NESA STUDENT NUMBER

S1

2019 Physics

Year 11 Examination

General Instructions

- Reading time – 5 minutes
- Working time – 1 hour and 55 minutes
- Write using blue or black pen.
- Draw diagrams using pencil.
- Show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

Total marks: 65

Section 1 – Multiple Choice **20 marks**

- Attempt multiple choice questions 1–20 using the multiple choice grid provided on the back of the Section 2C booklet

Section 2A – Extended response questions **25 marks**

- Attempt questions 1–6

Section 2B – Extended response questions **10 marks**

- Attempt questions 1–3

Section 2C – Extended response questions **10 marks**

- Attempt questions 1–3

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Use the multiple choice grid provided on the back of the Section 2C booklet to answer the following questions.

Question 1 (1 mark)

An object travels 300 m north then turns and travels 400 m east.

What will be its final displacement?

(A) 700 m

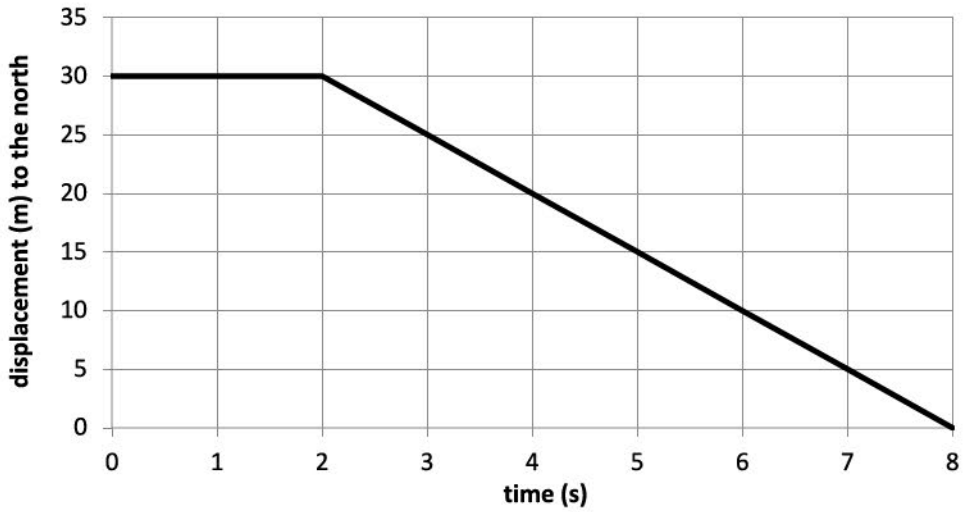
(B) 700 m bearing 053°

(C) 500 m bearing 037°

(D) 500 m bearing 053°

Question 2 (1 mark)

Consider the following graph of the motion of an object.



What is the instantaneous velocity of the object at time = 5 seconds?

(A) 15 m s^{-1} N

(B) 3 m s^{-1} S

(C) 5 m s^{-1} N

(D) 5 m s^{-1} S

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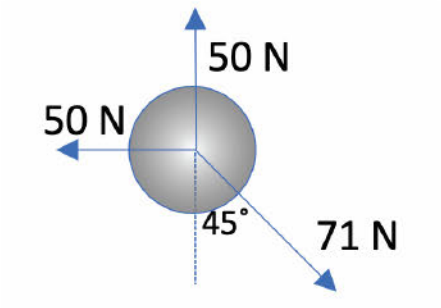
Question 3 (1 mark)

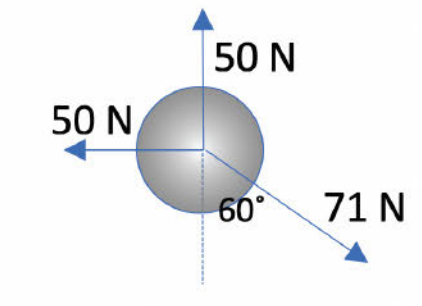
Which object shown below is in static equilibrium?

All objects are on a smooth surface and are viewed from above.

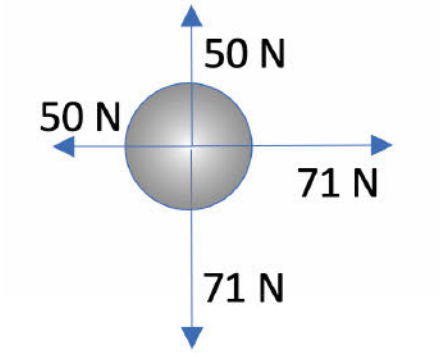
(A)



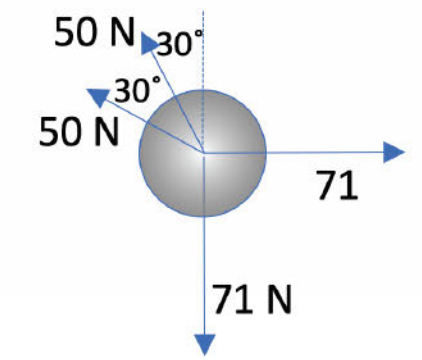
(B)



(C)



(D)



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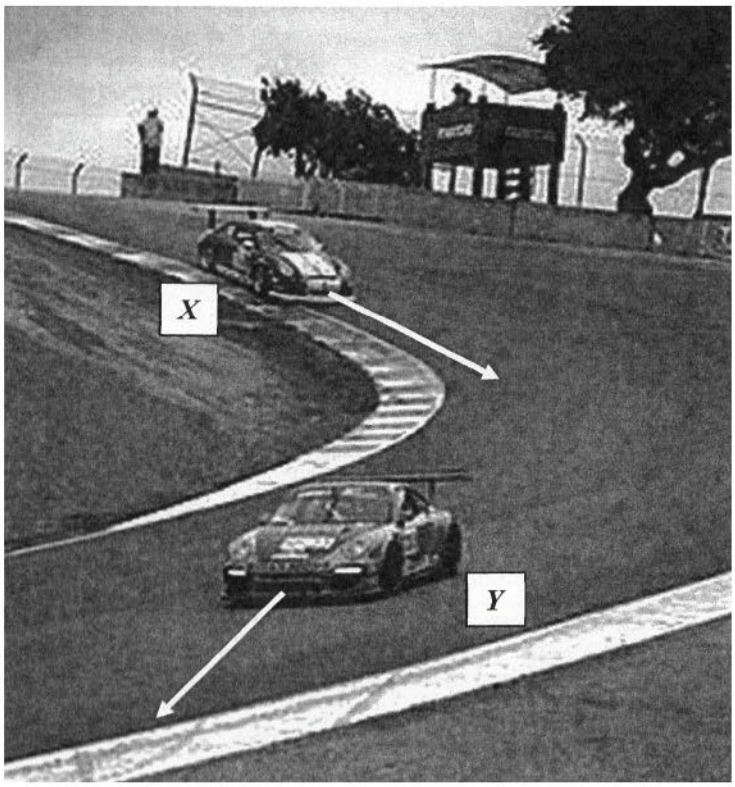
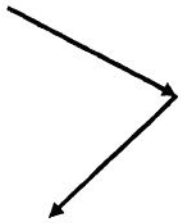
Question 4 (1 mark)

The photograph shows two cars during a race. Their instantaneous velocities are indicated by vector arrows.



Which diagram should be used to determine the velocity of car X relative to car Y?

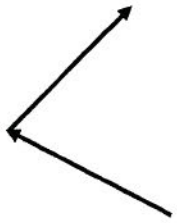
(A)



(B)

(C)

(D)



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Question 5 (1 mark)

A plane can fly at 300 km h^{-1}. The pilot wants to fly directly north over the ground but a crosswind of 100 km h^{-1} is blowing from the east.

In what direction must the pilot head the plane so that its course is directly north?

(A) N19.5ºE

(B) N19.5ºW

(C) N18.4ºE

(D) N18.4ºW

Question 6 (1 mark)

A 600 kg car is raised 2.0 metres above the ground by a mechanical car hoist. This takes 30 seconds.

What power does the hoist generate in lifting the car?

(A) 392 J

(B) 392 W

(C) 11760 J

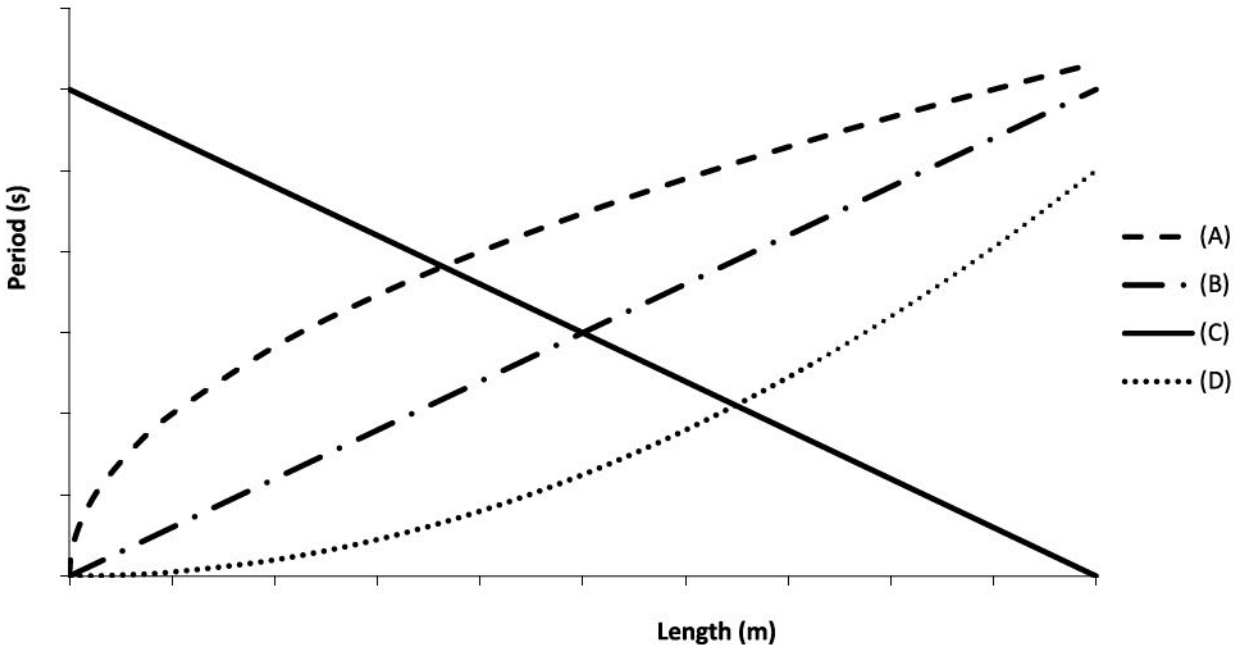
(D) 11760 W

Question 7 (1 mark)

The period T of a simple pendulum of length L is stated below:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Which line correctly shows the relationship between the period and the length of the pendulum?



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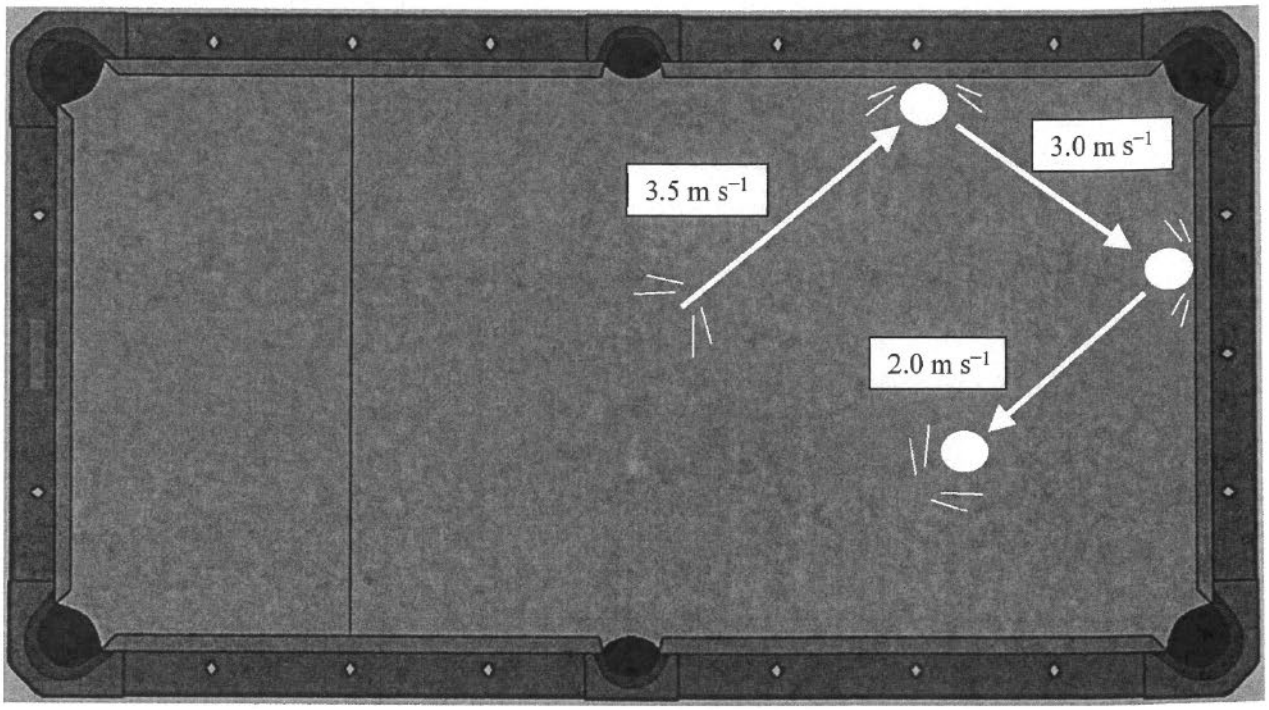
Question 8 (1 mark)

A billiard ball of mass 160 g is hit and follows the path as shown in the diagram, bouncing off two sides and returning on a path parallel to its original direction of travel. The speeds of the ball before and after each collision with an edge are shown.



What was the magnitude of the total change in momentum of the billiard ball for this set of collisions?

(A) 0.080 kg m s^{-1}

(B) 0.16 kg m s^{-1}

(C) 0.24 kg m s^{-1}

(D) 0.88 kg m s^{-1}

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Question 9 (1 mark)

A white billiard ball of mass m and an initial speed **u** collides with a stationary black billiard ball also of mass **m.**

After the collision the black ball moves off with a speed **v.**

The collision is elastic.

What is the speed of the white ball after the collision?

(A) zero

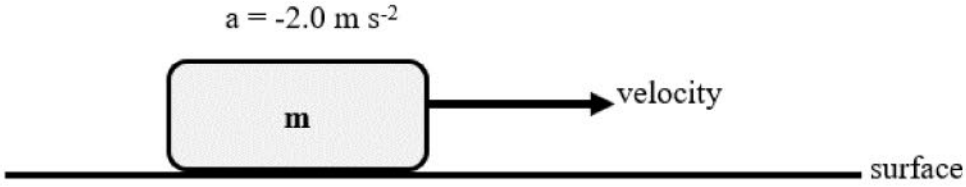
(B) **u**

(C) **v**

(D) **v**/2

Question 10 (1 mark)

The diagram shows a box of mass m sliding on a horizontal surface and decelerating at a constant rate of 2.0 m s^{-2}.



The coefficient of kinetic friction, μ, is closest to:

(A) 19.6

(B) 2.0

(C) 0.20

(D) 0.10

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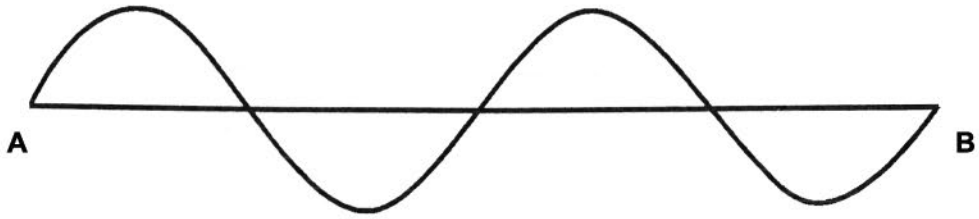
Use the information below to answer Questions 11 and 12 below.

Consider the following diagram which shows part of a wave in a medium. The part shown represents 0.6 s of time for the wave. The distance between the ends of the line **AB** is 12 cm.



Question 11 (1 mark)

Which choice shows correct data about this wave?

	Amplitude (cm)	Wavelength (cm)
(A)	1.3	3.0
(B)	1.3	6.0
(C)	2.6	3.0
(D)	2.6	6.0

Question 12 (1 mark)

Which choice shows correct data about this wave?

	Period (s)	Velocity (m s^{-1})
(A)	0.3	0.1
(B)	0.3	0.2
(C)	0.6	0.05
(D)	0.6	0.1

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Question 13 (1 mark)

The intensity of light reaching a spaceship from a distant star is 8 units. The spaceship is 60 AU from the star.

What will be the intensity reaching the ship when the distance between the star and the ship has been reduced 15 AU?

(A) 0.5 units

(B) 2 units

(C) 32 units

(D) 128 units

Question 14 (1 mark)

Which statement best defines our understanding of the temperature of a substance?

(A) Temperature is a measure of the internal heat energy of the matter.

(B) Temperature is a measure of the total heat capacity of the substance.

(C) Temperature is a measure of the average kinetic energy of the particles of matter.

(D) Temperature is the sum of the kinetic energy of the particles in the substance.

Question 15 (1 mark)

A beaker containing 200 g of a liquid is heated such that the liquid absorbs 6000 J of energy. Its temperature rises 7.0°C.

According to this data, what is the specific heat of the liquid?

(A) 4.3 J g^{-1} $°C^{-1}$

(B) 4.3 J kg^{-1} $°C^{-1}$

(C) 4.3 kJ g^{-1} $°C^{-1}$

(D) 4285 J g^{-1} $°C^{-1}$

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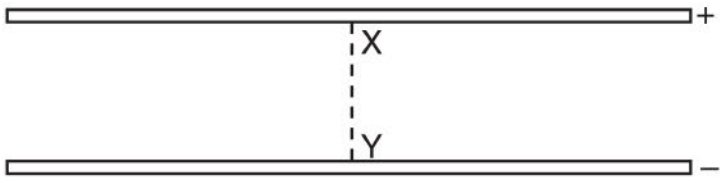
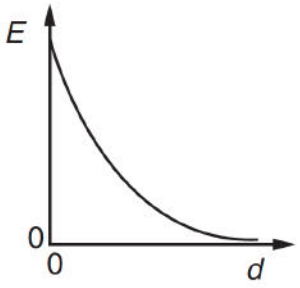
Question 16 (1 mark)

An electric field exists in the space between two charged metal plates.

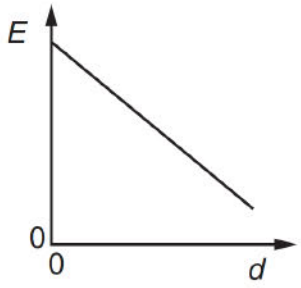


Which of the following graphs shows the variation of electric field strength E with distance d from X along the line XY?

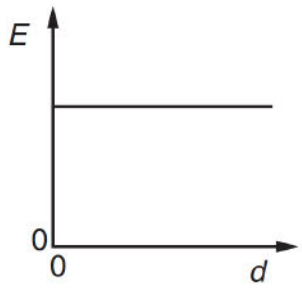
(A)



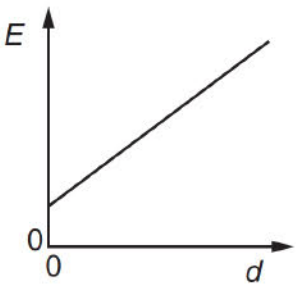
(B)



(C)



(D)



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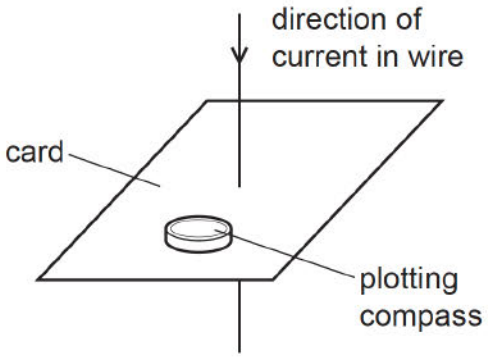
Question 17 (1 mark)

A vertical current-carrying wire passes at right angles through a piece of card as shown in the diagram below.



A compass is placed on the card.

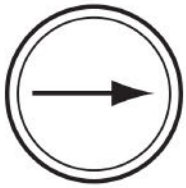
Which diagram shows the direction in which the needle of the compass points?

(A)

(B)

(C)

(D)



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Question 18 (1 mark)

An electric railway train has a maximum mechanical output power of 4.0 MW. Electrical power is delivered at 25 kV from overhead wires. The overall efficiency of the train in converting electrical power to mechanical power is 80%.

What is the current from the overhead wires when the train is operating at its maximum power?

(A) 130 A

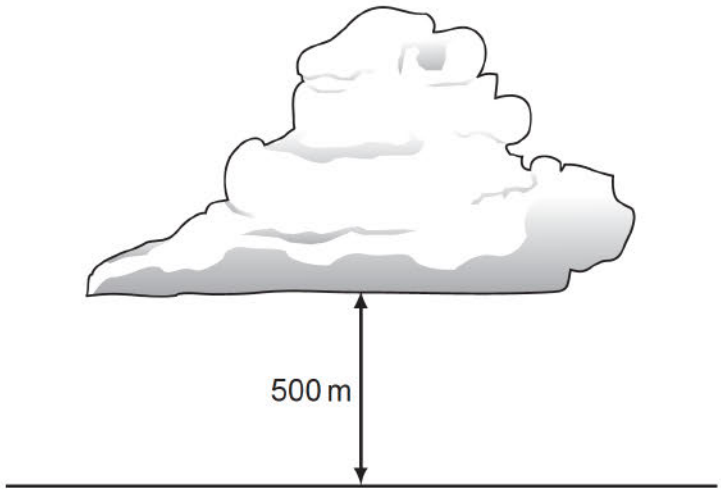
(B) 160 A

(C) 200 A

(D) 250 A

Question 19 (1 mark)

The diagram below shows a thundercloud whose base is 500 m above the ground.



The potential of the base of the cloud relative to the ground is +200 MV. A raindrop with a charge of 4.0×10^{-12} C is in the region between the cloud and the ground.

What is the electrical force on the raindrop?

(A) 1.6×10^{-6} N

(B) 8.0×10^{-4} N

(C) 1.6×10^{-3} N

(D) 0.40 N

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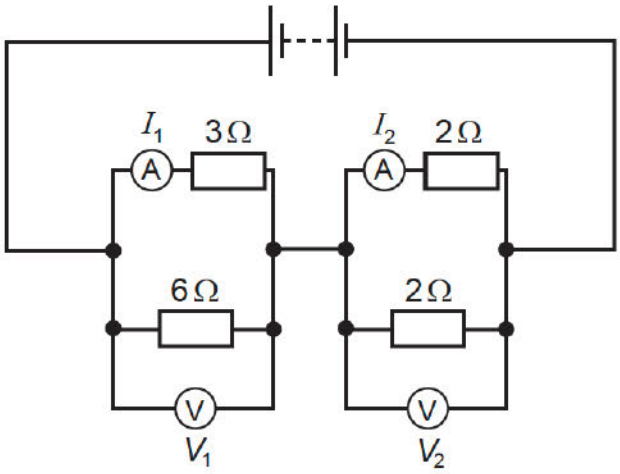
Question 20 (1 mark)

A student constructed the circuit below.



The readings on the meters are I_1, I_2, V_1 and V_2, as labelled on the diagram.

Which is correct?

(A) $I_1 > I_2$ and $V_1 > V_2$

(B) $I_1 > I_2$ and $V_1 < V_2$

(C) $I_1 < I_2$ and $V_1 > V_2$

(D) $I_1 < I_2$ and $V_1 < V_2$

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S2A

2019 Physics

Year 11 Examination

Section 2A (25 marks)

Questions 1–6

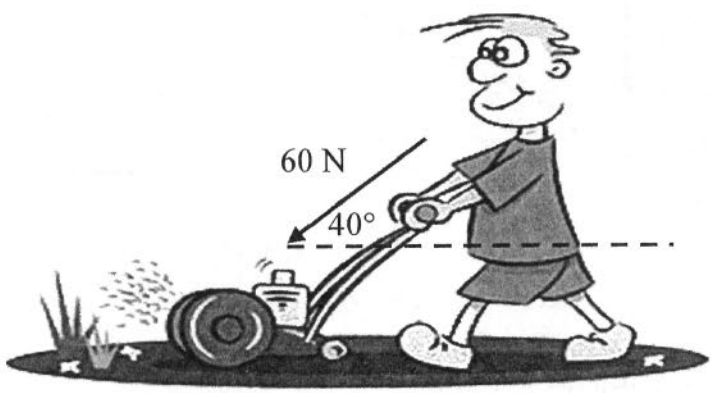
- Answer only Questions 1–6 from Section 2A in this booklet.
- Write using black pen.
- Draw diagrams using pencil.
- Show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

NESA STUDENT NUMBER

Marks

Question 1 (3 marks)

The cartoon shows a man pushing a 30 kg lawn mower. He applies a force of 60 newtons through the handles, directed at 40° to the ground.



(a) What is the normal reaction of the ground to the mower? **2**

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(b) The man is pushing the mower at a constant speed. **1**

What frictional force does the grass offer?

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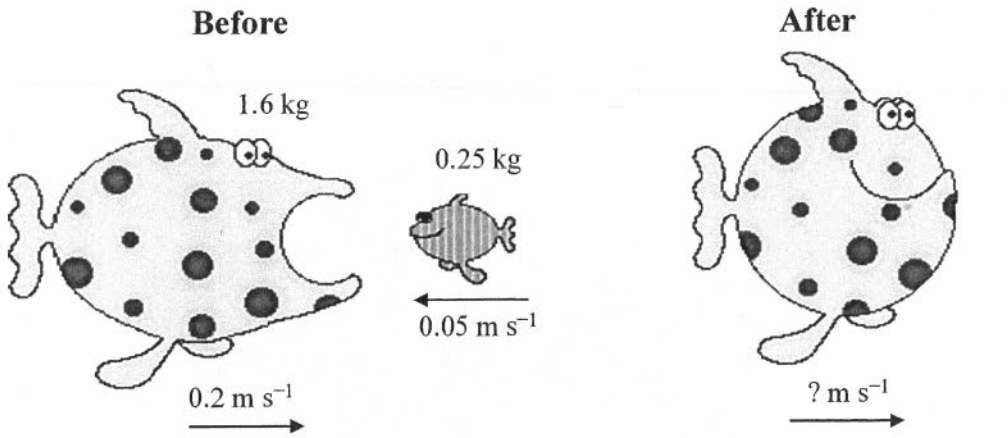
NESA STUDENT NUMBER

Marks

Question 2 (4 marks)

A 1.60 kg fish is swimming at 0.2 m s^{-1}. It opens its mouth to swallow a 0.25 kg fish swimming towards him at 0.05 m s^{-1}. After swallowing the smaller fish, the larger fish coasts onward in its original direction.



(a) Calculate the speed of the larger fish after swallowing the smaller fish. **2**

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(b) What impulse does the smaller fish apply to the larger fish? **2**

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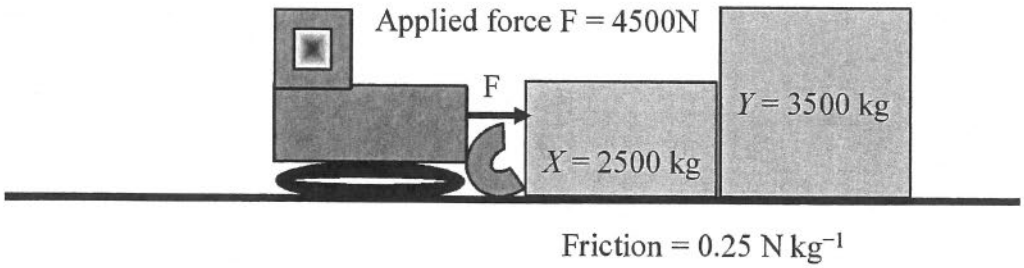
NESA STUDENT NUMBER

Marks

Question 3 (4 marks)

Consider the information in the diagram below of blocks being pushed by a bulldozer.



(a) Calculate the acceleration of the blocks as a result of being pushed by the bulldozer. **2**

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(b) What force does block Y apply to block X? **2**

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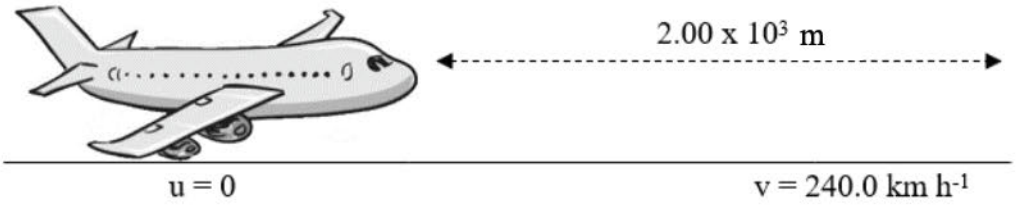
NESA STUDENT NUMBER

Marks

Question 4 (3 marks)

Boeing is designing a new aircraft which must accelerate from rest to reach a speed of 240 kilometers per hour within a distance of 2.00 kilometres.



What is the acceleration that this aircraft must achieve? **3**

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NESA STUDENT NUMBER

Marks

Question 5 (4 marks)

A car moving to the north at 14 m s^{-1} enters a turn which takes 10 s to complete. After turning, the car is moving at 12 m s^{-1} to the west.

(a) Represent the car's change of velocity by using a labeled vector diagram. **2**

(b) Find the magnitude and direction of the car's change of velocity. **2**

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NESA STUDENT NUMBER

Marks

Question 6 (7 marks)

A student is to determine the acceleration due to gravity, g, using the motion of an object down a smooth inclined plane. **7**

Describe a suitable procedure for this investigation. Explain how g will be calculated from the results. Include a sketch of the apparatus used.

NESA STUDENT NUMBER

S2B

2019 Physics

Year 11 Examination

Section 2B (10 marks)

Questions 1–3

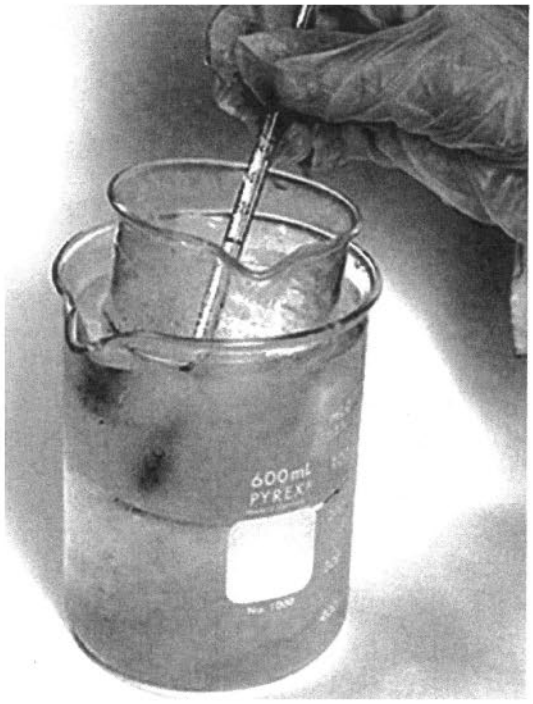
- Answer only Questions 1–3 from Section 2B in this booklet.
- Write using black pen.
- Draw diagrams using pencil.
- Show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

NESA STUDENT NUMBER

Marks

Question 1 (2 marks)

A beaker of hot water is placed inside a larger beaker of cold water as shown in the photo below and left for a period of time. **2**



Identify and account for the changes that will occur using appropriate Physics principle(s).

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NESA STUDENT NUMBER

Marks

Question 2 (2 marks)

When an ambulance with its siren blaring passes an observer, the Doppler effect is observed.

(a) The Doppler effect does not happen with the light from the ambulance's headlight as it passes by. **1**

Explain why this is so.

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(b) Calculate the observed frequency when the ambulance is moving at 30 m s^{-1} towards a stationary observer emits a sound with a frequency of 400 Hz. **1**

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NESA STUDENT NUMBER

Marks

Question 3 (6 marks)

(a) Using a labelled diagram, describe the difference between transverse and longitudinal waves. **3**

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(b) Using an example for each, what is the difference between electromagnetic and mechanical waves? **2**

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(c) Find the wavelength of a photon of light if it has a frequency of 4.2×10^{14} Hz. **1**

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NESA STUDENT NUMBER

S2C

2019 Physics

YEAR 11 EXAMINATION

Section 2C (10 marks)

Questions 1–3

- Answer only Questions 1–3 from Section 2C in this booklet and Section 1 Multiple Choice questions on pages 7–8.
- Write using black pen.
- Draw diagrams using pencil.
- Show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

NESA STUDENT NUMBER

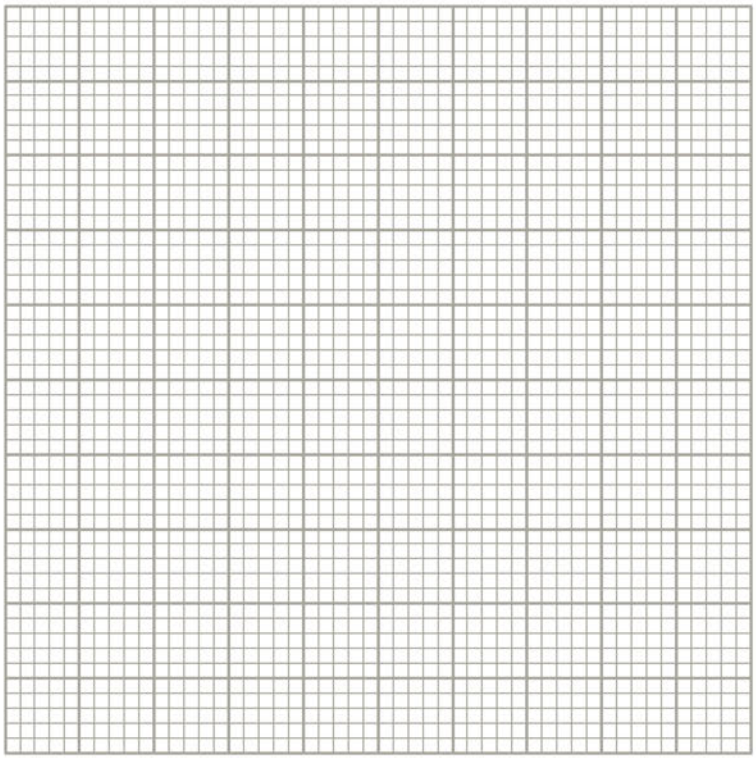
Marks

Question 1 (3 marks)

A light globe has the potential difference across it and the current flowing through it measured as the voltage of the power source is varied. The results are shown in the table below. **3**

Potential difference (V)	Current (A)
0	0.0
2	4.0
4	6.4
6	8.0
8	9.5
10	10.0

Using the grid provided below, plot a **current vs potential difference graph** of the data in the table.



NESA STUDENT NUMBER

Marks

Question 2 (3 marks)

Consider the diagram which shows a girl whose hair appears to be floating, or standing on end, after having just finished brushing her hair. **3**

Explain how this occurs, in terms of the principles of physics involved.

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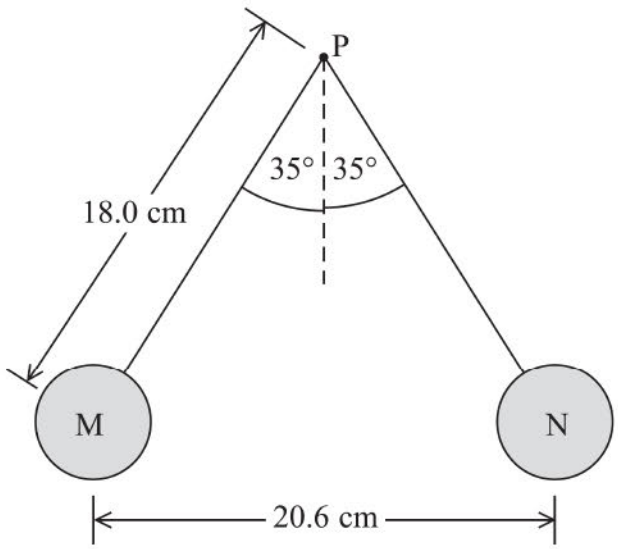
NESA STUDENT NUMBER

Marks

Question 3 (4 marks)

Two small spheres M and N are attached to non-conducting threads and suspended from a point P. The spheres are each given the same positive charge and they hang as shown in the diagram. **4**

The mass of each sphere is 2.7 g.



Calculate the charge on each ball.

2019 Physics

YEAR 11 EXAMINATION

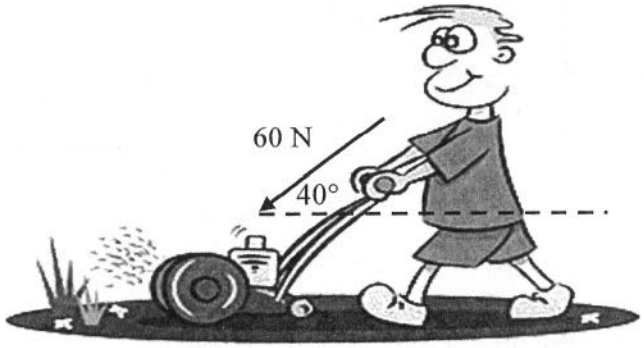
Marking Guidelines, Sample Responses and Notes from the Markers

S1

Question	Correct Response
1	D
2	C
3	A
4	A
5	A
6	B
7	A
8	D
9	A
10	C
11	B
12	B
13	D
14	C
15	A
16	C
17	B
18	A
19	A
20	A

Q1

The cartoon shows a man pushing a 30 kg lawn mower. To do this he applies a force of 60 N through the handles directed at 40° to the ground.



(a) What is the normal reaction of the ground on the mower?

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(b) If the man is pushing the mower at a constant speed, what fictional force does the grass offer?

(a) Two forces are acting, the weight of the mower and the man pushing

(b) Speed is constant; friction force is equal and opposite to the horizontal force component which the man applies.

Criteria	Marks
• Provides magnitude and direction	2
• Calculates weight or vertical component OR adds both components with an error	1

Sample answer: Normal reaction = mg + 60 sin 40°
= 294 + 38.6
= 332 N upwards

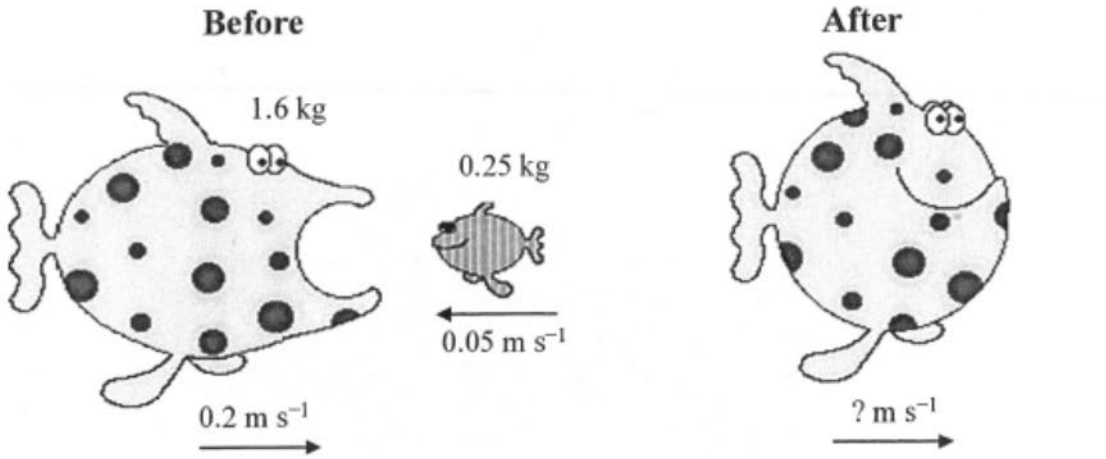
18(b)

Criteria	Marks
• Calculates horizontal component	1

Sample answer: Horizontal component of applied force
= 60 cos 40°
= 46 N
Therefore fictional force = 46 N against the motion

Q2

A 1.6 kg fish swimming at 0.2 m s^{-1} opens his mouth to swallow a 0.25 kg fish swimming towards him at 0.05 m s^{-1}. After swallowing the smaller fish, the larger fish coasts onwards in the same direction as he was initially going.



(a) Centre of mass speed

(b) The mass of the little fish mass is now ***inside*** the mass of the big fish, thus moving to the right. Out of sight is not out of mind. Impulse is momentum change.

Criteria	Marks
• Provides speed with correct working	2
• Applies conservation of momentum incorrectly	1

Sample answer: From the law of conservation of momentum

$m_1u_1 + m_2u_2 = (m_1 + m_2)\, v_{combined}$

$(1.6 \times 0.2) - (0.25 \times 0.05) = (1.6 + 0.25)\, v$

$v = 0.17$ m s^{-1} (right)

19(b)

Criteria	Marks
• Provides impulse with correct working	2
• Applies change of momentum incorrectly	1

Sample answer: Initial momentum of large fish = 0.32 Ns to the right

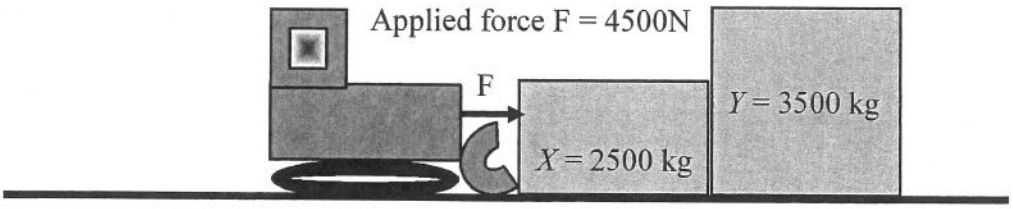
Final momentum of large fish = $1.6 \times 0.167 = 0.2656$ Ns to the right

Change in momentum = 0.054 Ns left

Impulse applied = 0.054 Ns left

Q3

Consider the information in the diagram below of blocks being pushed by a bulldozer.



Friction = 0.25 N kg^{-1}

(a) Calculate the acceleration of the blocks as a result of being pushed by the bulldozer.

(b) What force does block *Y* apply to block *X*?

(a) First calculate the net force.

(b) This can be done in several ways.

Criteria	Marks
• Calculates acceleration	2
• Provides acceleration based on incorrect working including friction	1

Sample answer: Net force = applied force – friction
= 4500 – (6000 × 0.25) = 3000 N
From net force = ma, 3000 = 6000a
Therefore a = 0.5 m s^{-2} to the right

23(b)

Criteria	Marks
• Provides magnitude and direction of force with working	2
• Provides force	1

Sample answer: Net force on X = ma = 2500 × 0.5 = 1250 N right,
Net force on X to right = applied force – force by Y – friction
1250 = 4500 – force by Y – 2500 × 0.25
Force by Y on X = 2625 N left

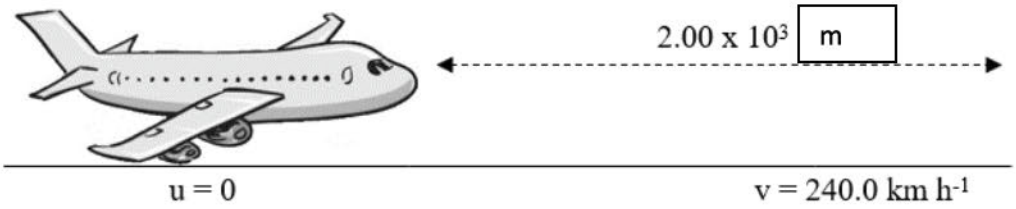
Alternative sample answer: Newton's third law; action and reaction.

Net force of X on Y = 3500 0.5 kg.m.s^{-2} + 3500 x 0.25 N = 3500 x 0.75 N = 2625 N to the right

Net force of Y on X = 2625 N to the left

Q4

Boeing is designing a new aircraft which must be capable of acceleration from rest and reach a speed of 240.0 km h^{-1} within a distance of 2.00 x 10^3 m.



What is the acceleration that this aircraft must achieved?….. **3**

Marking Criteria	Marks
• Correct answer with correct units and sig.figs	**3**
• Correct answer but either or both units and/or sig.figs incorrect	**2**
• A correct step made in calculation	**1**

Select $v^2 = u^2 + 2as$ where $v = 240/3.6 = 66.67$ m s^{-1}

and $u = 0$; s=2000m

$$2as = v^2 - u^2$$

$$a = \frac{66.67^2}{2 \times 2000}$$

$$= 1.11 \text{ m s}^{-2} \text{ to 3 sig. figs}$$

Please use conventional units; kilometer.hour^{-2} is not conventional

Unconventional units cause expen$ive error$; ask NASA about that units glitch!

Q5. A car moving to the north at 14.0 m s^{-1} enters a turn which takes 10.0 s. After turning, the car is moving at 12.0 m s^{-1} to the west.

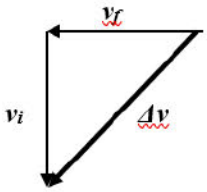
(a) Represent the car's change in velocity by using a labelled vector diagram.

(b) Find the magnitude and direction of the car's change in velocity.

Change is "final minus initial" in physics as well as chemistry and banking.

Marking Criteria	Marks
• Correct labelled vector diagram supplied clearly showing Δv	2
• Some aspect of a vector diagram supplied is correct	1

$$\Delta v = v_f - v_i$$
$$= v_f + (-v_i)$$



Most people didn't get the direction right with this second bite of the cherry.

Marking Criteria	Marks
• Correct answer with units and direction	2
• Correct answer omitting direction	1

$$\Delta v = \sqrt{v_f{}^2 + (-v_i)^2}$$
$$= \sqrt{12^2 + 14^2}$$
$$= 18.4 \text{ m s}^{-1}$$

$$\tan\theta = \frac{14}{12}$$

$\theta = 49°$ S of W

Conventional bearing is 221°

so Δv = 18.4 m s^{-1} W 49° S

Q6.

A student is to determine the acceleration due to gravity, g using the motion of an object down a smooth inclined plane.

Describe a procedure that is suitable for carrying out this investigation and explain how g will be calculated from the results. Include a sketch of the apparatus to be used.

Criteria	Marks
• Describes a suitable procedure with relevant details • Provides clear steps to analyse the data and obtain acceleration due to gravity • Draws a clear sketch of apparatus	6–7
• Outlines some steps of the procedure, the data analysis and draws a sketch	4–5
• Outlines some steps of the procedure OR outlines some steps of the data analysis	2–3
• Provides some relevant information	1

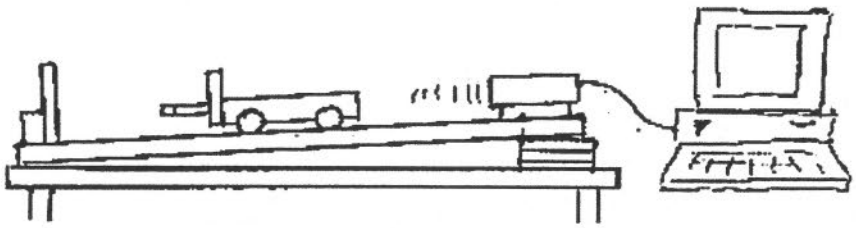
Sample answer:

Method:

1. Set up a smooth inclined plane of approximately 1 m in length. Place a motion sensor at the top of the plane, connected to a computer. Set the sensor to measure velocity of the trolley at 0.2 s intervals.
2. Turn on the sensor and place a trolley about 25 cm from the sensor. Release the trolley, stop trolley before end of slope and stop motion sensor. Check that the velocity readings are suitable to graph. Adjust slope angle if necessary.
3. Carry out 3 runs of trolley down slope.

Analysis of results:

1. Determine the angle Θ at the top of the slope by measuring height H and length L along slope and apply $\cos \Theta = H/L$.
2. Using data from sensor, plot velocity/time graphs for each run with a line of best fit.
3. Use the slope to determine the acceleration of the cart down the slope for each run.
4. Using the average acceleration a, calculate g from $a = g \cos \Theta$.



In general, not well answered.

Smooth surfaces in physical contact experience friction, and it is INDEPENDENT of the roughness, INDEPENDENT of the apparent surface area, DIRECTLY PROPORTIONAL to the normal force.

Four students used trolleys with wheels. You probably have YAY!!! written on your paper.

Several students used balls but did not include their rotational motion.

One student analysed sliding motion well.

No student told me that using an inclined plane increases the time interval and thus decreases the timing errors.

Ticker timers create friction as the tape goes through the machine; results are invalid unless using REALLY HEAVY masses, which has WHS implications.

Use of 10 cm distances is contra-indicated, especially when your 2.000 kg wooden block is more than 20 cm long and you are measuring from the centre of the block.

Year 11 Physics Task 3 2019 Marking Criteria 2B Mr Barr

Q1. A beaker of hot water is placed inside a larger beaker of cold water as shown in the photo below and left for a period of time.

Identify and account for the changes that will occur using appropriate Physics principle(s).

Marking Criteria	Mark
Identifies the physics principal of Thermal Equilibrium and accounts for the heat transfer	2
Only one of the above completed	1

The two beakers will reach thermal equilibrium as heat energy will flow from the hot water inside to the cold water outside. ie they reach the same temp = Zeroth Law of thermodynamics.

Q2. When an ambulance with its siren blaring passes an observer, the Doppler effect is observed.

(a) The Doppler effect does not happen with the light from the ambulance's headlight as it passes by.

Explain why this is so.

Marking Criteria	Mark
Explains ambulance speed is too slow compared to $c = 3X10^8\ ms^{-1}$	1

Ambulance is travelling too slow compared to c = speed of light. ∴ Doppler Shift is not observed. ie need to be around ≥ 10% for sound waves, light waves ≥ < 0.00001% too small to affect f of light from the headlights of Ambulance

Dopper Effect

Light = depends only on the velocity of the emitter (ambulance)

Sound = depends on both the velocity of the emitter and receiver.

b) Calculate the observed frequency when the ambulance is moving at 30 m s^{-1} towards a stationary observer emits a sound with a frequency of 400 Hz.

Marking Criteria	Mark
Correctly identifies Given Data; Substitutes into Equation and Correctly Calculates answer	1

Given: $V_{source} = 30\,ms^{-1}$ $f = 400\,Hz$ $V_{wave} = 340$ $V_{observer} = 0\,ms^{-1}$

Use: $f' = f\,\dfrac{(V_{wave} + V_{observer})}{(V_{wave} - V_{source})}$

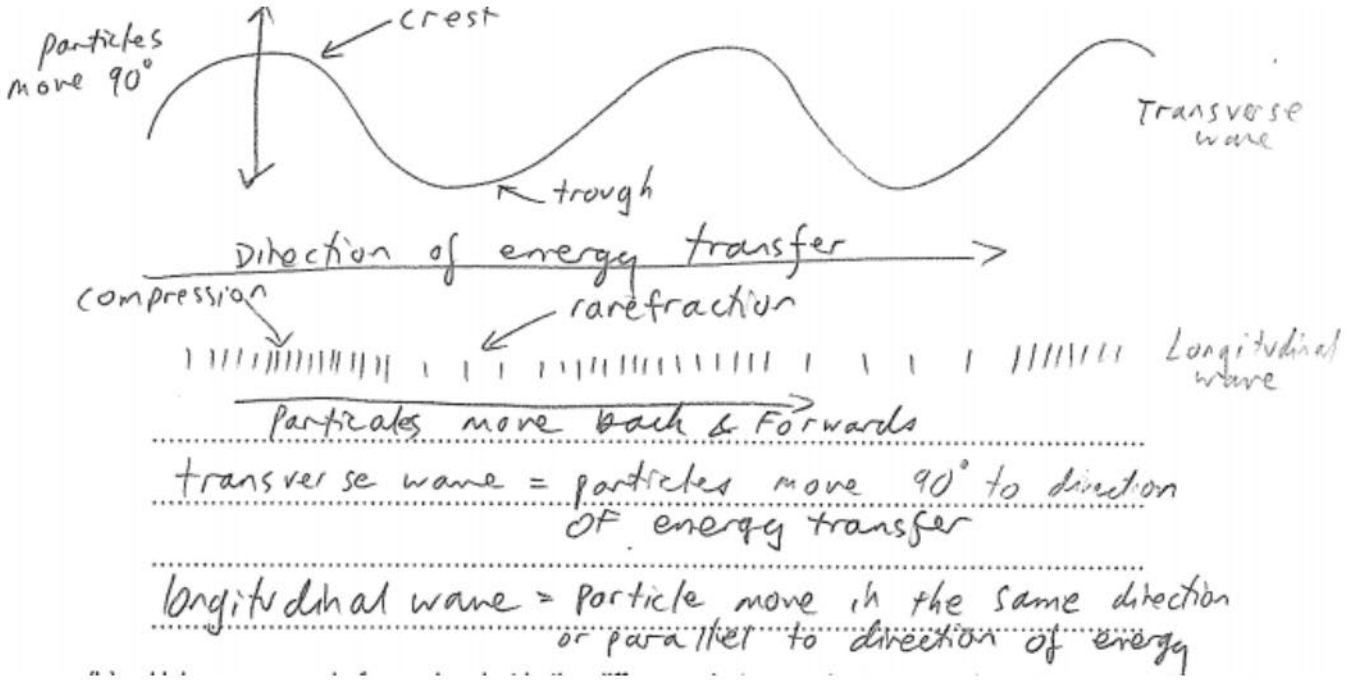
$= 400\,\dfrac{(340 + 0)}{(340 - 30)}$

$= 400 \times \dfrac{340}{310}$

$= \underline{\underline{439\ Hz}}$

Q3. (a) Using a labelled diagram, describe the difference between transverse and longitudinal waves.

Marking Criteria	Mark
Provides a labelled diagram of BOTH waves using: direction of energy transfer, crest, trough, compression, rarefaction AND describes the difference in particle movement	3
One of the above missing	2
Two of the above missing	1



transverse wave = particles move 90° to direction of energy transfer

longitudinal wave = particle move in the same direction or parallel to direction of energy

(b) Using an example for each, what is the difference between electromagnetic and mechanical waves?

Marking Criteria	Mark
Gives an example of BOTH waves AND the requirement of a medium/ no medium	2
Gives ONE example and ONE requirement of a medium/ no medium ONLY	1

EMR eg. Light don't require a medium to travel through

Mechcanical Wave eg. Slinky Spring do require a medium to travel through

(c) Find the wavelength of a photon of light if it has a frequency of 4.2×10^{14} Hz.

Marking Criteria	Mark
Correctly identifies Given Data; Substitutes into Equation and Correctly Calculates answer	1

Given: $f = 4.2 \times 10^{14}$ Hz $\quad c = 3 \times 10^{8}\ m s^{-1} \quad \lambda = ?$

Use: $v = f\lambda \quad \therefore \lambda = \frac{v}{f} = \frac{3 \times 10^{8}}{4.2 \times 10^{14}}$

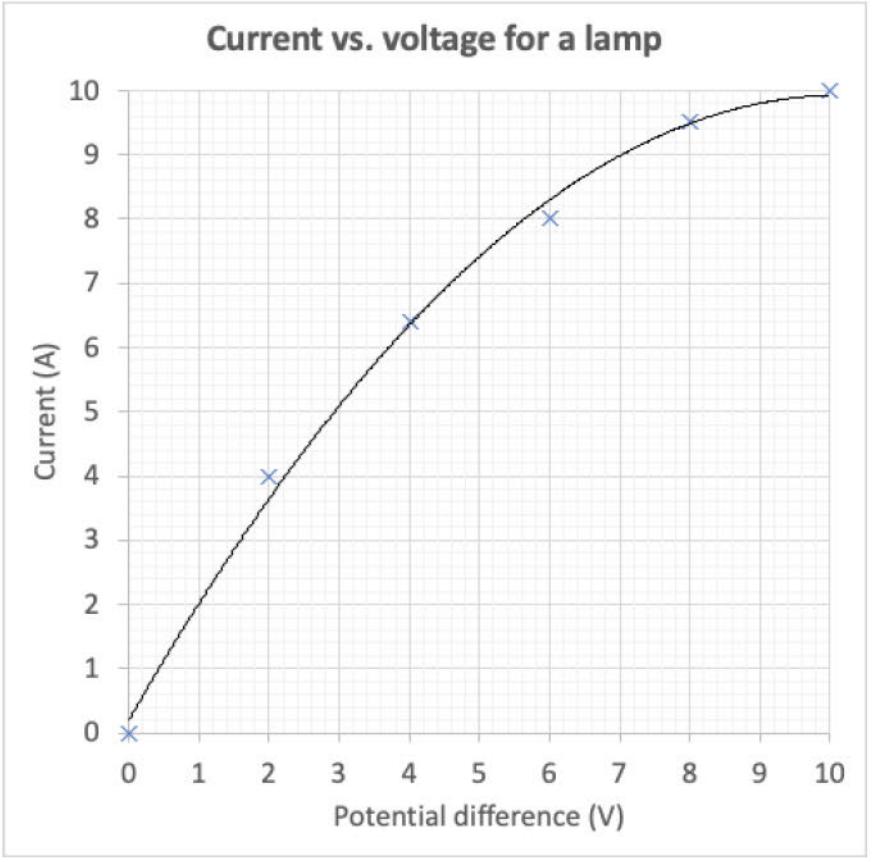
$= 7.14 \times 10^{-7}$ m

S2C

Question 1

Marking Criteria	Marks
• Constructs a graph which has: ○ an appropriate scaled set of labelled axes (current on the vertical axis and voltage on the horizontal axis) with appropriate units (A and V respectively) and markings ○ accurately plotted data points marked as ✖ ○ an appropriate line of best fit	3
• Constructs a graph with TWO of the above elements done correctly.	2
• Constructs a graph with ONE of the above elements done correctly.	1

Sample Answer



Notes from the Marker

- Include appropriate axes.
- Title is stated as Y vs X.
- Do not include a feathered line of best fit.

Question 2

Marking Criteria	Marks
• Explains the phenomenon relating THREE of the following: ○ electron transfer by friction from the neutral comb to the neutral hair resulting in the hair having a charge ○ repulsion of the hairs due to like charges (as predicted by Coulomb's law and resulting acceleration due to Newton's Second Law of Motion) ○ balanced forces once the hairs stop moving (as a result of Newton's First Law of Motion) to the observation provided in the photo.	3
• Briefly explains the phenomenon relating TWO of the above to partially account for observation provided in the photo.	2
• Outlines how ONE of the above can partially account for the observation provided in the photo.	1

Sample Answer

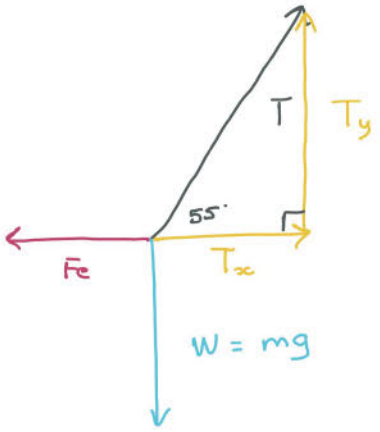
While combing the hair, friction between the hair and the comb results in electrons transferring from the hair to the comb. The comb becomes negatively charged and the hair becomes positively charged (or vice versa). Due to the hairs being positively charged, they exert a repulsive force on each other as predicted by Coulomb's law. As a result of this repulsive force, the hairs will accelerate as predicted by Newton's Second Law of Motion and move as far as they can until all repulsive forces and gravitational forces are balanced as accounted for by Newton's First Law of Motion.

Notes from the Marker

- **Explain** = Relate cause and effect; make the relationships between things evident; provide why and/or how
- Where appropriate, apply principles of physics to your response as it demonstrates your understanding of the question.
- Students needed to mention at least TWO Physics principles to score full marks in this question.

Question 3

Marking Criteria	Marks
• Correctly calculates the charge (3.0 x 10-7 C) by: ○ Calculating tension force or the T ○ Calculating the weight force correctly ○ Determining an appropriate expression for the electrostatic force ○ Equating horizontal component of T to the electrostatic force and solving for q with working shown and correct units	4
• Correctly demonstrates THREE of the above but incorrectly calculates force.	3
• Correctly demonstrates TWO of the above and makes an attempt at the question.	2
• Correctly demonstrates ONE of the above and makes an attempt at the question.	1



$W = mg$

$= (2.7 \times 10^{-3}) \times 9.8$

$= 0.02646\ N$

Since $T_y = W$

$T_y = W$

$T \sin 55° = 0.02646$

$T = 3.23 \times 10^{-2}\ N$

$\therefore T_x = T \cos 55°$

$= 3.23 \times 10^{-2} \times \cos 55°$

$= 0.0185\ N$

Since $T_x = F_e$

$F_e = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$

$0.0185 = \frac{1}{4\pi\varepsilon_0} \frac{q^2}{0.205^2}$

$q = 3.0 \times 10^{-7}\ C$

Notes from the Marker

- **Calculate** = Ascertain/determine from given facts, figures or information.

- Ensure that you convert to appropriate SI units.
- Draw an appropriate labelled diagram of the situations.
- Include reasoning for steps in calculations.
- Some students doubled the electrostatic force. This is not correct because the electrostatic force is the force acting on each of the objects.