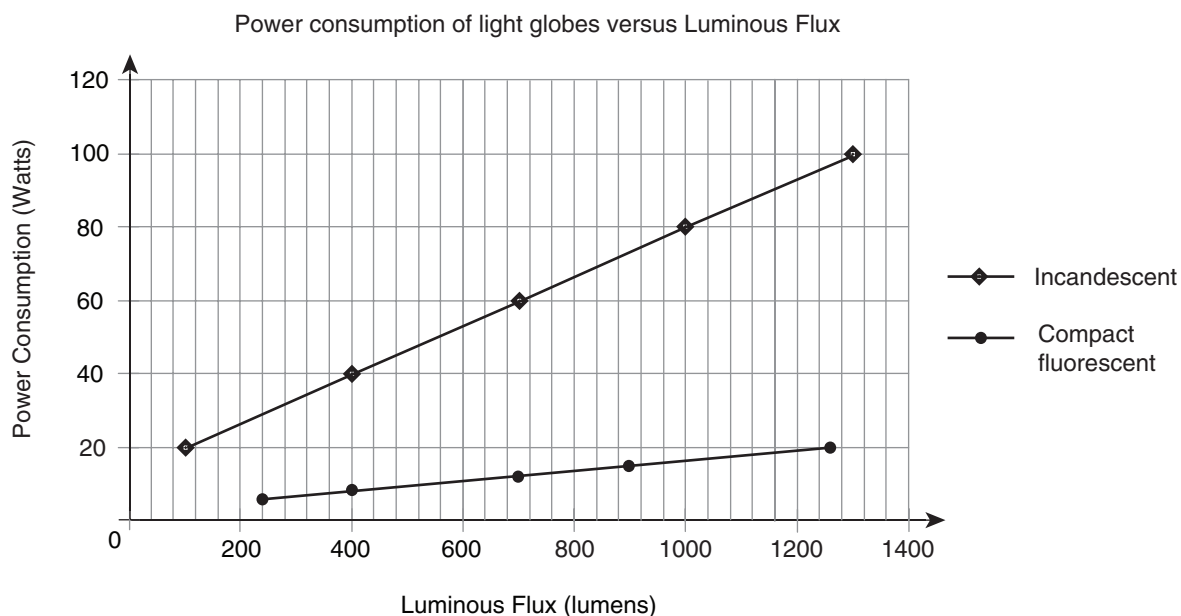

Figure 1

Question 7

A typical incandescent light globe uses 60 Watts of power.

Approximately what percentage does a compact fluorescent save when compared to an incandescent at this power consumption?

A. 17%
B. 83%
C. 10%
D. 60%

Question 8

A theoretically 100% efficient light source would produce 680 lumens per watt. A compact fluorescent globe produces about 66 lumens per watt.

This gives an efficiency of approximately

A. 66%.
B. 10%.
C. 90%.
D. 15%.

The following information relates to Questions 9 to 11.

Angelica and Betty are studying the current/voltage characteristics of a 100 cm^2 silicon solar cell. They expose the cell to three different intensities of light. The results are shown in Figure 2.
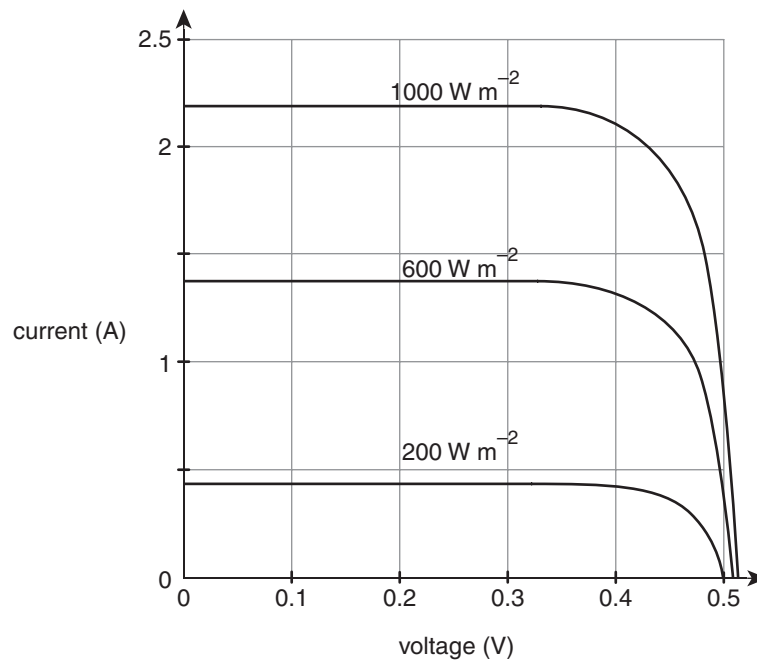
Figure 2

Question 9

What is the maximum power output of the solar cells when under illumination of power 600 W m^{-2} ?

A.   600 W
B.   0.54 W
C.   1.25 W
D.   0.45 W

Question 10

When comparing the three graphs, which is most likely to have occurred on a very cloudy day?

A. 200 W m^{-2}
B. 600 W m^{-2}
C. 1000 W m^{-2}
D.   cannot be determined

Question 11

Most solar panels on homes are placed facing in a northerly direction when located on homes. The main reason this is the case is because it

A.   avoids shade better.
B.   has cheaper installation costs.
C.   receives less light throughout the day.
D.   receives more light throughout the day.

Question 12

Hydroelectric dams uses falling water (potential energy converted into kinetic energy) to spin a turbine to generate electricity. One such turbine has 120 kg per second of water falling through a pipe 45 m high.

What is the power of the water as it hits the turbine? (take $g = 10$ m s^{-2})

A.   54 kW
B.   5400 W
C.   1200 W
D.   450 W

END OF DETAILED STUDY 5 – INVESTIGATIONS: SUSTAINABLE ENERGY SOURCES

Detailed study 6 – Medical Physics

Question 1

A radiologist is making a choice between imaging techniques for two different disorders.

Select the best option from the choices below.

	A skeletal abnormality in an unborn baby	**A suspected brain tumour in an adult patient**
A.	CT scan	Ultrasound
B.	Ultrasound	X-ray
C.	Ultrasound	CT scan
D.	X-ray	CT scan

Question 2

Medical imaging techniques often rely on the partial absorption or reflection of waves.

Which of the following is correct?

A. CT scans rely on reflection of waves.

B. X-ray imaging relies on absorption of waves.

C. Ultrasound relies on absorption of waves.

D. An MRI relies on the reflection of waves.

Question 3
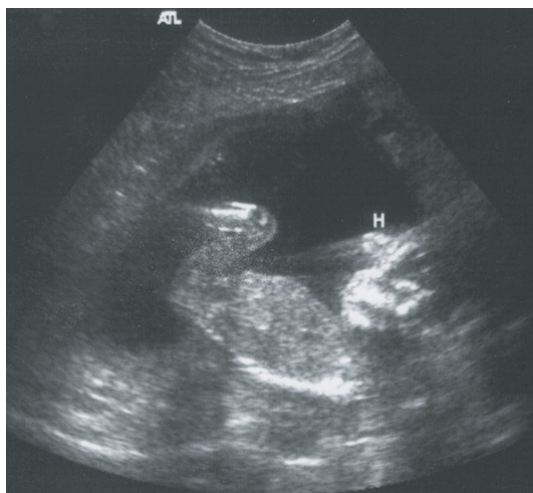
Figure 1

The above image of an unborn baby was made using a technique that

A. used a non-ionising form of electromagnetic radiation.

B. used sound to create the image.

C. used X-rays in combination with computers.

D. used laser light as a non-ionising form of radiation.

Question 4

Radioisotopes can be used as a diagnostic tool. Patients ingest the isotope and the radiation can then be tracked by an external sensor.

A suitable choice of isotope would emit

A.   alpha radiation because it would cause most ionisation in the body.

B.   beta radiation because it would be unable to travel through a large layer of tissue.

C.   gamma radiation because it would cause the least ionisation as it emerged from the body.

D.   a combination of all three types of nuclear radiation.

Question 5

High energy X-rays can be used to kill tumour cells inside parts of the body, such as the brain, that would be difficult to access in other ways.

X-rays can be used for this purpose because

A.   when tumour cells absorb the X-rays it allows for accurate imaging of the tumour.

B.   when the X-rays is absorbed by tumour cells it causes fatal damage to the cell.

C.   when tumour cells reflect the X-rays it causes fatal damage to the cell.

D.   when tumour cells reflect the X-rays it allows for accurate imaging of the tumour.

Question 6

It is possible to have the front of your eyeball, the cornea, reshaped by laser surgery.

Lasers are used for this type of surgery because

A.   lasers can be very accurately controlled over very small distances and depths.

B.   lasers are capable of transferring large amounts of energy in a very small volume.

C.   lasers can be tuned to a variety of different wavelengths.

D.   laser flight can travel over large distances.

Question 7

In Magnetic Resonance Imaging (MRI), a large magnetic field is used to cause the alignment of atoms in the body.

The atoms that will align themselves with the external magnetic field are

A.   carbon atoms.

B.   nitrogen atoms.

C.   oxygen atoms.

D.   hydrogen atoms.

Question 8

Which one of the following medical imaging techniques makes use of radioactive isotopes?

A.   PET

B.   MRI

C.   CT

D.   X-ray

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Question 9

Endoscopes make use of optical fibres to illuminate and transmit images from inside the body.

Optical fibres are used because they

A. can transmit light without attenuation.

B. are flexible and can bend in any direction required by the surgeon.

C. are able to carry light of many different wavelengths.

D. are strong and will not easily break while in use.

Question 10

The image produced by an endoscope travels through a 'coherent' bundle of optical fibres.

A coherent bundle of optical fibres is

A. a bundle of optical fibres of exactly the same length.

B. a bundle of optical fibres that remain in exactly the same relative position to each other throughout the bundle.

C. a bundle of optical fibres capable of carrying an image without distortion.

D. All of the above are correct.

Question 11

Endoscopes carry a second bundle of optical fibres that are not coherent.

This second bundle is needed to provide

A. a back-up to the coherent fibres.

B. illumination.

C. additional imaging.

D. a source of highly focused energy.

Question 12

The image below shows the large intestine of a human patient. The patient was given porridge containing Barium, to eat before the image was made.

Figure 2

The image was most likely produced using

A. a PET scan.

B. an MRI.

C. an ultrasound.

D. an X-ray.

END OF QUESTION AND ANSWER BOOKLET