INSIGHT

Year 11 *Trial Exam Paper*

2013

PHYSICS

Written examination 2

STUDENT NAME:

QUESTION AND ANSWER BOOK

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A – Core – Areas of Study			
1. Motion	5	5	40
2. Wave-like properties of light	8	8	30
B – Detailed studies – Areas of Study			
1. Astronomy	10	10	20
OR			
2. Astrophysics	10	10	20
OR			
3. Energy from the nucleus	10	10	20
OR			
4. Investigations: Flight	10	10	20
OR			
5. Investigations: Sustainable energy sources	10	10	20
OR			
6. Medical physics	10	10	20
Total	73	23	90

- Students are permitted to bring the following items into the examination: 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 sheets of blank paper or white out liquid/tape into the examination.

Materials provided

- A question and answer book of 43 pages.
- A formula sheet.
- An answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the box provided, and on the answer sheet for multiple-choice questions.
- Remove the data sheet during reading time.
- Unless otherwise indicated, the diagrams in this book are NOT drawn to scale.
- You must answer all questions in English.

Students are NOT permitted to bring mobile phones or any other electronic device into the examination.

SECTION A – Core

Instructions for Section A
Answer **all** questions for **both** Areas of Study in this section in the spaces provided. Write using a black or blue pen. If a unit is printed in an answer box, give your final 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.

Area of study 1 – Motion

The following information applies to Question 1.

Jonas is running a speed test for his PE class. The route requires him to run around his school, as shown in Figure 1. It takes Jonas 2 minutes to complete the course.
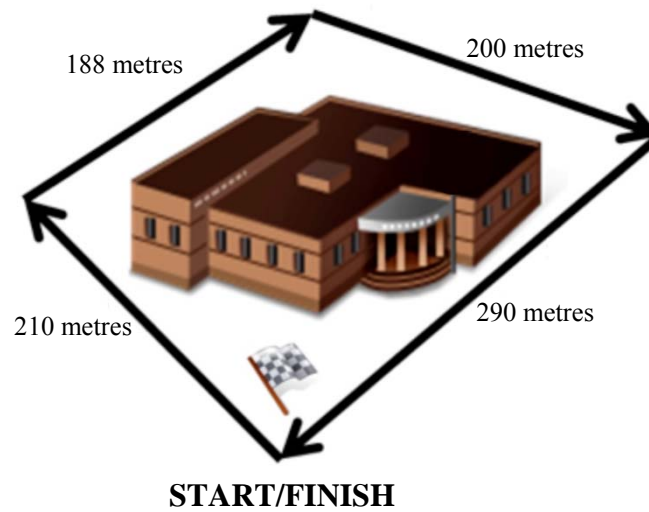

START/FINISH

Figure 1

Question 1 (7 marks)

a. Find Jonas' average speed.

2 marks

m s^{-1}

b.   Calculate Jonas' average velocity. Explain your answer.

2 marks

_____
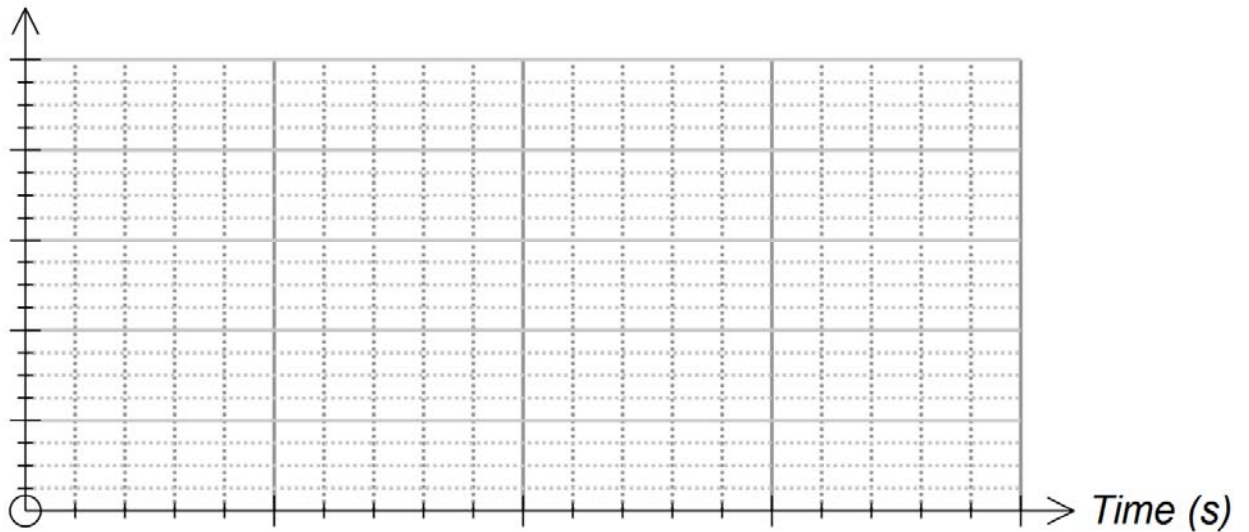
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m s^{-1}

c.   When Jonas started his run, he ran at 5 m s^{-1} for 4 s, then at 9 m s^{-1} for 7 s. He then tripped and fell, resting for 3 s.
Display this information on the following distance–time graph. Include appropriate scales.

3 marks

Distance (m)

Time (s)

CONTINUES OVER PAGE

The following information applies to Question 2.

A 4WD is pulling a boat, as shown in Figure 2. The boat is connected to the 4WD's tow bar. The boat has frictional force of 200 N acting on it and has a mass of 1500 kg. The 4WD has frictional force of 300 N acting on it and has a mass of 2000 kg.

Figure 2

Question 2 (7 marks)

a. Calculate the gravitational force acting on the 4WD.

2 marks

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                        N
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b. The 4WD is travelling at a constant velocity of 98 km h^{-1}. Calculate the driving force supplied by the engine of the 4WD.

2 marks

c. The driver then accelerates the 4WD at 5 m s^{-2} for a short time. Find the tension in the tow bar.

3 marks

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                        N
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The following information applies to Question 3.

Jenny is skiing at her favourite resort. Jenny and all her equipment have a combined mass of 85 kg.

Question 3 (10 marks)

a. Jenny starts by taking the ski lift up to the top of the mountain, an altitude change of 140 m.
Calculate Jenny's change in gravitational potential energy.

2 marks

J

Jenny then skis down a slope of 25° to the horizontal, at a brisk but steady 15 m s^{-1}, as shown in Figure 3.

b. Show all the forces acting on Jenny as she descends. Label the forces.

3 marks

Figure 3

c. Calculate the frictional force acting on Jenny as she skis.

2 marks

N

d.   Further down the slope, there is a smoother piece of snow, which has a
frictional force of 100 N. Calculate Jenny's acceleration down the hill whilst
on the smoother snow

3 marks

m s^{-2}

The following information applies to Question 4.

Angus has been investigating the properties of the diving board at his local swimming pool. He has produced the following graph (see Figure 4).

Figure 4

Question 4 (6 marks)

a.   What is the spring constant?

2 marks

b.   If a dog of mass 20 kg is lying on the diving board, how much potential energy would the board be storing?

2 marks

J

c.   The dog on the diving board is 3 m above the water. The dog then rolls off the board to have a swim. What would be the dog's kinetic energy just prior to hitting the water?
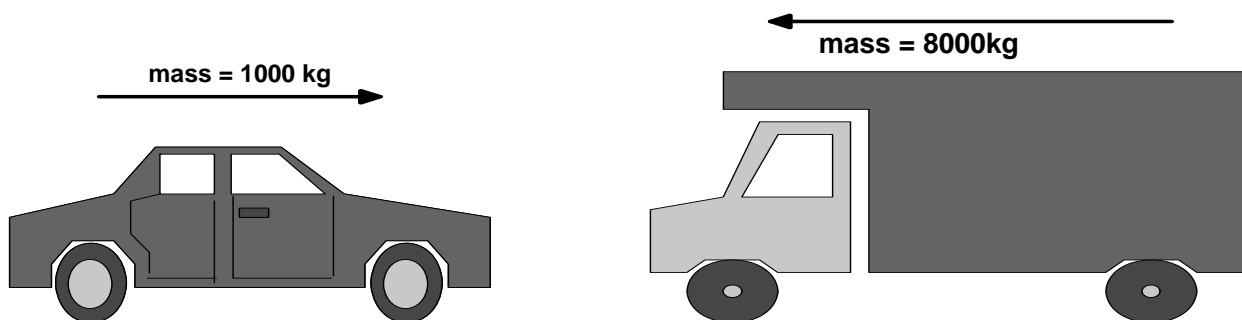
<div align="right">2 marks</div>

	J

The following information applies to Question 5.

A car and a lorry have a head-on collision. The lorry was travelling west at 10 m s^{-1} and the car was travelling east at 20 m s^{-1}.

mass = 8000kg

mass = 1000 kg

Question 5 (10 marks)

a. Calculate the total momentum of the car and lorry system. Include a direction in your answer.

3 marks

kg m s^{-1}

Direction:

b. The car and lorry get stuck together. Find the speed of the car and lorry just after the collision.

2 marks

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m s^{-1}

c. If the collision took 0.75 s, find the force that the lorry applied to the car.

<div style="text-align: right">3 marks</div>

N

d. It was later found that the car had been braking at 5 m s^{-2} prior to the collision. If the skid marks are 30 m long before the collision, calculate the speed of the car just prior to braking.

<div style="text-align: right">2 marks</div>

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m s^{-1}

<div style="text-align: right">

END OF AREA OF STUDY 1
SECTION A – continued
TURN OVER

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Area of study 2 – Wave-like properties of light

The following information applies to Question 1.

Tilly has set up a water ripple tank, and uses some data-logging equipment to produce the following graph (Figure 1).

Figure 1

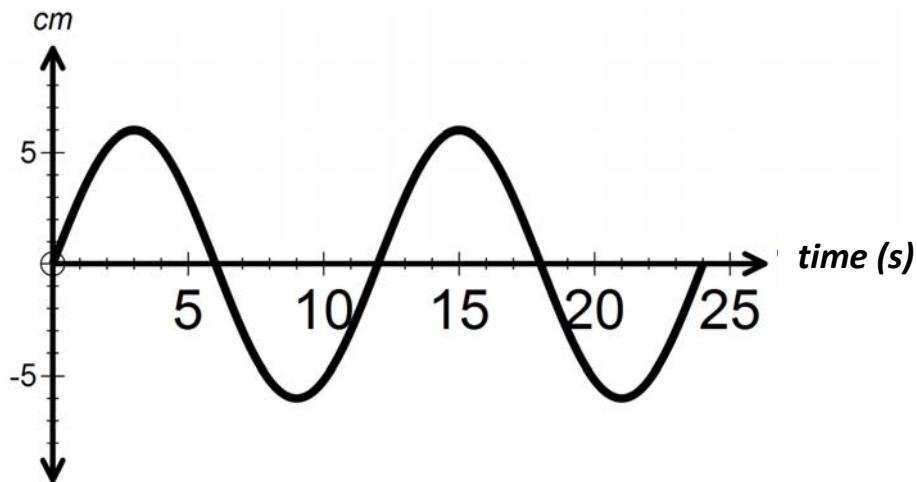**Question 1 (7 marks)**

a.   **i.**   What is the period of the wave?

1 mark

	s

         ii.   Calculate the wave's frequency.

1 mark

	Hz

SECTION A – Area of study 2 – continued

Tilly then changes the water level and the settings on her data-logger, and produces the following graph (Figure 2).

Figure 2

b. What is the amplitude of the wave, in metres?

2 marks

m	

c. Find the wavelength (λ), in metres.

1 mark

m	

d. Tilly measures the speed of the waves in water at 8 m s^{-1}.
What is the wave's frequency?

2 marks

Hz	

CONTINUES OVER PAGE

Question 2 (4 marks)

a. Light **never** displays properties of
A. mass
B. waves
C. velocity
D. energy

2 marks

b. Circle the correct responses.
Light is an example of a (transverse wave/longitudinal wave/slow wave).
It has the motion of the particles (perpendicular/parallel) to the direction of the wave.

2 marks

Question 3 (2 marks)

An image formed by a concave lens must be
A. upright and real
B. upright and diminished
C. inverted and diminished
D. upright and enlarged

Question 4 (2 marks)

Tommi has two identical pairs of polarising sunglasses. He puts on one pair. He then rotates the lenses in the **second** pair 90°, and puts these on *as well*. Explain what effect this will have.

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SECTION A – Area of study 2 – continued
TURN OVER

The following information applies to Question 5.

Donna is playing with a piece of glass and a ray of light, as shown in Figure 3. She notices that the light refracts when entering the glass. The refractive index of the glass is 1.55.

Figure 3

Question 5 (10 marks)

a. Find the angle of incidence.

1 mark

o

b.   Find the angle of refraction, x^o.

	o

c.   Find the angle at which the light leaves the glass.

	o

d.   Find the critical angle for the glass.

	o

e. Explain what happens when the critical angle at the lower surface is surpassed.

2 marks

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f. Give **two** examples of practical applications of this phenomenon.

2 marks

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Question 6 (2 marks)

Give **two** examples that demonstrate that light has wave-like properties.

_____

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Question 7 (1 mark)

Yellow can be made from the addition of which two colours of light?

_____

_____

Question 8 (2 marks)

Rainbows are examples of
A.   total internal reflection
B.   refraction
C.   dispersion
D.   All of the above.

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+-------------+
|             |
|             |
+-------------+
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END OF CORE STUDIES

END OF SECTION A
TURN OVER

SECTION B – Detailed studies

Instructions for Section B

Choose **one** Detailed study.

Answer **all** the questions for the Detailed study you have chosen on the multiple-choice answer sheet, in pencil.

Write the name of the Detailed study you have chosen on the multiple-choice answer sheet.

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

A correct response scores 2 marks; an incorrect response scores 0 marks.

No marks are deducted for an incorrect response.

No marks will be given if more than one response is completed for a question.

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

Detailed study 1 – Astronomy

Question 1

Which one of the following is famous for his laws of planetary motion?

A.   Newton
B.   Kepler
C.   Copernicus
D.   Galileo

Question 2

Which one of the following is the greatest advantage of the Hubble Space Telescope?

A.   It is closer to the stars it is photographing.
B.   It is the biggest telescope we have.
C.   It is in a dark place.
D.   It has no atmosphere to look through.

Question 3

Which one of the following is an example of a diurnal circle?

A.   stars going in a circular pattern during the night
B.   the motion of the Sun from west to east
C.   the clouds going across the sky
D.   the trajectory of the planets across the sky

Question 4

Select one of the following. The term *geocentric* literally means

A.   Earth's motion
B.   Earth centred
C.   Star centred
D.   Sun centred

Question 5

The Earth has a tilt on its axis that causes the variation in climate known as seasons. What is the approximate degree of tilt?

A.   3°
B.   13°
C.   23°
D.   33°

Question 6

A telescope has an objective lens with a focal length of 84 cm and an eyepiece with a focal length of 2.1 cm. What is the magnification of the telescope?

A.   40
B.   0.05
C.   176.4
D.   5

Question 7

In which one of the following shapes do the planets revolve around the Sun?

A.   circle
B.   egg shaped
C.   eclipse
D.   ellipse

SECTION B – Detailed Study 1 – continued

Question 8

Which one of the following is **not** a class of star?

A. A
B. O
C. M
D. T

Question 9

Cecilia is watching a spectacular sunset around the time of the spring equinox, during her September holidays. She is trout fishing from the banks of the beautiful Dartmouth Dam in north-east Victoria. She looks straight up and notices that the Moon is directly overhead. What type of moon is she looking at?

A. full moon
B. new moon
C. half-moon waning
D. half-moon waxing

Question 10

To the ancient Greeks, the Sun seemed to take 24 h to make a trip around the Earth. How long did the Moon seem to take?

A. a little less than 24 hours
B. 24 hours
C. a little more than 24 hours
D. 1 month

END OF DETAILED STUDY 1
TURN OVER

Detailed study 2 – Astrophysics

Question 1

What is a star's source of energy derived from?

A. nuclear fusion
B. nuclear fission
C. radioactive decay
D. radiation

Question 2

Which one of the following is **not** the reason for the brightness level of a star?

A. its proximity to the Earth
B. the size of the star
C. the quantity of light emitted
D. the colour of the star

Question 3

Which one of the following is the name given to a few stars in close proximity to each other?

A. constellation
B. galaxy
C. nebula
D. cluster

Question 4

Which one of the following is the name given to two stars that rotate around each other?

A. nebula
B. double yolker
C. double star system
D. binary system

Question 5

Which one of the following is most closely related to a star's colour?

A. size
B. temperature
C. brightness
D. density

Question 6

Our Sun has been classified according to which one of the following spectral types?

A. A
B. B
C. F
D. G

Question 7

Which one of these statements is correct?

A. The universe is getting smaller as gravity pulls everything together.
B. The universe is getting bigger but is slowing down its expansion.
C. The universe is getting bigger and accelerating outwards as it does so.
D. The universe is in a steady state.

Question 8

How long does it take the light of the Sun to reach the Earth?

A. 8 s
B. 8 min
C. 8 years
D. 8 light years

SECTION B – Detailed Study 2 – continued
TURN OVER

Question 9

Which one of the following is the correct name of the closest star to Earth?

A.   Sun
B.   Betelgeuse
C.   Helios
D.   Solar

Question 10

In 1964, Arno Penzias and Robert Wilson accidentally discovered cosmic background radiation. What theory was this later shown to support?

A.   the Big Bang theory
B.   the steady-state theory
C.   that dark matter exists
D.   the existence of extra-terrestrial life

END OF DETAILED STUDY 2

Detailed study 3 – Energy from the nucleus

Question 1

How many protons and neutrons does $^{238}_{92}\text{U}$ have?

A.   146 protons, 92 neutrons
B.   92 protons, 146 neutrons
C.   238 protons, 92 neutrons
D.   92 protons, 238 neutrons

Question 2

During World War II, the US, along with the British, developed the world's first atomic/nuclear bombs. What was the code name for this development?

A.   Manhattan Project
B.   USA Atomic Commission
C.   NASA
D.   General Electric

Question 3

Einstein theorised that matter can be converted into energy. What amount of energy would be released if 0.1g of matter is converted to energy?

A. 9.0×10^{12} J
B. 9×10^{15} J
C.   1 J
D.   1500 J

Question 4

$^{2}_{1}\text{H}$ is present in heavy water. It is different from $^{1}_{1}\text{H}$ because it has an extra

A.   proton
B.   neutron
C.   electron
D.   donut

SECTION B – Detailed Study 3 – continued
TURN OVER

Question 5

In a nuclear power station, it is vital to ensure that there aren't too many neutrons available, or there will be an uncontrolled chain reaction. Using which one of the following helps to achieve this?

A.   moderator
B.   control rods
C.   fuel rods
D.   radiation shields

Question 6

Which one of these statements is correct?

A.   A fusion reaction may be found easily by going to NASA.
B.   A fusion reaction may be found easily by going to Russia.
C.   A fusion reaction may be found easily by going to England.
D.   A fusion reaction may be found easily by looking up at the stars.

Question 7

The only nuclear bombs ever to be used against people were the two dropped in World War II by the US. The blast alone killed more than 150 000 people. Hundreds of thousands more were killed by radiation sickness in the years that followed. The bombs were dropped on which two cities?

A.   Tokyo and Hiroshima
B.   Hiroshima and Nagasaki
C.   Tokyo and Nagasaki
D.   Hiroshima and Kyoto

Question 8

Which one of these statements is correct?

A. Australia has no nuclear reactors.
B. Australia has nuclear reactors but no nuclear power plants.
C. Australia has nuclear power plants but no nuclear reactors.
D. Australia has nuclear reactors and nuclear power plants.

Question 9

The 'fast' in a fast-breeder reactor refers to the speed of which one of the following?

A. turbines
B. super-heated steam
C. neutrons
D. electricity supplied

Question 10

Which of the following equations can occur in a typical nuclear power station?

A. $^{235}_{92}U + {}^1_0n \rightarrow {}^{141}_{56}Np + {}^{92}_{36}Kr + 3{}^1_0n$

B. $^{235}_{92}U + {}^1_0n \rightarrow {}^{141}_{56}Np + {}^{92}_{36}Kr + 2{}^1_0n$

C. $^{235}_{92}U + {}^1_0n \rightarrow {}^{141}_{56}Np + {}^{91}_{36}Kr + 3{}^1_0n$

D. $^{235}_{92}U + {}^1_0n \rightarrow {}^{142}_{56}Np + {}^{92}_{36}Kr + 3{}^1_0n$

END OF DETAILED STUDY 3
TURN OVER

CONTINUES OVER PAGE

Detailed study 4 – Investigations: Flight

Question 1

How far was the first flight at Kitty Hawk, North Carolina, by Wilbur Wright?

A. 3.7 mm
B. 37 m
C. 3700 m
D. 37 km

Question 2

Jackson throws a paper plane vertically. He throws it from a height of 2 m and notices that it travels 8 m before it hits the ground. What is the glide ratio?

A. 0.04
B. 0.4
C. 4
D. 0.5

The following information applies to Questions 3–5.

An aircraft is flying from Melbourne to London. Its force vectors are shown in Figure 1 below.
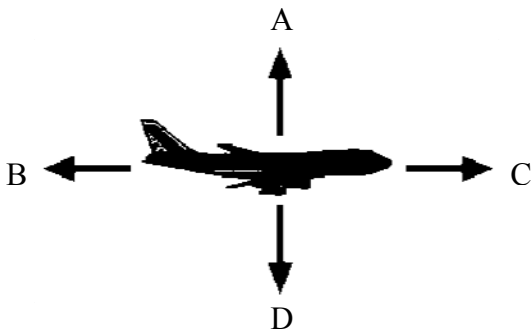

Figure 1

Question 3

Which one of the following correctly describes the forces on an aircraft?

A.   A is weight, B is thrust, C is drag and D is lift.
B.   A is lift, B is weight, C is thrust and D is drag.
C.   A is thrust, B is drag, C is lift and D is weight.
D.   A is lift, B is drag, C is thrust and D is weight.

Question 4

For the aircraft shown in Figure 1, which one of these statements is correct?

A.   The aircraft is accelerating.
B.   The aircraft is decelerating.
C.   The aircraft is stationary.
D.   The aircraft is travelling at a constant velocity.

Question 5

For the aircraft shown in Figure 1, which one of these statements is correct?

A. The aircraft is stationary.
B. The aircraft is rising.
C. The aircraft is descending.
D. The aircraft is travelling at a constant altitude.

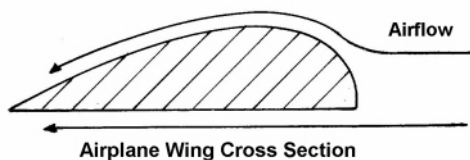**SECTION B – Detailed Study 4** – continued

Question 6

Which of the following statements matches the motion to its proper axis?

A. Motion about the lateral axis is pitch; motion about the vertical axis is yaw; and motion about the horizontal axis is roll.
B. Motion about the vertical axis is yaw; motion about the longitudinal axis is pitch; and motion about the lateral axis is roll.
C. Motion about the lateral axis is pitch; motion about the vertical axis is yaw; and motion about the longitudinal axis is roll.
D. Motion about the lateral axis is roll; motion about the vertical axis is pitch; and motion about the longitudinal axis is yaw.

Question 7

Bernoulli's principle is used to describe how the wings of an aircraft create lift.

Which of the following statements is correct in explaining how an aircraft's wing produces lift?

A. The air is moving faster over the top of the wing, creating a lower air pressure which sucks the wing up.
B. The air is moving faster over the top of the wing, creating a higher air pressure which pushes the wing up.
C. The air is moving slower over the bottom of the wing, creating a lower air pressure which sucks the wing up.
D. The air is moving slower over the bottom of the wing, creating a higher air pressure which pushes the wing up.

The following information applies to Questions 8–10.

A 4-engine plane has identical engines that are delivering 10 000 N of force each. The aircraft has a total mass of 200 000 kg and is travelling at a constant velocity and altitude.

Question 8

Calculate the drag that the plane experiences.

A.   4000 N
B.   400 000 N
C.   200 000 N
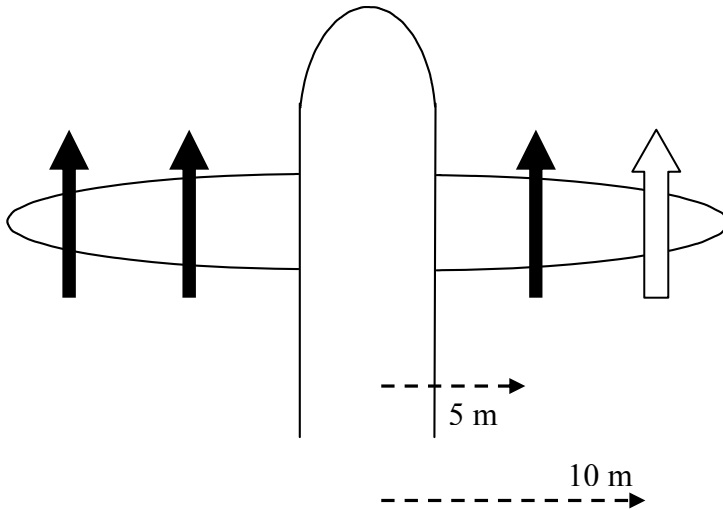D.   2 000 000 N

Question 9

Calculate the lift force of the plane.

A.   4000 N
B.   400 000 N
C.   200 000 N
D.   2 000 000 N

Question 10

As shown in Figure 2, the outside engines are 10 m from the centre of the plane, whereas the inner engines are 5 m from the centre of the plane. Suddenly the right outer engine cuts out. What force should the outside right engine be delivering now so that the plane remains in a straight line?

5 m

10 m

Figure 2

A.   6300 N
B.   16 300 N
C.   20 000 N
D.   30 000 N

Detailed study 5 – Investigations: Sustainable energy sources

Question 1

Which one of the following is not a sustainable energy source?

A.   coal
B.   wind
C.   geothermal
D.   solar

Question 2

Alicia has put together 24 solar cells, each producing 3 V at 100 mA each. How much power can she harness?

A.   7.2 W
B.   7200 W
C.   0.3 W
D.   72 W

Question 3

Thomas has a heater that is only 40% efficient. If he needs it to have an output of 1000 W to warm his toes, how much input does he require?

A.   400 W
B.   1400 W
C.   2500 W
D.   4000 W

Question 4

As energy is converted from one form to another, there will be some energy loss. In which one of the following forms is this energy lost?

A.   electrical energy
B.   mechanical energy
C.   light energy
D.   heat energy

Question 5

Which one of the following forms of energy conversion does **not** require a turbine for creating electricity?

A.   solar power
B.   tidal power
C.   wind power
D.   hydropower

SECTION B – Detailed Study 5 – continued
TURN OVER

Question 6

Which one of the following does **not** influence the amount of solar power that is produced?

A.   efficiency of panels
B.   temperature
C.   insulation
D.   panel area

Question 7

Australia has an abundance of uranium, and nuclear power produces no greenhouse gases, yet it is not used in Australia. Which one of the following statements explains the reason why?

A.   Nuclear power plants kill lots of people each year.
B.   The electricity generated by nuclear power would cost more than what consumers are paying now.
C.   Nuclear power plants are dangerous to the Earth.
D.   Coal mining is a safe practice.

Question 8

A house uses twelve 100 W light globes to drive back the dark for an average of 5 h per day for each globe. The inhabitants change to 15 W energy-efficient light globes. If electrical energy costs $0.24 per kW h, how much will they save in 1 year?

A. $525.60
B. $78.84
C. $446.76
D. $604.44

Question 9

General Hospital is in an isolated part of the Sahara, and is not on any electricity power grid. It needs to have electricity on demand, at all times, no matter the weather. Hospital administrators are shopping for a new power generator. Which of the following would be best?

A.   electrical batteries
B.   wind-powered generator
C.   solar-powered generator
D.   A combination of all of the above.

Question 10

In a coal-powered electrical power plant, energy is transformed according to which one of the following paths?

A.   chemical energy $\rightarrow$ kinetic energy $\rightarrow$ electrical energy
B.   chemical energy $\rightarrow$ heat $\rightarrow$ kinetic energy $\rightarrow$ electrical energy
C.   kinetic energy $\rightarrow$ gravitational potential energy $\rightarrow$ electrical energy
D.   kinetic energy $\rightarrow$ gravitational potential energy $\rightarrow$ heat $\rightarrow$ electrical energy

END OF DETAILED STUDY 5
TURN OVER

Detailed study 6 – Medical physics

Question 1

Which one of the following areas of medical physics is made possible because of radioactive decay?

A.   X-ray
B.   PET
C.   MRI
D.   CT scans

Question 2

A doctor needs a radioactive source of 5000 Bq to use in her hospital. If it falls below 2500 Bq, it becomes ineffective; yet if it is above 20 000 Bq, it is too dangerous. If it has a half-life of 2 months, what is the effective life-span of the doctor's radioactive source?

A.   2 months
B.   4 months
C.   6 months
D.   8 months

Question 3

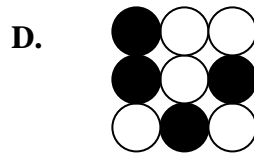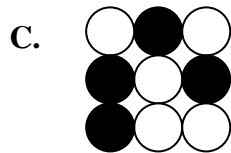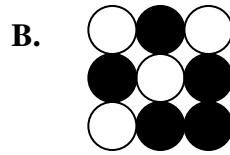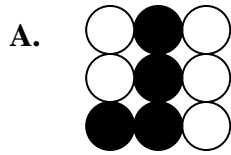If an X-ray has a period of 2.5×10^{-21} s, what is its frequency?

A. 4×10^{20} Hz
B. 4×10^{19} Hz
C. 4×10^{13} Hz
D. 4×10^{-15} Hz

Question 4

An endoscope needs its optical fibres to be coherent. Figure 1 shows one end of an endoscope.

Figure 1

Which one of the following is coherent to the one shown in Figure 1?

A.   B.

C.   D.

Question 5

Of the following, which radiation is appropriate for therapy?

A.   α
B.   β
C.   γ
D.   All of the above.

Question 6

Which one of the following would be best used as a tracer?

A. α
B. β
C. γ
D. X-rays

Question 7

Lead shields are used to protect people during which one of these procedures?

A. lasers
B. X-ray
C. MRI scan
D. ultrasound

Question 8

A CT scan uses which one of the following?

A. X-rays
B. sound waves
C. lasers
D. optical fibres

Question 9

The percentage of radiation in our lives due to human-made radiation, such as X-rays and mobile phones, is approximately which of the following?

A.   1.5%
B.   15%
C.   85%
D.   99.5%

Question 10

If an X-ray has a frequency of 1.8×10^{14} Hz, what is its wavelength?

A. 1.67×10^{-6} m
B. 1.67×10^{14} m
C. 5.55×10^{-15} m
D.   0.55 m

END OF QUESTION AND ANSWER BOOK