
Student Number

Gosford High School

2022

Year 11 Preliminary Examination

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- A data sheet, formulae sheet and Periodic Table are provided at the back of this paper
- For question in Section II, show all relevant working in questions involving calculations
- Write your Student ID at the top of this page

Total marks: 75

Section I — 20 marks (pages 2-9)

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

Section II — 55 marks (pages 10-23)

- Attempt Questions 21–30
- Allow about 1 hour and 30 minutes for this par

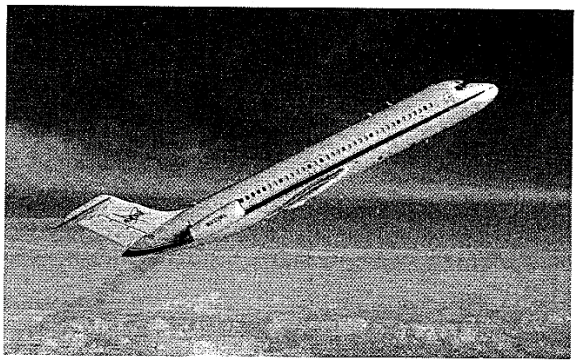
Section I

20 marks
Attempt Questions 1–20
Allow about 30 minutes for this section

Answer questions 1-20 using the multiple-choice answer sheet at the back of this booklet.

---

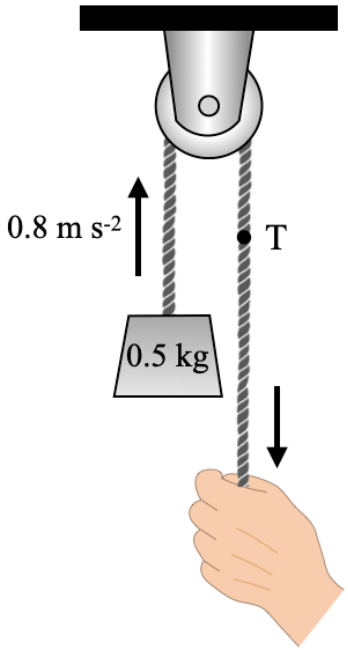
1. The diagram shows a plane flying at 130 m s^{-1} at an angle of 27 degrees above horizontal.



What is the vertical component of its velocity?

A. 59 m s^{-1}
B. 75 m s^{-1}
C. 92 m s^{-1}
D. 115 m s^{-1}

2 Calculate the tension at T for the system shown.



A. 0.4 N
B. 1.6 N
C. 3.9 N
D. 5.3 N

3 The graph below shows the motion of an object.

What was the object's displacement at time 12 s?

A. About 42 m

B. About 42 m south

C. About 175 m south

D. About 252 m south

4 A 747 airplane lands with a maximum velocity of 84.9 m s^{-1}. It has an average breaking deceleration of 3.25 m s^{-2}. What would be the minimum length needed for a runway if 747s were to land on it?

(A) 1110 m

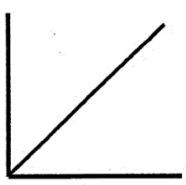
(B) 1320 m

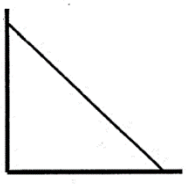
(C) 1480 m

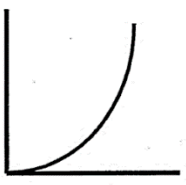
(D) 1630 m

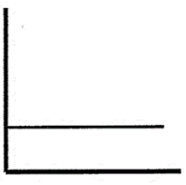
5 A car is accelerating uniformly along a road.

Which graph shows the relationship between the net force and time?

A. 

B. 

C. 

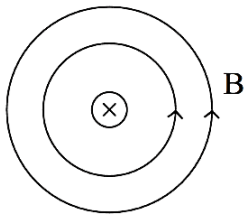
D. 

6 Which row of the table shows two properties of a sound wave?

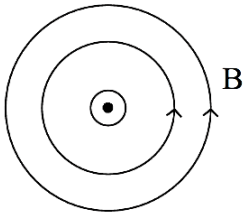
	Property 1	*Property 2*
A.	transverse	mechanical
B.	transverse	electromagnetic
C.	longitudinal	mechanical
D.	longitudinal	electromagnetic

7 Which of the following diagrams shows the direction of a magnetic field around a conducting wire that has the current directed into the page?

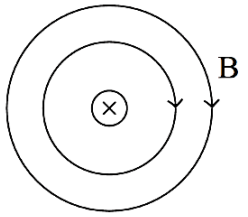
A.



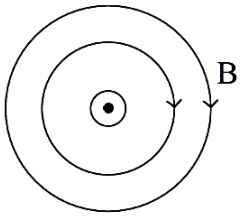
B.



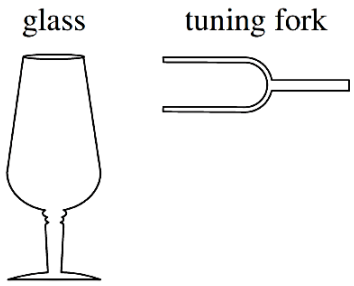
C.



D.



8 A glass and tuning fork are shown.



When the tuning fork is struck and brought very close to the top of the glass, a loud sound is heard.

Which of the following wave behaviours is responsible for this effect?

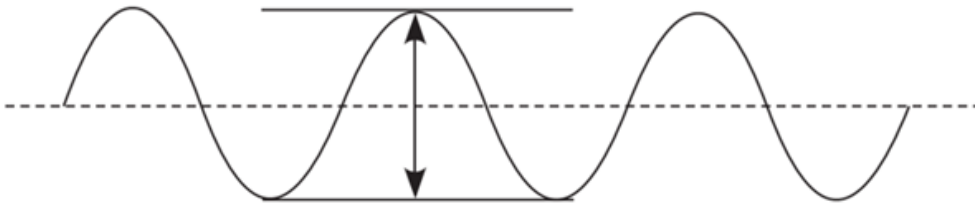
A. diffraction

B. resonance

C. dispersion

D. refraction

9 The diagram below shows a wave. The arrow shows the distance from the top of the wave to the bottom of the wave.



This arrow represents:

A. Amplitude

B. Wavelength

C. Twice the amplitude

D. Twice the wavelength

10 A standing wave is formed by waves of frequency 128 Hz. The speed of the waves is 64.0 m/s. The distance between the nodes must be

A. 0.250 m

B. 0.500 m

C. 1.00 m

D. 2.00 m

11 A positive point charge experiences a repulsive force of 3.20 mN at a distance of 75.0 mm in air from another point charge. Calculate the force experienced if the separation distance was increased to 125 mm.

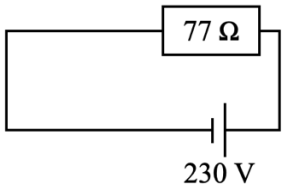
(A) 1.15 mN

(B) 1.44 mN

(C) 2.11 mN

(D) 2.54 mN

12 Calculate the power used by the appliance shown below.



(A) 123W

(B) 428 W

(C) 569 W

(D) 687 W

13

When a wave moves from shallow water to deep water, the:

A. frequency decreases, the wavelength increases, and the speed remains constant.

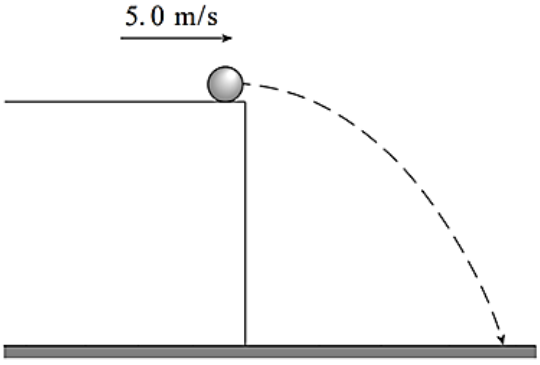
B. frequency does not change, the wavelength increases, and the speed increases.

C. frequency does not change, the wavelength decreases, and the speed increases.

D. frequency increases, the wavelength decreases, and the speed remains constant.

14

A 0.5 kg ball rolls off a horizontal surface as shown in the diagram.



Determine the magnitude of the impulse given to the ball by gravity during the 0.80 seconds it takes the ball to fall to the ground.

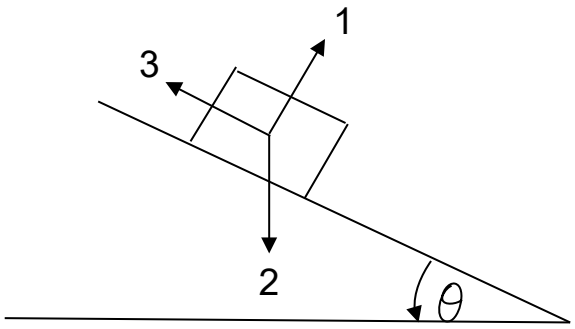
A. 0.9 N.s

B. 1.8 N.s

C. 2.9 N.s

D. 3.9 N.s

15 The diagram below shows the forces acting on a block on an inclined plane. The block has mass, m, and is situated on earth with a gravity, g, acting. The inclined angle is represented by θ.

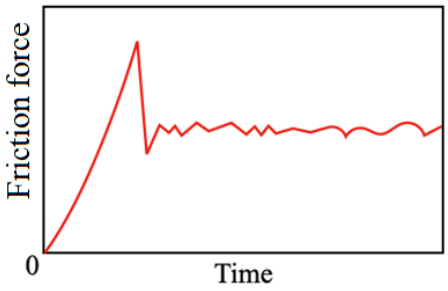


Which row correctly represents the mathematical expression for the magnitude of the forces acting on the block?

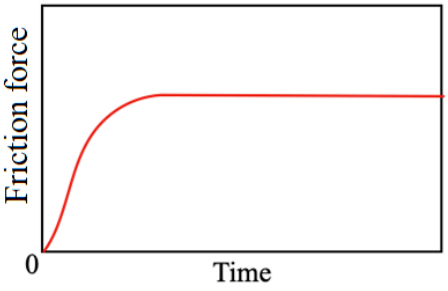
	1	Force acting down the slope	2	3
A.	mg	mgcosθ	mg	mgsinθ
B.	mgsinθ	mg	mgcosθ	μmgcosθ
C.	mgcosθ	mgsinθ	mg	μmgcosθ
D.	mgsinθ	mgcosθ	mg	μmgcosθ

16 An object on a horizontal surface is being pushed with an increasing force. The object is initially stationary and then begins to move. Which of the following graphs indicates the friction force acting on this object?

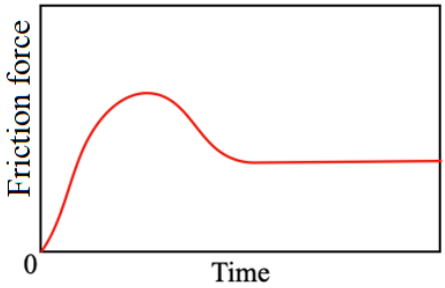
(A)



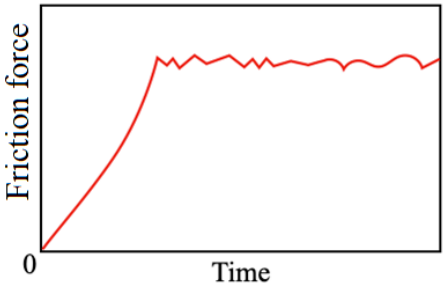
(B)



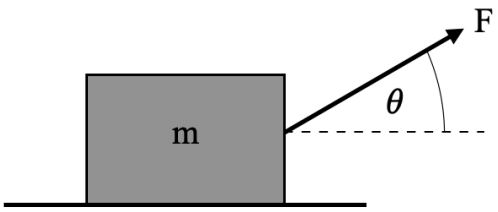
(C)



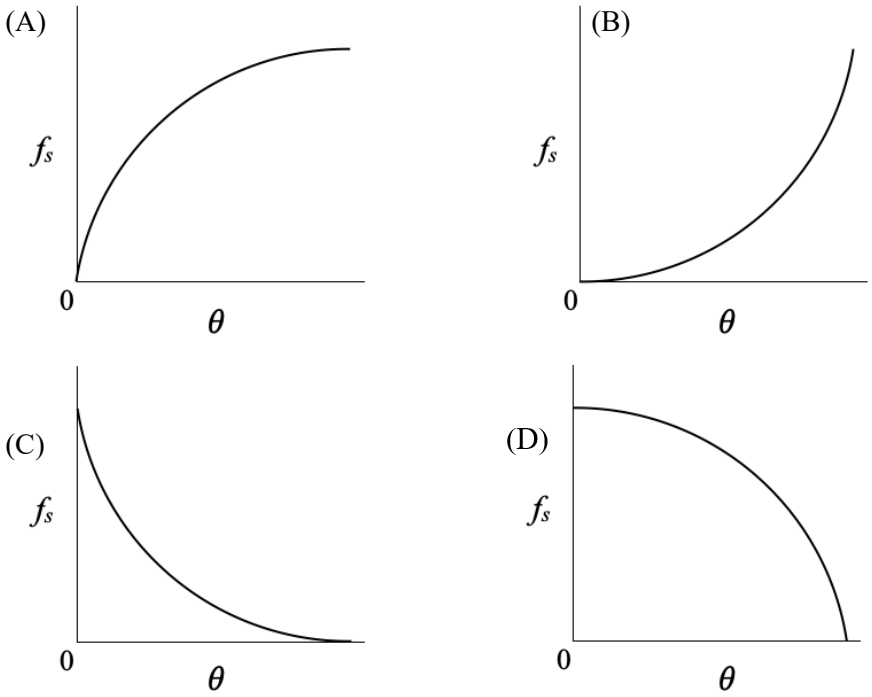
(D)



17 Below shows a mass on a surface being pulled by an applied force at an angle of θ to the horizontal.



Which of the following graphs most closely represents the change in the friction force as θ increases from 0°?



18 Thermal equilibrium would be best described as:

(A) A cease of energy flow between two objects in thermal contact.

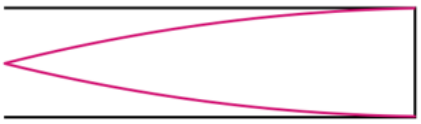
(B) Two objects of the same temperature.

(C) The transfer of heat energy from a colder body to a hotter one.

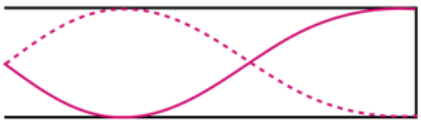
(D) The transfer of heat energy from a hotter body to a colder one.

19 For the four air columns shown below, which shows a wave with a third harmonic?

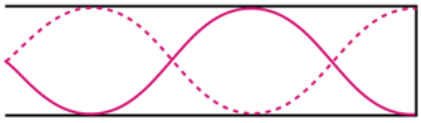
(A)



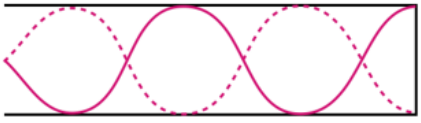
(B)



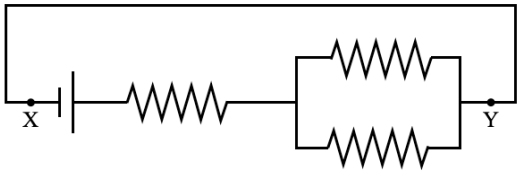
(C)



(D)

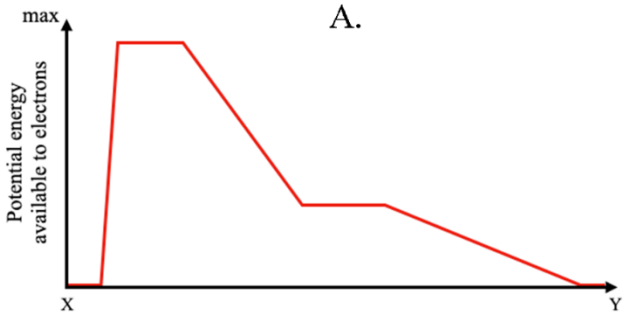


20 Below is a circuit diagram with identical resistors.

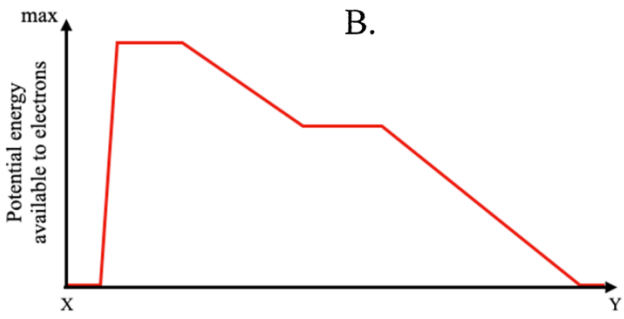


Which of the following graphs best show the change in potential energy available to <u>electrons</u> from X to Y?

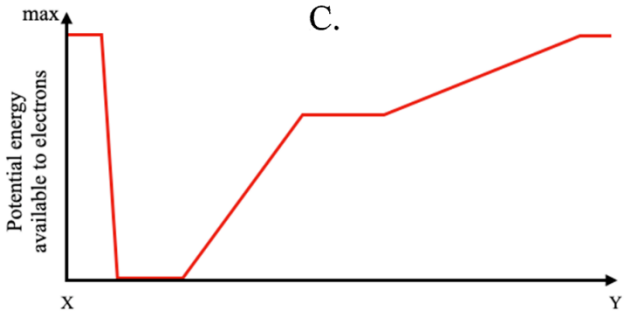
A.



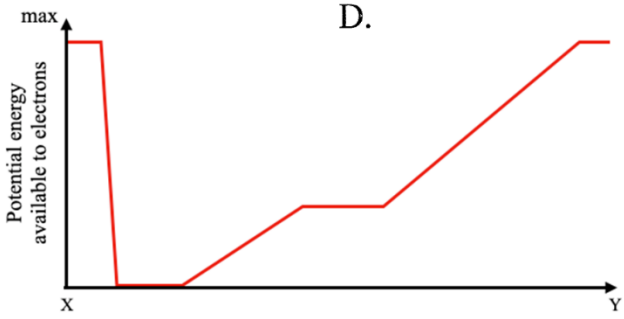
B.



C.



D.



Section II

55 marks
Attempt Questions 21–30
Allow about 1 hour 30 minutes for this section

Answer the questions in the space provided. Extra writing space is available at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 21 (7 marks)

(a) Compare refraction with diffraction. **4**

.....

.....

.....

.....

.....

.....

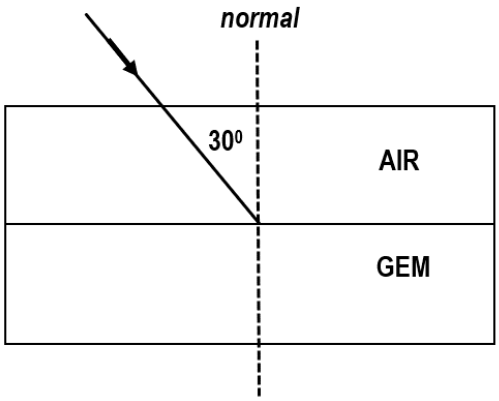
.....

.....

Question 21 continued

(b) Refractive index can be used to identify different gems. **3**

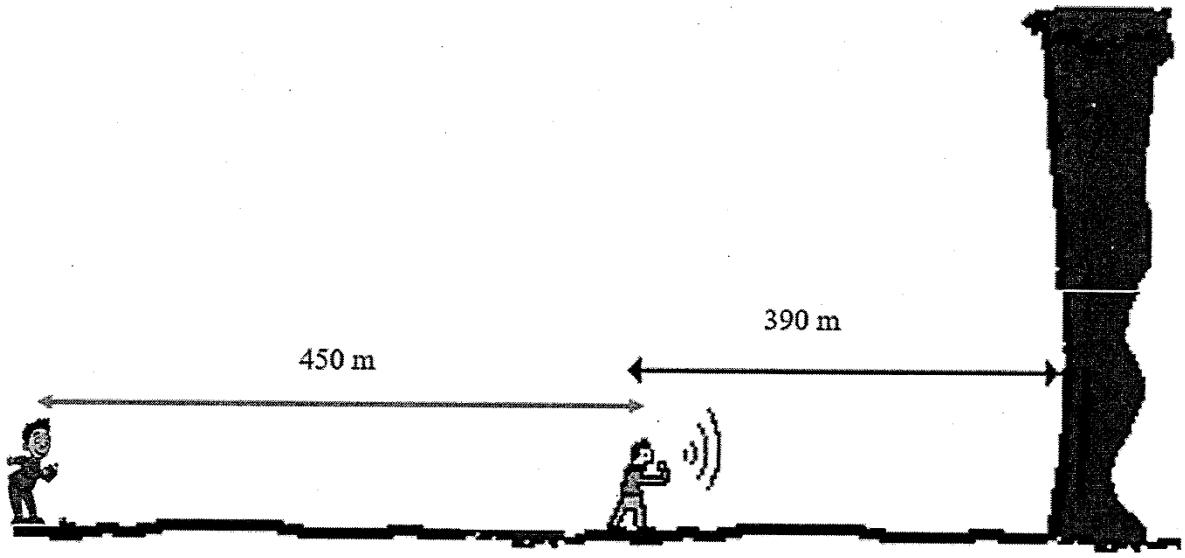
It was used to investigate a pink diamond (n = 2.42) and a ruby (n = 1.71) using the set up shown below.



Explain how you could use this set up to distinguish between a pink diamond and a ruby, use calculations to support your answer.

Question 22 (3 marks)

In an experiment to measure the speed of sound in air, two friends used an echo from a cliff. One walked to a position 390 m from the cliff and 450 m in front of his friend, and shouted. The friend timed the difference between the time he heard the shout and its echo from the cliff. **3**



Their results which are shown in the table.

Time difference between shout and echo(s)	2.37	2.21	2.54	2.31	2.64

Analyse these results to find the speed of sound in this experiment.

.....

.....

.....

.....

.....

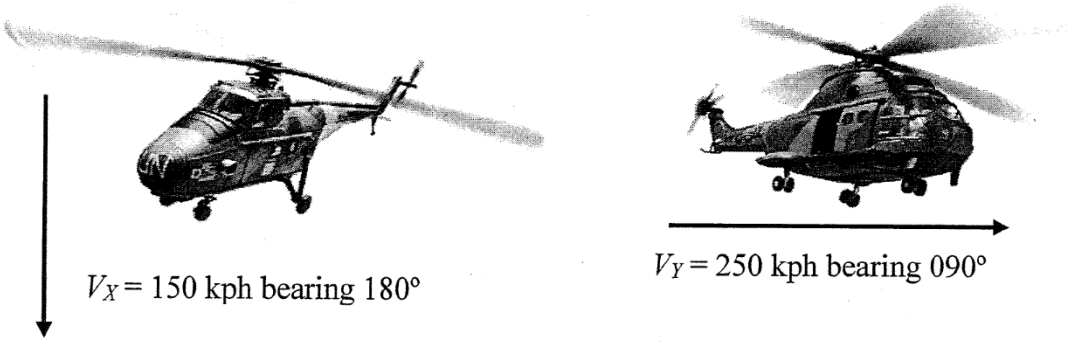
.....

.....

.....

Question 23 (3 marks)

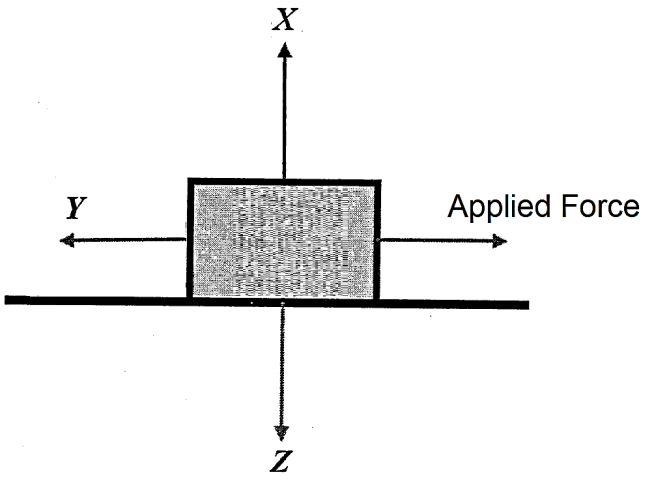
Consider the two helicopters in the diagram below.



By drawing an appropriate vector diagram, determine the velocity of helicopter X relative to helicopter Y.

Question 24 (5 marks)

Consider the mass which is moving to the right at 2.0 m s^{-1}.



(a) Identify appropriate labels for forces *X*, *Y* and *Z*. **3**

.....

.....

.....

(b) A student looked at this diagram and said that the applied force vector should be longer. **2**

Evaluate the statement.

.....

.....

.....

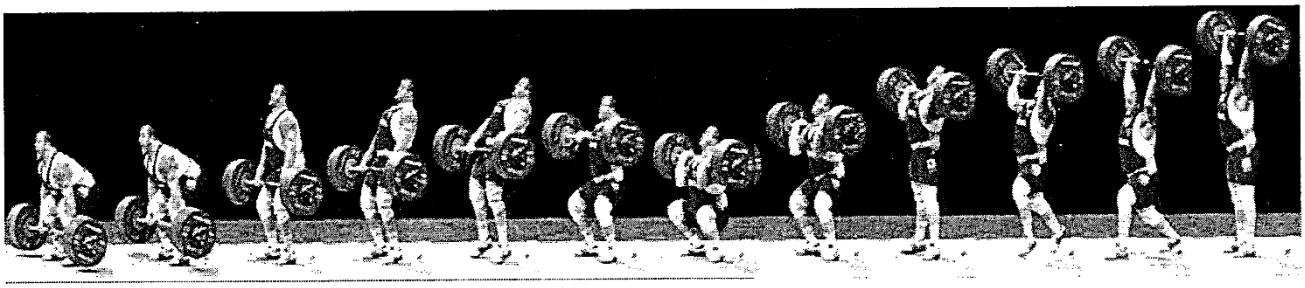
.....

.....

.....

Question 25 (4 marks)

The world record for the "clean and jerk" in weightlifting is 266 kg. The strobe photo below shows a weightlifter completing the lift. At the end of the lift he is holding the weights, not moving, 2.50 m above the floor.



(a) Calculate the increase in energy of the weights and explain how it compares to the energy expended by the weightlifter in the photo. **3**

.....

.....

.....

.....

.....

.....

(b) How could the weightlifter change this lift to demonstrate greater power? **1**

.....

.....

Question 26 (9 marks)

Two oppositely charged two parallel plates are 200 mm apart and have a voltage of 200 V across them. The top plate is positively charged relative to the bottom plate (i.e. at an electrical potential of 200 V relative to the bottom plate).

(a) Draw the electric field between the plates as solid lines. Draw two equipotential lines within this electric field as dashed lines. **2**

(b) Calculate the work required for a proton to travel between the plates. **2**

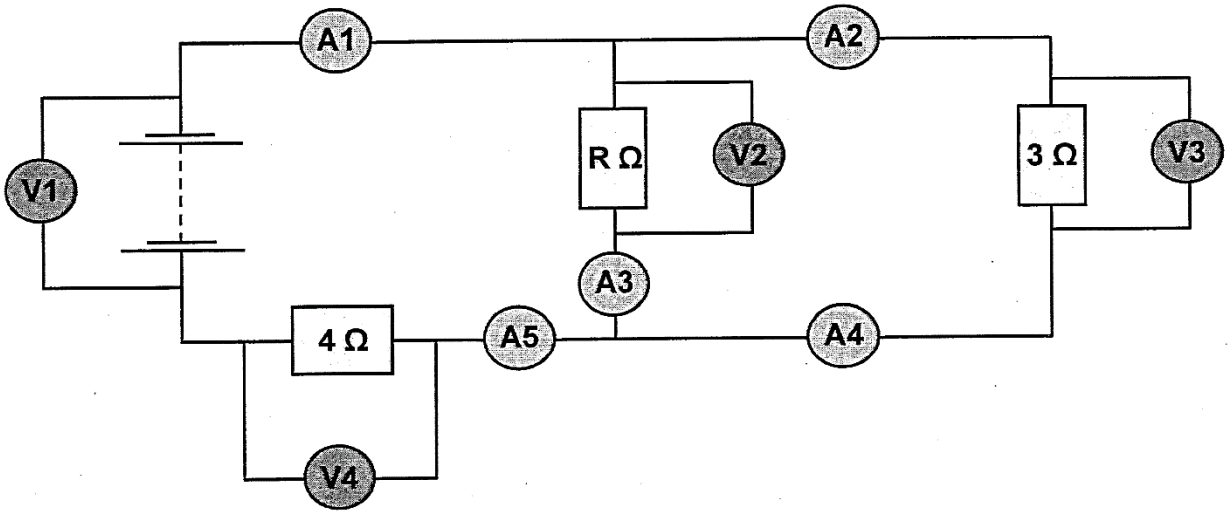
Question 26 continued

(c) Calculate the strength of the electric field between the plates. **2**

(d) Determine the force on a proton in this electric field and describe its motion. **3**

Question 27 (6 marks)

Students set up the circuit shown below to study resistors in parallel. They connected voltmeters and ammeters as shown in the diagram and recorded the readings on four of them.



During the experiment the students made the following observations:

The current in ammeters A1 and A5 was 9 A and the voltmeters V2 and V3 each read 18 V.

(a) Calculate the reading on ammeter A2. **1**

.....

.....

(b) Calculate the reading on voltmeter V4. **1**

.....

.....

Question 27 continued

(c) Calculate the value of the resistance R. **1**

.....

.....

(d) Calculate the reading on voltmeter V1. **1**

.....

.....

(e) Calculate the total resistance of the circuit. **2**

.....

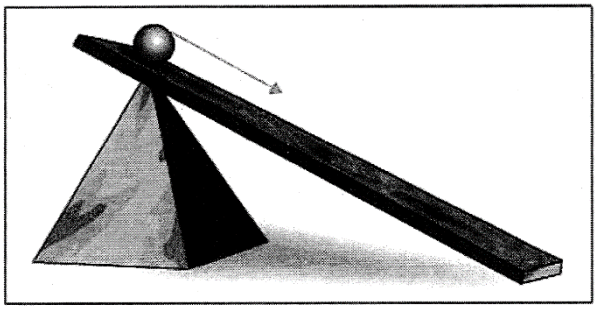
.....

.....

.....

Question 28 (8 marks)

The diagram shows an experiment where a ball being rolled from rest down an incline. Students start the ball from various points along the incline to determine its acceleration. The time for the ball to roll down the incline was measured using a stopwatch.



(a) Identify the dependent variable, the independent variable and a controlled variable in this experiment. **3**

.....

.....

.....

.....

.....

.....

(b) Outline how the experimental results can be used to determine the acceleration of the ball down the incline. **2**

.....

.....

.....

.....

.....

.....

Question 28 continued

(c) Explain how the reliability of this experiment could be tested. **1**

.....

.....

.....

.....

(d) How could the validity of the experiment be determined? **2**

.....

.....

.....

.....

.....

.....

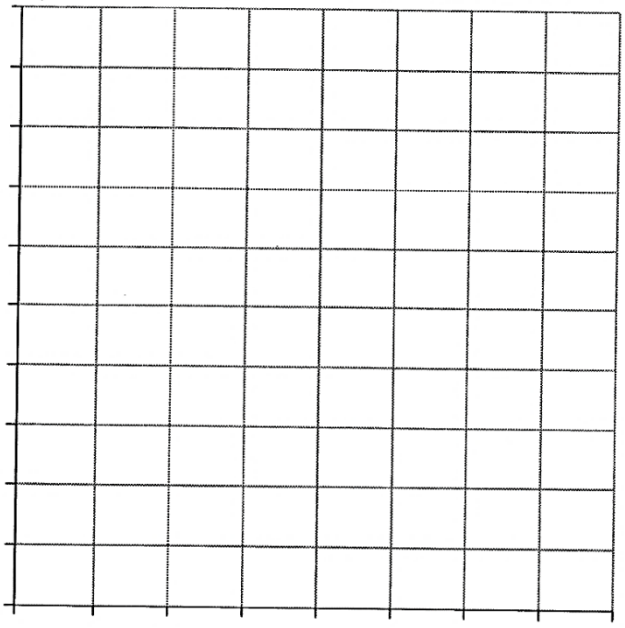
Continue on to next page

Question 29 (6 marks)

A student performs an experiment to measure the strength of the magnetic field produced by a current-carrying wire at particular distances away from it. Data from the experiment is shown in the table.

Distance (cm)	*Magnetic field strength* ($\times 10^{-6}$ *T*)
5	8.0
10	4.0
20	2.0
35	1.1

(a) Graph the data on the axes provided. **4**



(b) Describe the relationship between the magnetic field strength and distance. **2**

.....

.....

Question 30 (4 marks)

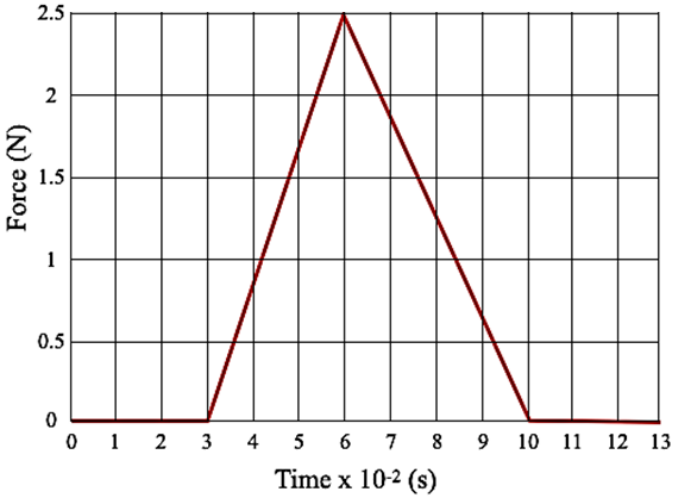
A student undertook a depth study to analyse the effectiveness of crumple zone designs. The student fixed two different types of crumple zones to the front of a trolley, as shown below, and used a force meter to measure the forces during the collision.

Crumple zone A

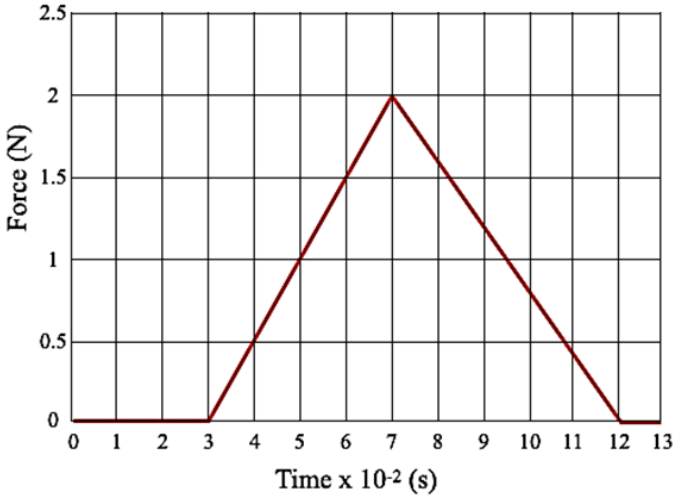
Crumple zone B

The results of the investigation as shown by the force meter are shown below.

Crumple zone A



Crumple zone B



4

Use the data to analyse the effectiveness of the designs.

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of exam

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Student Number

Multiple Choice Answer Grid

Write your student number on this sheet and carefully tear it from the booklet.

Use it to answer questions 1-20, indicating your answers with a cross (X).

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

	A	B	C	D
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

- List any annotations/changes on this
- 2 extra answer booklets with MC sheets

2022 Year 11 Physics Preliminary Exam Marking Criteria

Section I

Multiple-choice Answer Key

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

21b

Use a ray box to determine r

- Use $n_r = \frac{\sin i}{\sin r}$ (1)

for

Pink diamond: $r = 12^\circ$ (1)

Ruby: $r = 17^\circ$ (1)

Section II

Question 21

Criteria	Marks
Defines both refraction and diffraction and describes the factor which determines the extent of the phenomena.	4
Defines both refraction and diffraction and describes the factor which determines the extent of one of the phenomena.	3
Defines both refraction and diffraction	2
Defines refraction or diffraction	1

Sample answer:

Refraction is a change in the direction of the wave caused by a change in its speed through the medium. The amount of refraction that occurs is dependent on the difference between the refractive indices of the two mediums. A greater difference will result in a greater refraction as described by Snell's law. Incident light waves with smaller wavelengths will also refract more than longer wavelengths.
Diffraction is the bending of waves as they pass through a narrow opening or travel around obstacles. Diffraction is significant when the size of the opening or obstacle is similar to or smaller than the wavelength of the wave.

22

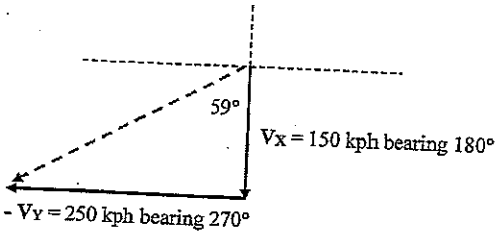
Criteria	Marks
• Determines the speed of sound using average time	3
• Determines the speed of sound using average time and incorrect distance	2
• Determines the speed of sound using incorrect time and incorrect distance	1

Sample answer:
Distance from shouting person to timer = 450 m
Distance echo travels (to cliff and back to timer) = 1230 m
Difference in distance = 780 m
Average difference in time = 2.41 s
Therefore, speed of sound = 780/2.41 = 324 m s^{-1}

23

Criteria	Marks
• Provides vector diagram with correct magnitude and bearing for relative velocity	3
• Provides correct relative velocity statement with velocity based on incorrect diagram OR • Provides vector diagram with correct magnitude for relative velocity	2
• Provides correct relative velocity statement only OR • Provides vector addition diagram	1

Sample answer: Velocity of X relative to Y = velocity of X – velocity of Y



From the vector diagram, velocity of X relative to Y = 291 kph bearing 239°

24 a)

Criteria	Marks
• Identifies THREE labels correctly	3
• Identifies TWO labels correctly	2
• Identifies ONE label correctly	1

Sample answer: X = normal reaction force, Y = frictional force, Z = weight force

24 b)

with some valid reasoning provided

Students statement is incorrect. (1)
Object is moving at a constant velocity, therefore the horizontal forces are balanced. This means that the diagram is correct in showing an applied force vector that is the same length as the friction force vector. (1)

25(a)

+ correct units

Criteria	Marks
• Calculates the increased gravitational potential of the weights and provides details of the need for more work done over distance lowered mid-lift or due to heat produced	3
• Calculates the increased gravitational potential of the weights and identifies the need for more work done over distance lowered mid-lift + makes a comparison	2
• Calculates the increased gravitational potential of the weights	1

Sample answer: Work done on the weights = gravitational potential energy gained
$= mg\Delta h$
$= 266 \times 9.8 \times 2.5$
$= 6517\ J$

or 6.52×10^3 J

due to heat produced.

The weightlifter uses more energy than 6517 J. ~~He lowers the weights a short distance in the middle of the lift, decreasing the potential energy of the weights and using energy to stop their downward movement. He then used energy to lift back up over same distance.~~

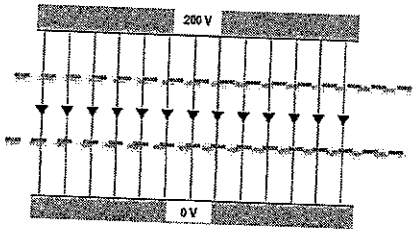
or because weights were lowered slightly and raised again.

25(b)

Criteria	Marks
• Identifies less time	1

Sample answer: He would have to complete the lift in a shorter time.

26 a)



26 b)

Criteria	Marks
• Calculates the amount of work required by a proton to travel from the negative to positive plate and includes units	2
• Provides some relevant information	1

Sample answer:
$\Delta V = W/q$
$W = (\Delta V)(q)$
$W = (200)(1.6 \times 10^{-19}\ C)$
$W = 3.2 \times 10^{-17}\ J$

26 c)

Criteria	Marks
• Correctly calculates the strength of the electric field and includes units	2
• Provides some relevant information	1

Sample answer:
$E = \Delta V/d$
$= (200)/(200 \times 10^{-3})$
$= 1000\ NC^{-1}$

26 d)

Criteria	Marks
• Correctly calculates force, includes direction AND describes motion as constant acceleration	3
• Correctly provides 2 of the above points	2
• Provides 1 of the above points	1

The proton experiences a force which attracts it to the negative plate. The force experienced by this proton
$F=qE$ or $F = (\Delta V)q/d$
$F = (1.6 \times 10^{-19})\ (1000)$
$= 1.6 \times 10^{-16}$N which moves in the same direction as the electric field (i.e. ~~upwards~~ downwards)
This motion of the proton will be constant acceleration in the same direction as the electric field.

27 a)

Criteria	Marks
• Calculates correct current	1

Sample answer: V3 = 18 V Current in 3 Ω resistor = 18/3 = 6 A Current A2 = 6 A

27 (b)

Criteria	Marks
• Calculates correct voltage	1

Sample answer: Voltage V4 = IR = 4 × 9 = 36 V

27 (c)

Criteria	Marks
• Calculates correct resistance	1

Sample answer:
R Ω resistor is in parallel to 3 Ω resistor
V2 = V3 = 18 V
Current through R is 9 A – 6 A = 3 A
R = V/I = 18/3 = 6 Ω

27 (d)

Criteria	Marks
• Calculates correct voltage	1

Sample answer: V1 = V4 + V2 (or V3) = 36 + 18 = 54 V

27 (e)

Criteria	Marks
• Calculates correct resistance and includes units	2
• Calculates correct resistance	1

Sample answer: Total R = V1 reading/A1 reading = 54/9 = 6 Ω

A_1 & A_2 NOT in series

28(a)

Criteria	Marks
• Identifies THREE variables	3
• Identifies TWO variables	2
• Identifies ONE variable	1

Sample answer: Dependent variable is time to roll down the incline, independent variable is distance rolled down the incline, controlled factors are angle of incline, ball used or surface of incline.

28(b)

Criteria	Marks
• Provides a clear outline of calculation required	2
• Provides an incomplete outline of calculation required	1

Sample answer: $s = ut + \frac{1}{2}at^2 = \frac{1}{2}at^2$ since $u = 0$
Therefore, $a = 2s/t^2$
OR

The average velocity of the ball down the incline can be found using: $v_{av} = \frac{\text{distance rolled}}{\text{time to roll}}$

Since ball started from rest, velocity at the bottom of the slope, $v = 2v_{av}$

Then acceleration can be calculated using: $a = \frac{\text{change in velocity}}{\text{time for change}} = \frac{v}{\text{time to roll}}$

28(c)

Criteria	Marks
• Identifies comparing multiple readings	1

Sample answer Multiple measurements of the times it takes the ball to roll down the incline from each starting position need to be taken and compared – if very similar, then reliability is good.

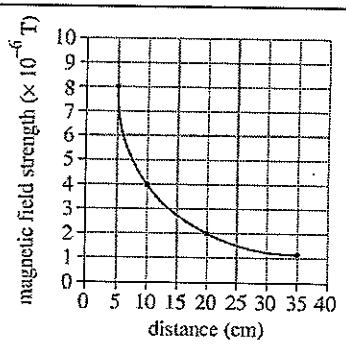
28(d)

Criteria	Marks
• Outlines method for comparing acceleration down incline calculation based on known value of g and results and angle of inclination	2
• Identifies comparison of experimental and known value of g	1

Sample answer: The average acceleration value determined in the experiment can be compared to the theoretical value, given by $a = g\sin\Theta$. If variation is less than about 5%, then the experimental design could be considered valid.

Correctly assesses validity, regulate controlled variables

Defines validity or partially assesses

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 29	
(a) 	Mod 4 Electricity and Magnetism PH11–5, 11–11 Bands 4–6 • Labels axes, including units. + correct orientation AND • Uses an appropriate scale. AND • Plots the data points. AND • Draws a line of best fit. smooth curve, no extras ..... 4 • Any THREE of the above points... 3 • Any TWO of the above points..... 2 • Any ONE of the above points 1
(b) Magnetic field strength is inversely proportional to distance. NOT EXPONENTIAL	Mod 4 Electricity and Magnetism PH11–5, 11–11 Bands 4–5 • Determines the mathematical relationship between magnetic field strength and distance ..... 2 • Provides some relevant information 1

i.e. as distance increases B decreases

Question 30

Criteria	Marks
Outlines how efficacy is determined, compares the raw data of each collision, and makes a judgement of efficacy.	4
Compares the raw data of each collision and makes a judgement of efficacy.	3
Makes a judgement of efficacy	2
Compares the raw data of each collision	1

$I_1 = 0.0875\ Ns$

$I_2 = 0.09\ Ns$

Sample answer:

Efficacy of a crumple zone is determined by how well it increases the time of the collision and as a result decreasing the maximum force. This is established through the formula for impulse, $impulse = ft$, where impulse is the change in momentum, which should be consistent throughout trials.

In crumple zone A the maximum force is 2.5 N over a period of 0.07 seconds.
In crumple zone B the maximum force is 2.0 N over a period of 0.09 seconds.

Crumple zone B effectively reduces the force compared to crumple zone A by increasing the time of the collision. Crumple zone B is therefore more efficient than crumple zone A.