NORTHERN BEACHES SECONDARY COLLEGE

MANLY SELECTIVE CAMPUS

PRELIMINARY HIGHER SCHOOL CERTIFICATE

YEARLY EXAMINATION

2018

PHYSICS

General Instructions ▪ Reading time – 5 minutes ▪ Working time	This paper has two parts, Part A and Part B <u>Part A</u> – 20 marks ▪ Attempt Questions 1-20 ▪ Allow abou

– 2 hours

- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student number in the space provided

t 30 minutes for this part

Part B – 56 marks

- Attem Questi s 21-3
- Allow about 1 hour and 30 minutes for this part

Weighting: 40%

PART	TOTALS	MARKS
A	20	
B	56	
TOTAL	76	

2018 PRELIMINARY EXAMINATION
PHYSICS

Part A – 20 marks
Attempt Questions 1-20
Allow about 30 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1-20

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you have changed your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

A ⊗ B ⊗ (correct) C ○ D ○

1 Which of the following contains only vector quantities?

(A) Displacement, velocity, acceleration

(B) Displacement, velocity, time

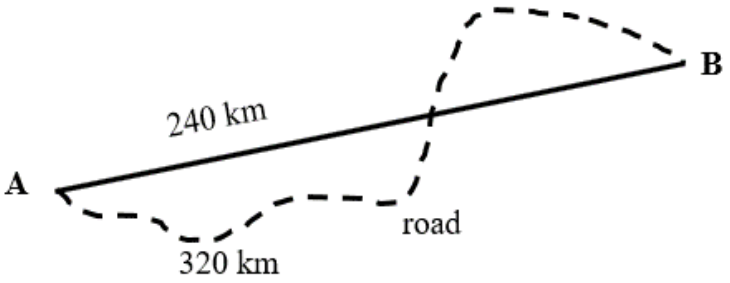
(C) Distance, speed, time

(D) Distance, velocity, time

2 The straight-line distance between two towns, A and B, is 240 km. The road that connects the towns is 320 km long. Town B is 67° from town A.

A ca

Whi



	Average speed of car (km h^{-1})	Average velocity of car (km h^{-1})
(A)	80	60 at 67°
(B)	80 at 67°	60
(C)	60	80 at 67°
(D)	80	80 at 67°

3 Which of the following is an example of an elastic collision?

(A) Two cars colliding

(B) Two atoms colliding

(C) Two billiard balls colliding

(D) A cricket ball bouncing on a concrete floor

4 Which statement correctly shows how a sound wave is different to a light wave?

(A) Sound waves are capable of refraction and light waves are not.

(B) Sound waves always have a smaller frequency than light waves.

(C) Sound waves are produced by oscillating objects and light waves are not.

(D) Sound waves require a medium to propagate whereas light waves do not.

5 A car travelling at 80 kmh^{-1} slams on its brakes and comes to a complete stop in 7 seconds.

What was the acceleration of the car?

(A) $-11.4\ ms^{-2}$

(B) $-3.2\ ms^{-2}$

(C) $3.2\ ms^{-2}$

(D) $11.4\ ms^{-2}$

6 A golf ball is struck and given an initial speed of 40.0 m s^{-1} at an angle 30° above the horizontal.

Which expression gives the golf ball's initial vertical component of its velocity?

(A) 30 sin 40°

(B) 40.0 cos 30°

(C) 40.0 sin 30°

(D) 40.0 tan 30°

7 What quantity is defined as the product of the resultant force experienced by an object and its total displacement?

(A) Work

(B) Momentum

(C) Acceleration

(D) Kinetic Energy

8 Blue light in the visible part of the electromagnetic spectrum has a wavelength of 450 nm.

Calculate the frequency of this light.

(A) 1.5×10^{-15} Hz

(B) 6.6×10^{5} Hz

(C) 6.6×10^{14} Hz

(D) 6.7×10^{14} Hz

9 Which option correctly shows how each factor influences the movement of electricity through a conductor?

	Increased length	*Increased cross sectional area*	*Increased temperature*	*Change in conductor material*
(A)	Resistance increased	Resistance decreased	Resistance increased	Resistance varies with different materials
(B)	Resistance increased	Resistance decreased	Resistance decreased	Resistance varies with different materials
(C)	Resistance increased	Resistance increased	Resistance increased	Resistance increased
(D)	Resistance decreased	Resistance decreased	Resistance decreased	No change in resistance with change of materials

10 An air column open at one end only resonates with a fundamental frequency of 420 Hz.

The frequency of the third harmonic for the same air column is:

(A) 1260 Hz

(B) 920 Hz

(C) 840 Hz

(D) 630 Hz

11 A material to be used for a fibre optic cable, has a refractive index of 1.44.

Which of the following would be the critical angle for this material?

(A) 14.48^0

(B) 35.24^0

(C) 43.98^0

(D) 53.18^0

12 What is the kinetic energy of a person of mass 70 kg running at a speed of 12 kmh^{-1}?

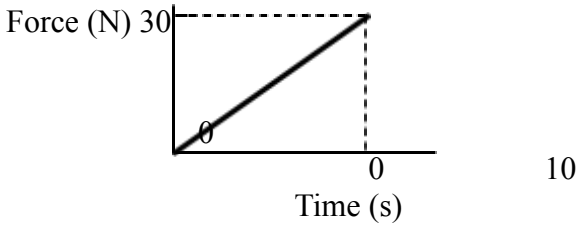
(A) 389 J

(B) 420 J

(C) 778 J

(D) 5040 J

13 A 5 kg hovercraft was placed at rest above a smooth floor with negligible friction**.** The graph below shows the force acting on the hovercraft as a function of time over a period of 10 seconds.



Which of the following can be determined from the results shown on the graph?

(A) The hovercraft was undergoing constant acceleration of 3 ms^{-2}

(B) The hovercraft reached a speed of approximately 30 ms^{-1}

(C) The kinetic energy of the hovercraft increased by 150 joules

(D) The hovercraft travelled approximately 5 metres

14 A crane uses a 5.0 kW motor to lift a mass of 200 kg from the ground to a height of 40.0 m.

Assuming the motor is 100% efficient, how long would it take the crane to perform this task?

(A) 16 s

(B) 16000 s

(C) 32 s

(D) 78 s

15 A 2400W electric kettle with an efficiency of 95% provides 2.28kJ of energy per second when used to boil water. If one litre of water, initially at 20ºC is placed into the kettle and the kettle is turned on, approximately how long (to the nearest 5 seconds) will it take for the water to start to boil? (The boiling point of water is 100ºC)

(A) 1 minute and 5 seconds

(B) 2 minutes

(C) 2 minutes and 25 seconds

(D) 3 minutes and 5 seconds

16 A solenoid with 20 turns and a length of 10 cm has a current of 60 A running through it.

What is the magnetic field strength produced by the solenoid?

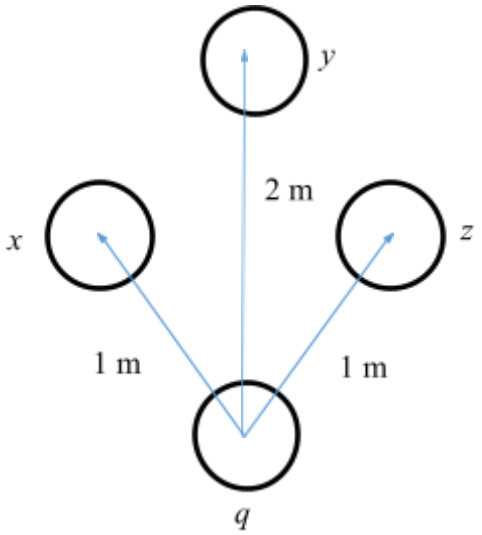
(A) 1.5×10^{-4} T

(B) 1.5×10^{-2} T

(C) 1.2×10^{-4} T

(D) 3.0×10^{-2} T

17 The diagram below shows the force vectors experienced by charge q due to charges x, y and z.



$< xqy = < zqy = 45^0$

Which vector diagram most correctly represents the direction of the resultant force felt by q?

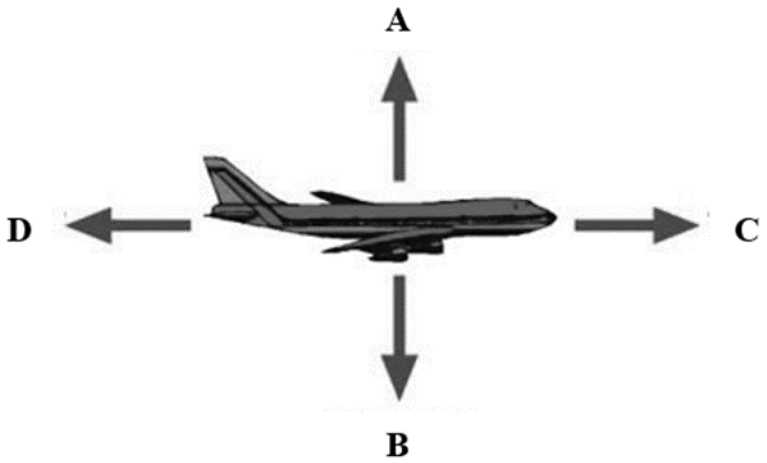
(A) 

(C)

(B) 

(D)

18 The forces on an aircraft flying 10 km above the ground are shown in the diagram.



The magnitude of Force A = the magnitude of Force B.
The magnitude of Force C = the magnitude of Force D

By referring only to the diagram, which statement could be correct?

(A) The aircraft is motionless in the sky.

(B) The aircraft is descending at a constant rate.

(C) The aircraft's speed is increasing.

(D) The aircraft is flying at a constant velocity.

19 What is the sum of the e.m.f. around any loop, equal to?

(A) Sum of the current

(B) Sum of the resistance

(C) Sum of the current per second

(D) Sum of the potential difference

20 Which statement about the amount of energy needed to heat 100 mL of two different substances by 1 ^{0}C is correct?

(A) The substance with the lowest density requires the least energy.

(B) The substance with the highest density requires the least energy.

(C) The substance with the lowest specific heat capacity requires the least energy.

(D) The substance with the highest specific heat capacity requires the least energy.

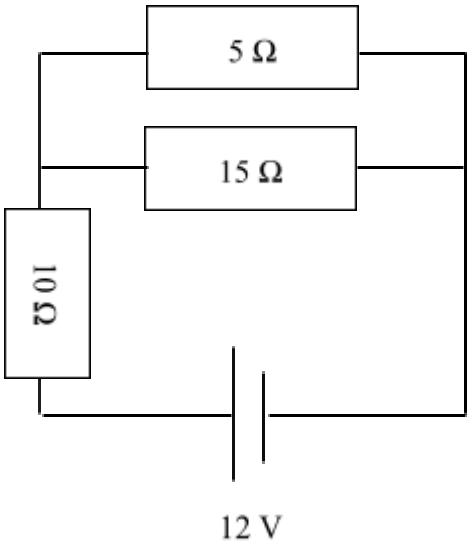
2018 PRELIMINARY EXAMINATION
PHYSICS

Part B – 56 marks
Attempt Questions 21-32
Allow about 1 hour and 30 minutes for this part

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 21 (7 marks)

This question refers to the following electric circuit.



(a) Through which resistor will the current be the greatest? **1**

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(b) Calculate the total current through the circuit. **3**

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Question 21 continues on page 10.

Question 21 (continued)

(c) Calculate the power dissipated in the 15Ω resistor. **3**

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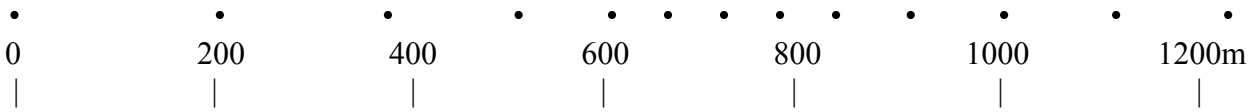
Question 22 (6 marks)

A truck travelling along a long straight road drops oil at the rate of one drop every 10 seconds. The pattern of oil on a 1200m section of the road is represented by the dots below.



(a) Construct a table to show displacement and time data for the motion of the truck over the 1200m section of road. **2**

(b) Calculate the average speed of the truck over the 1200m section of road. **2**

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(c) Determine the acceleration of the truck over the first 50 seconds. **2**

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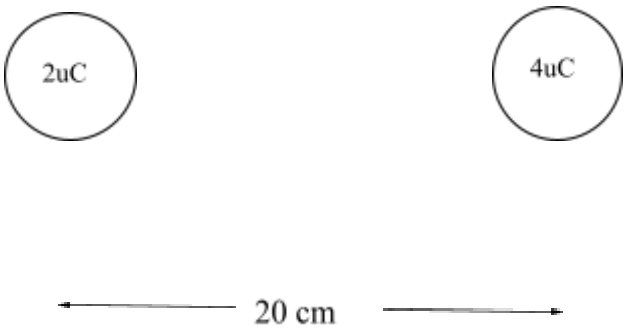
Question 23 (4 marks)

The centres of two small positively charged objects are separated by 20cm as shown in the diagram below.



(a) Draw lines **on the diagram above** to represent the electric field pattern between the two charges. **2**

(b) Calculate the magnitude and direction of the electrostatic force between the two charges. **2**

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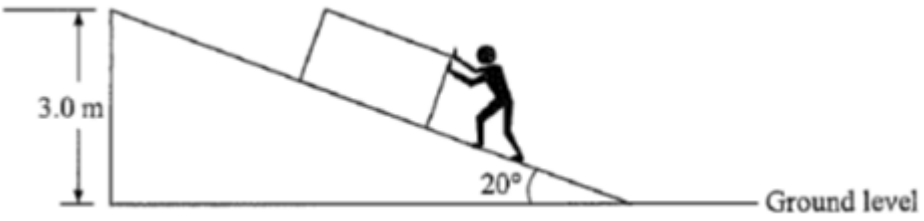
Question 24 (4 marks)

The diagram shows a 10 kg box being pushed at constant speed up a slope of 20°, increasing its height by 3 m.



(a) Calculate the work done if the force of friction along the slope is 21 N. **2**

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(b) Calculate the final velocity of the box if it is allowed to slide down the slope to ground level. **2**

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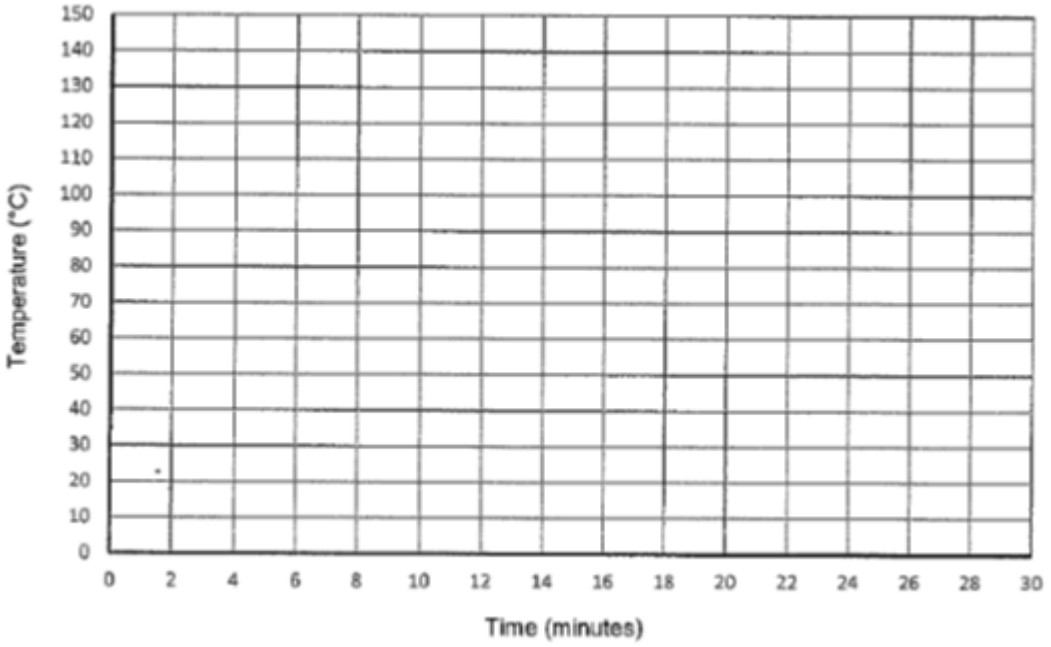
Question 25 (6 marks)

Some students provided constant heat at a rate of 2700 joules per minute to a 100 g of liquid. The initial termperature of the liquid was 18°C. The liquid took 8 minutes to reach boil (100°C) and an additional 18 minutes for the liquid to completely evaporate.

(a) Plot the data and draw a graph to show the temperature/time relationship for this experiment. **2**



(b) Calculate the specific heat of the liquid in appropriate units. **2**

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(c) Explain the shape of the graph. **2**

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Question 26 (4 marks)

(a) Describe the role played by friction when a car accelerates, moves around a corner and stops. **2**

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(b) A 1200 kg car has a coefficient of static friction between the tyres and the ground of 0.75. Find the maximum acceleration for this car. **2**

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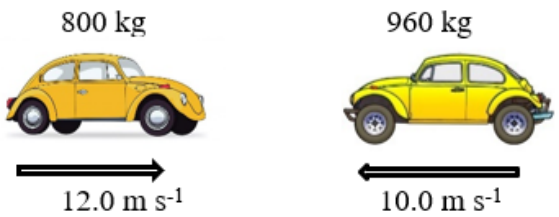
Question 27 (4 marks)

Two cars collide head-on, as shown in the diagram. **2**

(a) When the wreckage



combined

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(b) Explain why the collision is inelastic, using equations where appropriate. **2**

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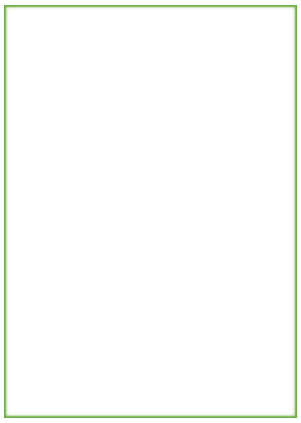
Question 28 (3 marks)

A glass block, surrounded by air and with a refractive index of 1.50, has a light ray incident on it at an angle of 32°. The light beam passes through the block and out the other side. Label the diagram below showing the passage of this light including all angles and showing all working. **3**



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Question 29 (4 marks)

During the Year 11 Physics course, many first-hand investigations were undertaken where there were elements of risk involved.

(a) Identify one such investigation and state *two* risks relevant to that investigation and the control measures taken for each risk to ensure your safety and the safety of others. **3**

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(b) Describe how you would ensure that the results of a first-hand investigation would be <u>reliable</u>. **1**

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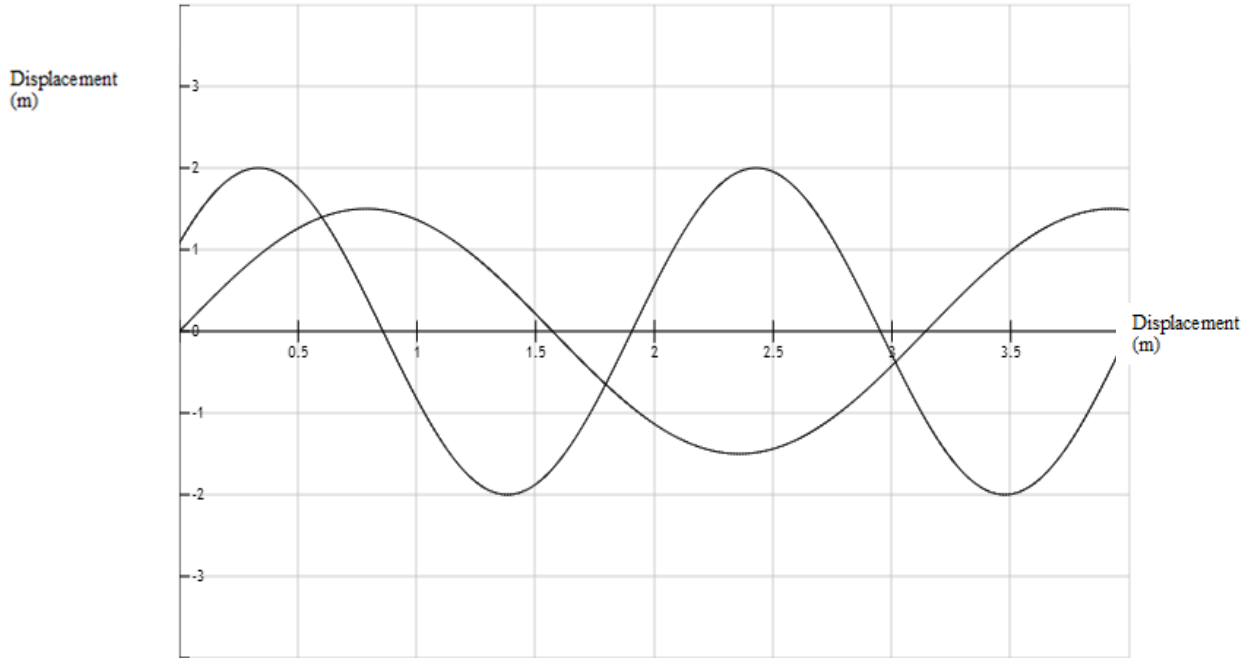
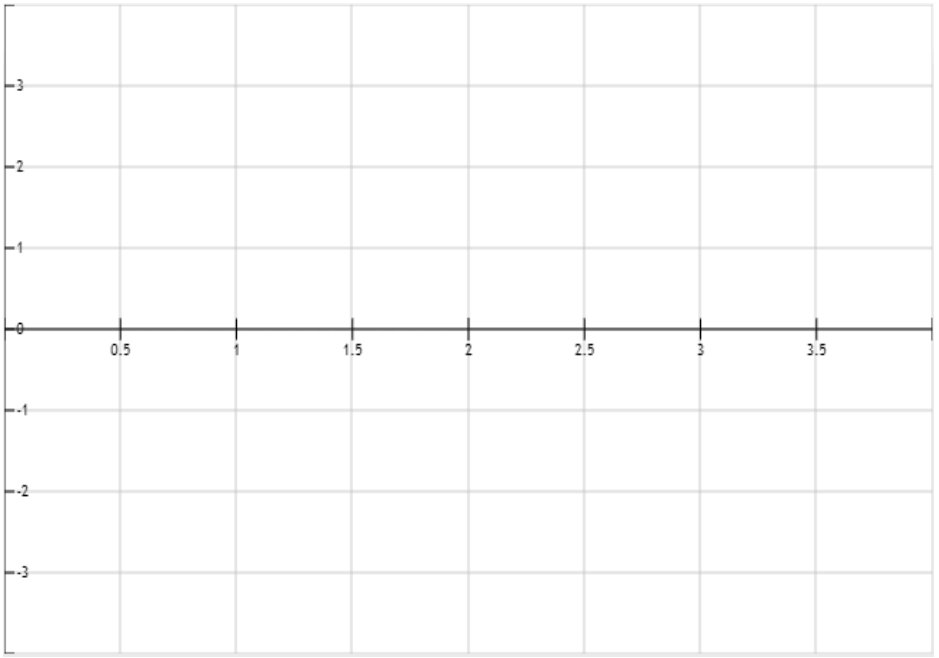
Question 30 (4 marks)

The following two radio waves were detected separately by a receiver during a simple scientific experiment and displayed on a screen.



(a) Draw the resultant wave on the empty graph below. **2**



Question 30 continues on page 19.

Question 30 (continued) **2**

(b) With reference to their physical properties, explain why electromagnetic, and not mechanical waves, are generally used in communication technology.

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Question 31 (3 marks)

Explain the physical phenomenon of ferromagnetism. Include a diagram in your answer. **3**

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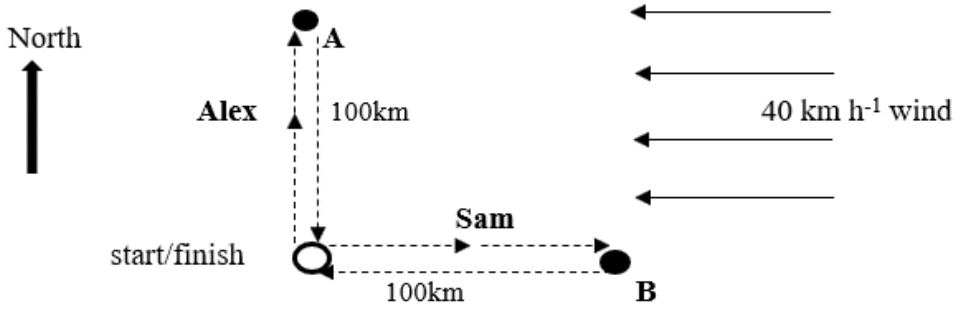
Question 32 (7 marks)

Two students, Sam and Alex, propose to have a race using their small aircraft, both of which can fly through still air at the same speed, 140 km h^{-1}. They will both start and finish at the same point, but they will fly to different points, **A** and **B** which are 90° apart and both 100 km from the start.

They will then turn around and come back to the finish. The distance they will race is the same, but a steady wind blows from the east at 40 km h^{-1} throughout the race.

The details are shown on a map below.



(a

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Question 32 continues on page 21.

Question 32 (continued)

(b) Using a diagram, find the direction that Alex will need to head so that the plane travels directly north over the ground.

2

(c) Find the time it takes Alex to fly to point **A** and back to the finish.

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(d) Describe what would occur if the wind was blowing from the east at 140 km h^{-1}.

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Student Number

PHYSICS – MULTIPLE-CHOICE ANSWER SHEET

ATTEMPT ALL QUESTIONS

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

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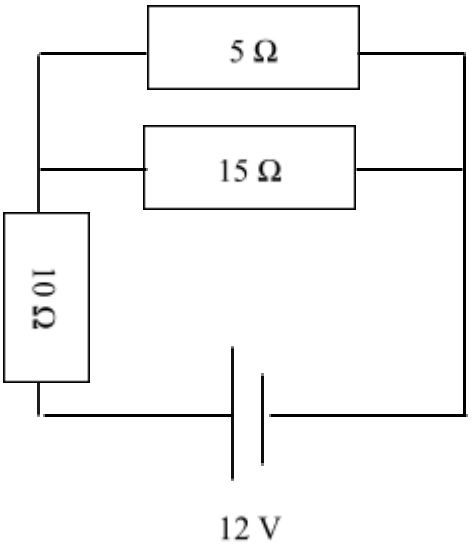
Marking Guidelines

2018

PHYSICS

Question 21 (7 marks)

This question refers to the following electric circuit.



(a) Through which resistor will the current be the greatest? **1**

Criteria	Mark
● Correctly identifies the 10Ω resistor	1

Sample answer
10Ω resistor.

(b) Calculate the total current through the circuit. **3**

Criteria	Marks
● Correctly calculates total resistance ● determines the total current using V=IR ● Shows all working	3
● Correctly determines the total resistance of the circuit	2
● Correctly determines the resistance of the parallel resistors or shows a fully substituted equation and answer of V=IR	1

Sample answer
$R_T = 10 + (1/5 + 1/15)^{-1}$
$= 10 + 3.75$
$= 13.75\ \Omega$

$V = I\ R$
$I = V / R$
$= 12/13.75$
$= 0.87$ A

Question 21 (continued)

(c) Calculate the power dissipated in the 15Ω resistor. **3**

Criteria	Marks
● Correctly calculates the power through the 15 Ω resistor with correct units. ● Shows all working	3
● Identifies a correct formula to calculate power ● Shows a fully substituted equation with units	2
● Identifies watts as the correct units for power	1

Sample answer

Current through 15 Ω resistor = 0.87/4 = 0.22 A.

$P = I^2R$

$= 0.22^2 \times 15$

= 0.71 Watts

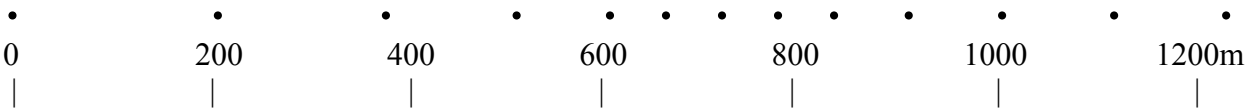
OR

The voltage drop across the 10 Ω resistor V = I R = 0.87 x 10 = 8.73 V therefore the voltage drop across the 15 Ω resistor = 3.27 V

$P = V^2/R = 3.27^2/15 = 0.71$ W

Question 22 (6 marks)

A truck travelling along a long straight road drops oil at the rate of one drop every 10 seconds. The pattern of oil on a 1200m section of the road is represented by the dots below.



(a) Construct a table to show displacement and time data for the motion of the truck over the 1200m section of road. **2**

Criteria	Marks
Inputs correct data into the table	2
Creates a two-column table with the headings displacement and time	1

Sample answer

Time (seconds)	Displacement (metres)
10	200
20	370
30	500
40	590
50	650
60	700
70	760
80	810
90	900
100	1000
110	1090
120	1200

Approximate displacements

(b) Calculate the average speed of the truck over the 1200m section of road. **2**

Criteria	Marks
• Correctly calculates the average velocity and • shows all working with correct units	2
• One of the above	1

Sample answer

$v_{(av)} = s / t$

$= 1230/120$

$= 10.25\ ms^{-1}$

(c) Determine the acceleration of the truck over the first 50 seconds. **2**

Criteria	Marks
Determines the initial and final velocities during appropriate time periods	2
Identifies when the maximum acceleration occurred	1

Sample answer
$a = (v - u) / t$

u = Average velocity in the first 10 seconds = 208/10 = 20.8 ms^{-1}.
v= Average velocity during the time 40 to 50 seconds = 96.2/10 = 9.62 ms^{-1}.

$a = (9.62 - 20.8) / 50$
$= - 0.224\ ms^{-2}$

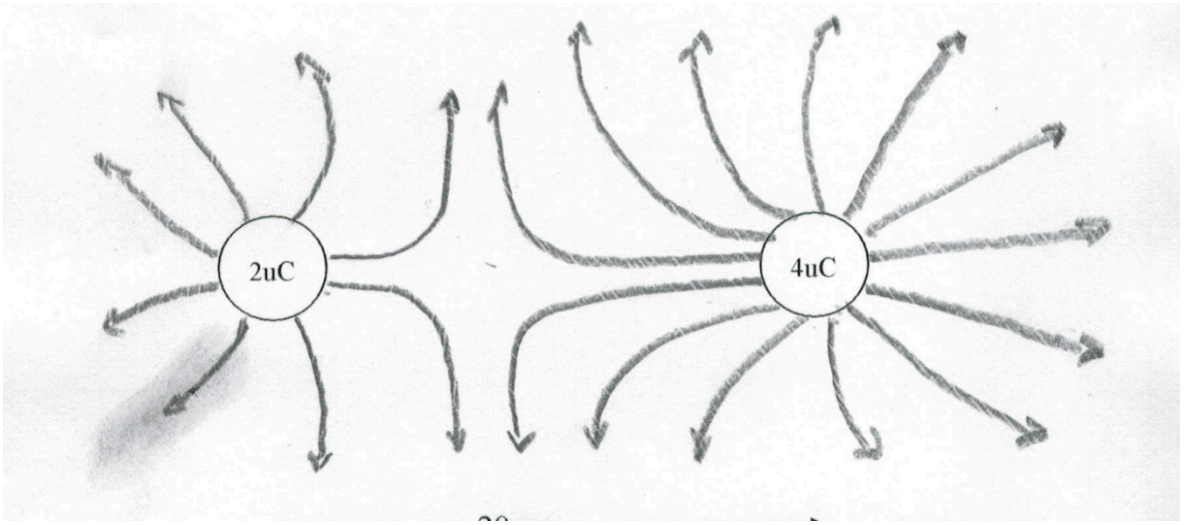
(NB approximate values ought to be relatively close to those provided)

Question 23 (4 marks)

The centres of two small positively charged objects are separated by 20cm as shown in the diagram below.

Criteria	Marks
• There is a clear null point in the field that is closer to the 2 uC charge or greater number of field lines showed around the 4uC charge • Field lines drawn correctly, pointing radially from each charge	2
• One of the above	1

Sample answer



(a) Draw lines **on the diagram above** to represent the electric field pattern between the two charges. **2**

(b) Calculate the magnitude and direction of the electrostatic force between the two charges. **2**

Criteria	Marks
Correctly calculates the magnitude of the force	2
Identifies that the force is repulsion	1

Sample answer

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

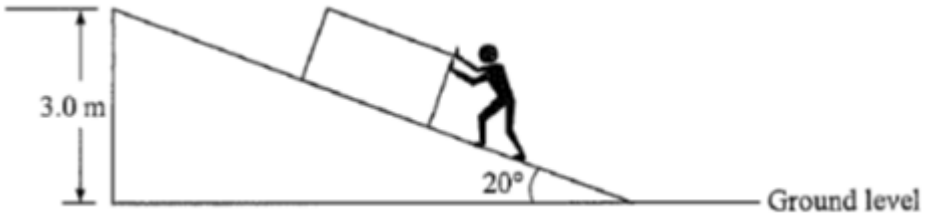
$$F = \frac{1}{4\pi\times 8.854\times 10^{-12}}\frac{2\times 10^{-6}\times 4\times 10^{-6}}{(0.2)^2}$$

$$F = 1.8N$$

Since both charges are positive, the force is one of repulsion.

Question 24 (4 marks)

The diagram shows a 10 kg box being pushed at constant speed up a slope of 20°, increasing its height by 3 m.



(a) Calculate the work done if the force of friction along the slope is 21 N. **2**

Criteria	Marks
• Provides correct answer	2
• Calculates work against friction OR loss of gravitational energy	1

Sample answer: Work done = Gain in gravitational potential energy + work against friction
Slope distance = 3/sin20°
Work done = mgh + Fs = 10 × 9.8 × 3 + 21 × 3/sin20°
Work done = 478 J

(b) Calculate the final velocity of the box if it is allowed to slide down the slope to ground level. **2**

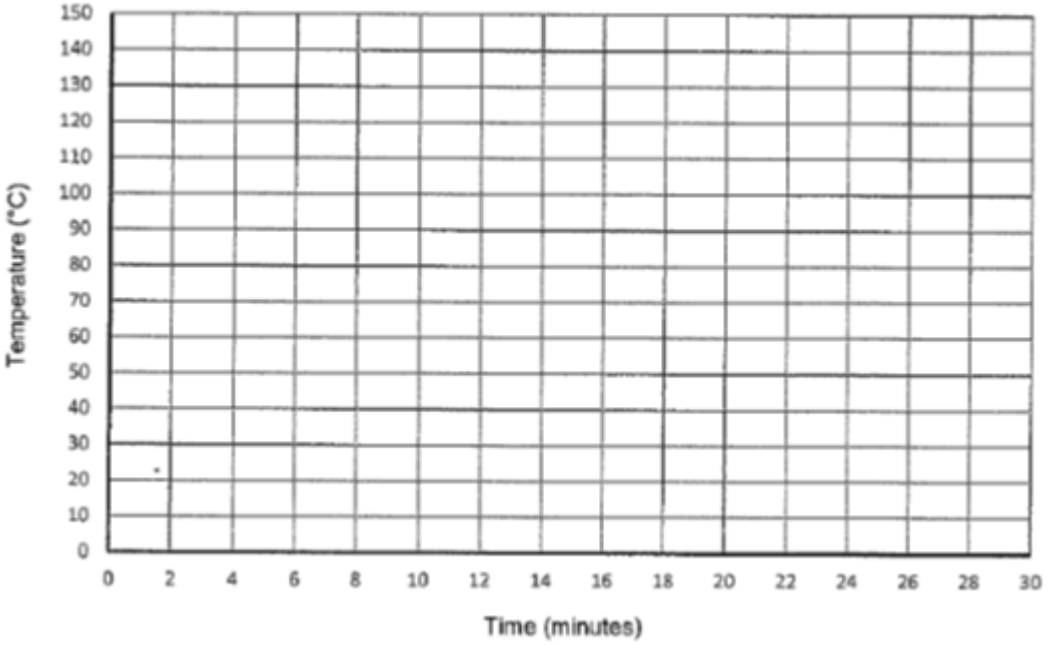
Criteria	Marks
• Provides correct answer	2
• Calculates speed ignoring friction	1

Sample answer: Kinetic energy at bottom = mgh – Fs = 10 × 9.8 × 3 – 21 × 3/sin20° = 110 J
$110 = ½ mv^2$ $v^2 = 2 \times 110/10$ Speed = 4.7 ms^{-1}

Question 25 (6 marks)

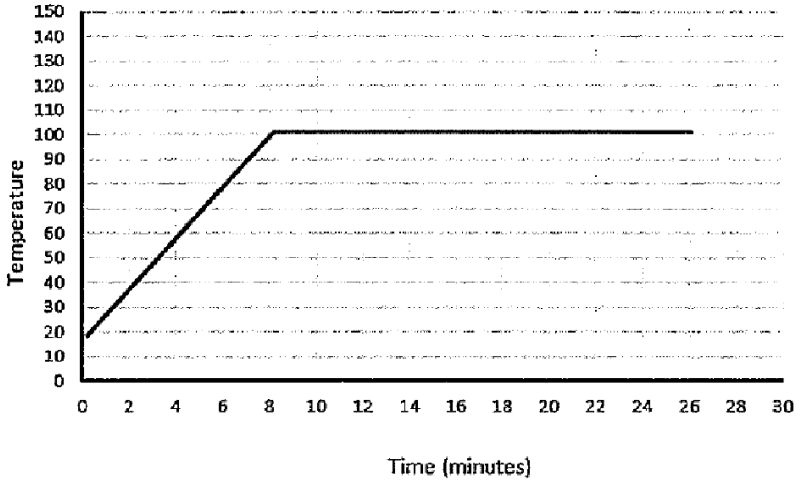
Some students provided constant heat at a rate of 2700 joules per minute to a 100 g of liquid. The initial termperature of the liquid was 18°C. The liquid took 8 minutes to reach boil (100°C) and an additional 18 minutes for the liquid to completely evaporate.

(a) Plot the data and draw a graph to show the temperature/time relationship for this experiment. **2**



Criteria	Marks
• Draws correctly TWO ruled lines on graph	2
• Draws correctly ONE ruled line on graph	1

Sample answer:



(b) Calculate the specific heat of the liquid in appropriate units. **2**

Criteria	Marks
• Calculates answer with units	2
• Substitutes correctly	1

Sample answer: $\Delta Q = m\ c\ \Delta T \quad 2700 \times 8 = 0.100 \times c \times 82$
Specific heat, $c = 2.6 \times 10^3\ J\ kg^{-1}\ K^{-1}$

(c) Explain the shape of the graph. **2**

Marking Criteria	Marks
Explains the shape of the graph ● Links proportionality of constant heat (0-8min) ● Links additional heat energy being used to cause phase change (break bonds), not a tempertaure rise	**2**
● describes the function	**1**

Sample answer:
From 0-8 minutes a constant heat applied produces a linear increase in temperature as $\Delta Q \propto \Delta T$. From 8-26 minutes the constant heat applied is not increasing the temperature of the substance, but rather the heat is providing the energy required to break the intermolecular bonds, causing a phase change from liquid to gas.

Question 26 (4 marks)

(a) Describe the role played by friction when a car accelerates, moves around a corner and stops. **2**

Marking Criteria	Marks
● role of friction including force is described for all situations given	**2**
● role of friction is partly described or described for some of the situations only	**1**

When acceleration is happening, the tyres are pushing back on the road so the road pushes forward on the car. When cornering, the road must be able to exert a sideways force on the car through the tyres without slipping, and when stopping the tyres must be able to exert a forward force on the road so the road surface exerts a backwards force on the tyres, again, without slipping which could not happen without friction.

(b) A 1200 kg car has a coefficient of static friction between the tyres and the ground of 0.75. Find the maximum acceleration for this car. **2**

Marking Criteria	Marks
● acceleration is calculated using a correct method	**2**
● Force due to friction is calculated	**1**

$$f_{\text{friction}} = \mu F_N$$
$$= 0.75 \times 1200 \times 9.8$$
$$= 8820 \text{ N}$$

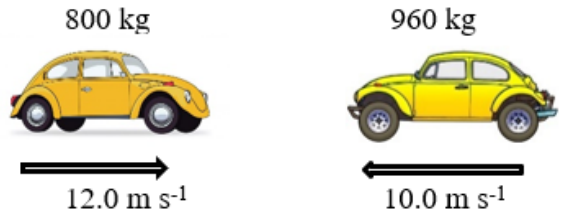
$$F = ma$$
$$a = \frac{f_{\text{friction}}}{m}$$
$$= \frac{8820}{1200}$$
$$= 7.35 \text{ m s}^{-2}$$

note that same answer obtained using a = 0.75 x g

Question 27 (4 marks)

Two cars collide head-on, as shown in the diagram. **2**

(a) When the combined wreckage



Marking Cri	**Marks**
● conser ● calcula	**2**
● conservation of momentum is referenced OR ● an appropriate or relevant calculation is attempted	**1**

Momentum of system before collision = momentum of system after collision, so: 800 kg x 12.0 m s^{-1} + 960 kg x -10.0 m s^{-1} = 0
Therefore, as p = 0, entangled wreckage is stationary.

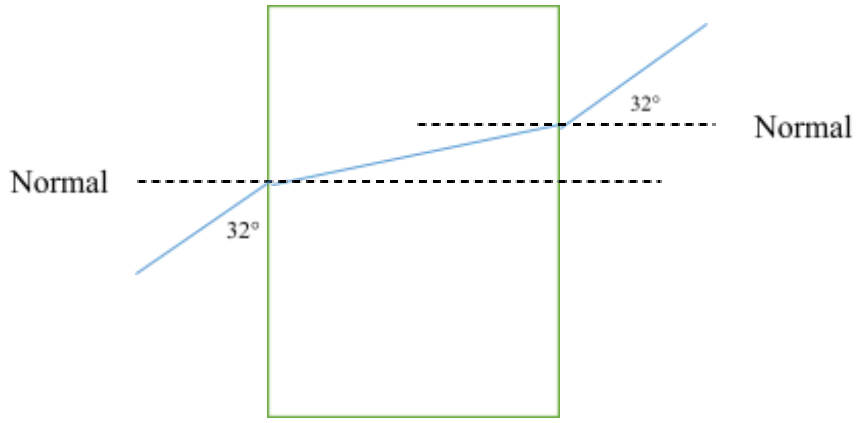
(b) Explain why the collision is inelastic, using equations where appropriate. **2**

Marking Criteria	**Marks**
● explanation is correct and supported by relevant equations	**2**
● explanation in words only	**1**

As E_K is not conserved during this collision, it is regarded as inelastic: E_K before = ½ x 800 x 12.0^2 + ½ x 960 x 10.0^2 = 1.06 x 10^5 J which is clearly not =0, the final E_K of the system as v = 0.

Question 28 (3 marks)

A glass block, surrounded by air and with a refractive index of 1.50, has a light ray incident on it at an angle of 32°. The light beam passes through the block and out the other side. Label the diagram below showing the passage of this light including all angles and showing all working. **3**



Marking Criteria	Marks
• Appropriate labelled diagram • Correct calculation • Shows all working	**3**
• Any number of the above	**1-2**

Sample answer

$n_1 \sin \theta_1 = n_2 \sin \theta_2$

$1 \sin 32 = 1.5 \sin \theta_2$

$\theta_2 = 20.69°$

Question 29 (4 marks)

During the Year 11 Physics course, many first-hand investigations were undertaken where there were elements of risk involved.

(a) Identify one such investigation and state *two* risks relevant to that investigation and the control measures taken for each risk to ensure your safety and the safety of others. **3**

Marking Criteria	**Marks**
● A relevant investigation identified ● Two specific risks which are relevant to the investigation stated ● Two control measures which are relevant stated	**3**
● Any number of the above	**1-2**

e.g. observing spectra from discharge tubes and the Sun using hand held spectroscopes
i) very high voltage could cause electric shock – keep well clear of operating apparatus and switch off in 2 places when handling **1**
ii) accidentally observing the Sun directly will cause retina damage – only ever observe indirect sunlight by turning away from the Sun.

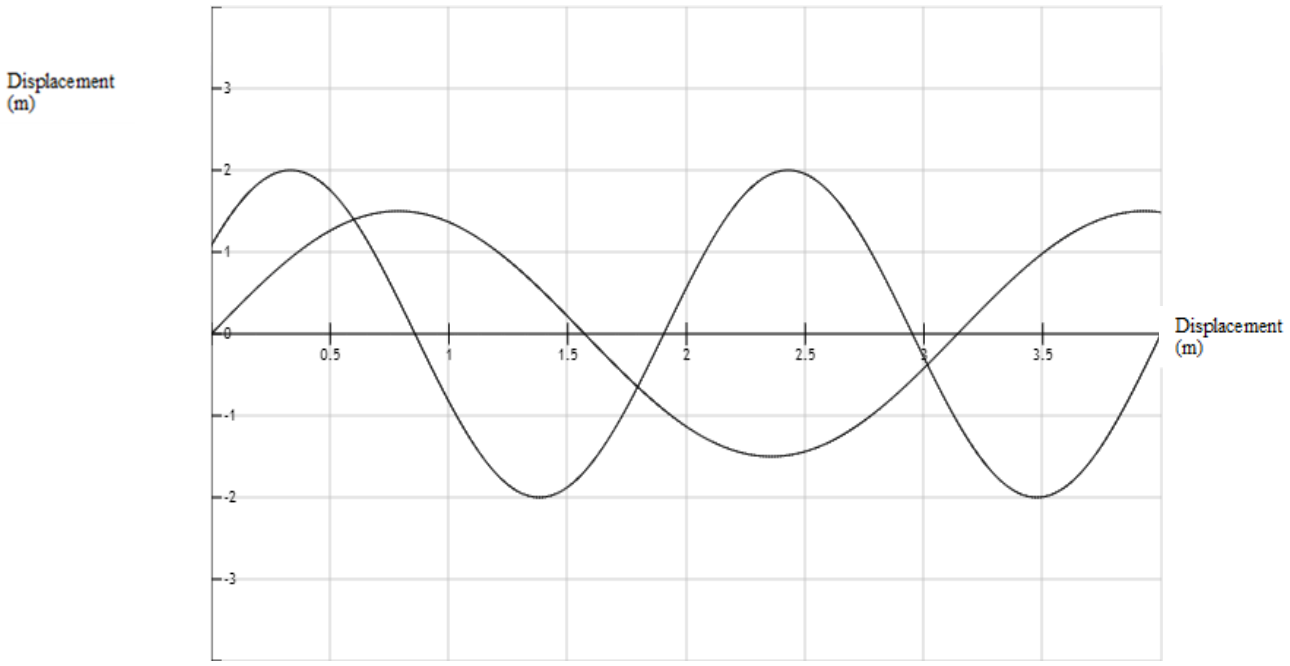
(b) Describe how you would ensure that the results of a first-hand investigation would be <u>reliable</u>.

Marking Criteria	**Marks**
● The description refers to at least two factors that increase reliability	**1**

Reliability is how repeatable the results of an investigation are. The method must be sufficiently detailed so that there is no ambiguity in how any apparatus is used, or measurements made. All variables other than the independent variable must be controlled so that the dependent variable is only influenced by the intended changes made to the independent variable. This should result in a reliable investigation.

Question 30 (4 marks)

The following two radio waves were detected separately by a receiver during a simple scientific experiment and displayed on a screen.

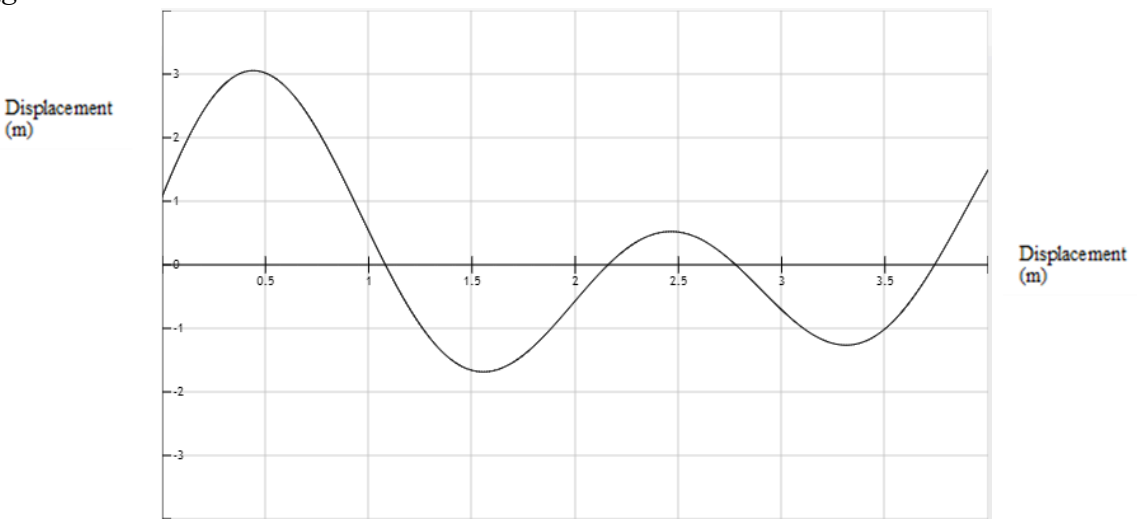


(a) Draw the resultant wave on the empty graph below. **2**

(a) 2 marks

Criteria	Marks
• Resultant wave is entirely correct	2
• Resultant wave has only one error	1

Suggested answer:



Question 30 (continued) **2**

(b) With reference to their physical properties, explain why electromagnetic, and not mechanical waves, are generally used in communication technology.

Criteria	Marks
● Explains with reference to their physical properties, why electromagnetic, and not mechanical waves are generally used in communication technology	2
● States a relevant feature of electromagnetic waves for use in communication technology	1

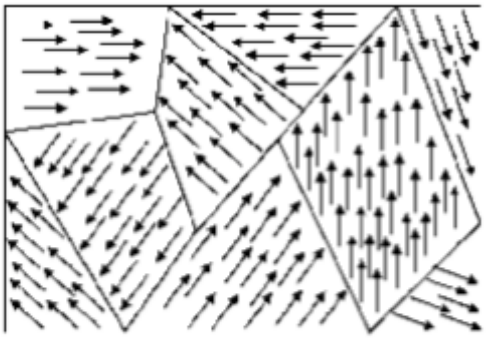
Suggested answer:
Electromagnetic waves are used by the communications industry primarily for two advantages. Unlike mechanical waves they do not require a medium to propagate, and can thus be used to communicate to satellites and vessels in space, and they generally move much faster than mechanical waves allowing for much faster communication.

Question 31 (3 marks)

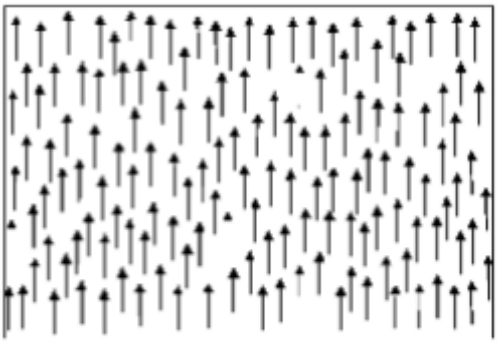
Explain the physical phenomenon of ferromagnetism. Include a diagram in your answer. **3**

Criteria	Marks
Shows understanding of ferromagnetism Outlines how ferromagnetism occurs Includes a relevant diagram	3
Shows some understanding of ferromagnetism Includes a relevant diagram OR Shows some understanding of ferromagnetism Outlines generally how ferromagnetism occurs	2
Makes a relevant point about ferromagnetism OR Includes a relevant diagram	1

Suggested answer:



Domains before external magnetic field is applied



Domains after external magnetic field is applied

Iron, nickel, cobalt and some of the rare earths, exhibit a unique magnetic behaviour called ferromagnetism.

Ferromagnetic materials exhibit a long-range ordering phenomenon at the atomic level which causes unpaired electron spins to line up parallel with each other in a region called a domain. Within a domain, the magnetic field is intense, but overall a sample of the material will usually be unmagnetized because the many domains will be randomly oriented with respect to one another.

Ferromagnetism occurs when an externally imposed magnetic field, causes the magnetic domains to line up with each other. The driving magnetic field will then be increased by a large factor, and the material is said to be magnetised. There are many practical applications of ferromagnetic materials, such as electromagnets.

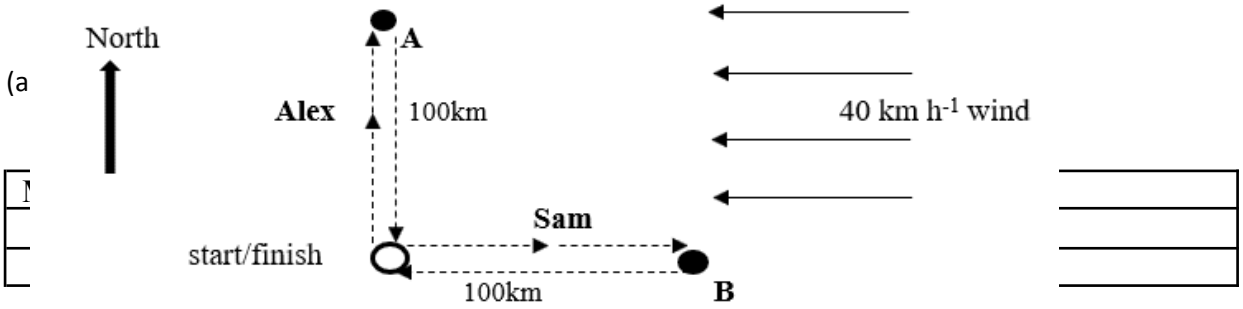
Question 32 (7 marks)

Two students, Sam and Alex, propose to have a race using their small aircraft, both of which can fly through still air at the same speed, 140 km h^{-1}. They will both start and finish at the same point, but they will fly to different points, **A** and **B** which are 90° apart and both 100 km from the start.

They will then turn around and come back to the finish. The distance they will race is the same, but a steady wind blows from the east at 40 km h^{-1} throughout the race.

The details are shown on a map below.

(a



To B: speed over ground = 140 – 40 =100 km h^{-1}; time = dist/speed = 100 km/100 km h^{-1} = 1 hour
To return: speed over ground = 140 + 40 = 180 km h^{-1}; time = dist/speed = 100/180 km h^{-1} = 0.556 hr = 33 min 20 s
Total time = 1hr 33 min 20 s

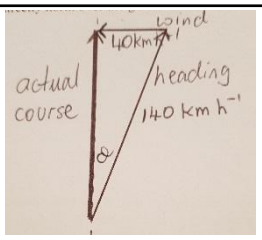
Question 32 continues on page 21.

Question 32 (continued)

(b) Using a diagram, find the direction that Alex will need to head so that the plane travels directly north over the ground.

Marking Criteria	Marks
• Correct diagram drawn • Diagram used with correct calculation to obtain correct angle • Correct heading given	**2**
• Diagram is drawn correctly	**1**

OR ● diagram is incorrect but used to find a heading without further error	**2**



Using the diagram:

$$\sin\theta = \frac{40}{140}$$
$$\theta = 17°$$

Alex must head N17°E so that the plane travels directly north.

(c) Find the time it takes Alex to fly to point **A** and back to the finish.

Marking Criteria	**Marks**
● All necessary calculations performed correctly	**2**
● Alex's speed over the ground is calculated	**1**

speed, v, found from previous triangle: $v^2 + 40^2 = 140^2$

$$v = \sqrt{140^2 - 40^2}$$
$$= 134.16 \text{ km h}^{-1}$$

2

time = distance/speed = 200 km / 134.16 km h^{-1} = 1.4908 hr = 1 hr 29 min 27 s

(d) Describe what would occur if the wind was blowing from the east at 140 km h^{-1}.

Marking Criteria	**Marks**
● An appropriate prediction is given	**1**

Neither plane could make headway towards their destinations – the race would go nowhere.

1

Student Number

PHYSICS – MULTIPLE-CHOICE ANSWER SHEET

ATTEMPT ALL QUESTIONS

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